In: Raimo P. Hämäläinen and Esa Saarinen, eds. 2007. Systems Intelligence in Leadership and Everyday Life.
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CHAPTER 17

Systems Intelligence as Opportunity Appreciation

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"Opportunity is missed by most people because it is dressed in overalls and looks like work." – Thomas A. Edison

Options thinking, an opportunity evaluation framework founded on financial options theory, appreciates similar aspects in human decision making that systems intelligence celebrates. A key insight from the distortions in human thinking, that systems intelligence has highlighted, is that often humans make decisions not based on valuable long-term opportunity creation, but rather on hesitation and myopic behaviour. Humans tend to predict 'cash-flows', good feeling, social status, and so on; arguably, decisions based on predicting such outcomes are biased towards familiar alternatives with satisfying outcomes. Options theory is used in this essay to argue why opportunities are more valuable than is traditionally understood.

Introduction

All man-made decisions are functions of some purposes that derive from either inner goals or are influenced by the outer environment, and often both. Humans tend to predict "cash-flows", good feeling, social status, and so on. Arguably, decisions based on predicting such outcomes are biased towards familiar alternatives with satisfying outcomes. Action, perceptions and beliefs produce systems, and often the systems that individuals co-construct for themselves do not encourage reaching good or satisfying behaviour. Hämäläinen and Saarinen (2006) and Saarinen and Hämäläinen (2004) have given importance to the concept of a *systemic world* around the human actor in studying human action and phenomena in social structures. Designating their paradigm *systems intelligence*, they push forward the idea of a human being that can act intelligently and productively in his natural environment, by understanding different systemic interdependencies and connectivities between himself and other agents in the system. Systems intelligence is mainly determined by outcome-driven action and the cause of that action, this very nature of systems is not only the determinant of our actions, but also the main determinant of cause in our actions. This produces interest towards the decision making processes that humans use, as part of their everyday action or as part of some larger entities, organizations that collectively conduct value-maximizing and/or risk-minimizing decisions. Studying the way that

humans reason and take decisions is on the top of the list for a scholar who aims to reveal why humans act as they do.

The problem that all agents overcome in decision making is the evaluation of alternatives that produce desirable outcomes. There are numerous methods that decision makers use in the evaluation process, and often these methods are determined by the nature of the decision alternatives, and by the information that is available of them. An individual can, for example, use only their intuition and *a priori* knowledge to decide which route to take for travelling from *A* to *B*. A firm can use astonishing amounts of effort to select whether to invest in production facility *C* or *D*. The field of operations research in general, and decision analysis in particular, has concentrated on assisting the decision maker to make better decisions (see e.g. Keeney and Raiffa 1976, Clemen 1996). Of course, most of the decisions we make everyday are conducted without any kind of formal analysis – the human being is a decision making machine by nature. If our natural decisions were not good and ideal for the present circumstances, our species would have very likely become extinct.

The human being is a decision making machine by nature.

There are several 'cognitive rules of thumb', or heuristics, that humans use when analysing the decision alternatives they see. This is especially true in mental modelling, when one must assess probabilities for uncertain events, as Tversky and Kahneman (1974) point out. Mental modelling is important, since according to utility theory, decisions are made by evaluating future events based on probabilities that are assessed on them (Clemen 1996). One cognitive constraint is that a vast array of alternatives is *not* seen, i.e. remains largely invisible for the decision maker, thus undermining the possibilities of an individual to influence his decisions. Whatever is the reason for this, the concept of *visibility of the decision alternatives* ties us to a certain interpretation of the world around the decision maker. The world is composed of systemic structures that are either visible or non-visible, visibility considered in the sense of 'seeing', 'experiencing', and 'acknowledging' the environment of the systemic actor. Non-visibility, or simply unawareness, of decision alternatives causes humans to make bad or poor decisions. It goes without saying, then, that visibility of different possible courses of action largely determines decision making.

This essay is about the relationships of options thinking to systems intelligence, that both acknowledge that opportunities are valuable. In the following paragraphs I will explore why thinking in terms of options is valuable, and why it especially suits to everyday decision making that humans conduct. The options thinking approach to decision making is very intuitive and simple. Many choices are simply regarded as options that carry a value that is not self-evident with the traditional attitude of discounting future values to the present and selecting the best among them. The traditional methods do not account for the opportunities that the inherent variability in different decision alternatives carry within them. Thus options thinking can be seen as both an art and a science – 'art' or everyday skill in the attitude part, the appreciative inquiry that the decision maker takes when critically thinking about ones thinking towards future opportunities, and science in the valuation part, the analytic explanation of the value that variability and flexibility bring

Choices That Individuals Make

Human decision making as a descriptive theory would best be explained by observing the behaviour of the decision maker. Systems sciences give us understanding about what is causing deviations and distortions from intelligent behaviour. Systems intelligence gives a promise of what ideal behaviour is like: a systems intelligent individual is capable of mentally abstracting

away of his beliefs about the structure of the system that affects him, gaining a "heightened awareness" from the present systems, that enables him to act intelligently (Hämäläinen and Saarinen 2006, p. 17). Beliefs about the structure of the system are by some authors understood as mental models that "determine what we see" (Senge et al. 1994, p. 235). Perception of choices that are available are dependent on the individual's beliefs about them. We can thus understand systems intelligent action as a sort of benchmark, an ideal, that one should strive for to gain that heightened awareness of the situation and produce better outcomes in everyday action.

A systems intelligent agent perceives he is part of a system or systems, that are generative frames within which experience of life takes place, but maintains the sensitive ability to think and act rationally[1] without having to take an outsider's view. The agent knows by intuition, or at least trusts that he knows enough, what local action produces which global outcomes. The concept of systems intelligence is versatile in the sense that it can be used not only as a descriptive theory, but also as a prescriptive theory of human decision making, i.e. used for observing the possible biases of the complex decision making environment, and suggesting alternative courses of action that might produce better outcomes. Then, choices for decisions should be under the spotlight.

The notion that some alternatives are non-visible is rather trivial, but important nonetheless. The literature on decision making emphasizes the role of options generation in a phase in decision support. It is quite obvious that sometimes an individual simply cannot see the 'goodness' or 'appropriateness' of some of his decision alternatives. If one is free to choose his actions, one can do almost anything all the time, but only a certain amount of alternatives are *feasible*, i.e. are possible solutions for their decision making problem. When straddling a bridge, for example, you can either crawl, walk, or run. You cannot fly unless you have a flying device nor if you cannot come up with an idea of having a flying device in the first place; thus, your feasible alternatives are those that are possible solutions, but those alternatives that you cannot choose remain infeasible. From the feasible alternatives, even fewer of them are desirable, i.e. optimize the objective. In the bridge example it is most satisfying to walk over it since it does not take too long (compared to crawling) and it does not require special effort, as is the case in running.

Another example, now from the feasible but invisible alternative space, would be that of selecting a career as a teenager: one may not be able to see himself as an architect, for example, although going to an architect school would be a perfectly feasible decision alternative. The system that appears for the decision making teenager invisible hides some crucial information, such as the high pleasure that the work of an architect could bring. This system is a product of the decision maker's beliefs and assumptions, or mental models, about different career alternatives. This discussion brings us back to the concept of the systemic world. There are certainly many infeasible alternatives in the invisible alternative space, but are there also feasible alternatives that the average decision maker does not see?

I begin discussing decision making in this essay from the viewpoint of corporations, institutions in which economic stakes are high and decisions far more formal and professional than in everyday life. This exploration gives us a needful analogue to human intuitive, myopic behaviour and a motivation to suggest another way to confront future uncertainties and contingencies that are present whether the decision maker is a corporation or an individual. My presumption is that institutional decision making is for the most part analogous to individual decision making.

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[1] It is not a straightforward task to define what rationality is. In common language, it means the same as *logical*, *reasonable*, or *sound*, but in decision sciences rationality is defined by a set of assumptions related to individual choice behavior. In this essay, being rational simply means being sound, as opposed to being 'irrational' or 'stupid'.

How Decisions Are Made in Corporations

One method of evaluating the worthiness of an investment that a business organization makes is to see how much some material benefit it will produce. The dynamics of an investment come to the picture when the time dimension is taken into account. Then, one must understand that the benefit does not immediately follow the investment. A common way to evaluate whether an investment is worthwhile to take is to determine how soon it will pay itself back. However, the payback period thinking does not account for the time value of money: a dollar now is more valuable than a dollar tomorrow, since one can invest that dollar now and make extra profit, yielding more than a dollar tomorrow. In corporate capital budgeting the awareness of the time value of money is important, since investments are strategic by nature, and often also contingent on future courses of action. Discounted cash flow analysis (DCF), based on the net present value rule, forms the basis for the *neoclassical theory of investment* (Dixit and Pindyck 1994). The discounted cash flow method is also widely accepted as a best practice not only by scholars of corporate finance, but also by practitioners in industrial organizations. Luenberger points out that the net present value criterion (that uses the DCF method) is "generally regarded as the single best measure of an investment's merit" (1998, p. 25).

Despite the power and popularity of the DCF method, it is weak in evaluating *opportunities* in the environment of the firm. Very valuable opportunities, such as investments in costly medicines, are understood to contain enormous uncertainties, and are thus valued very risky. The DCF method tends to over-rationalize issues such as opportunities that especially new ventures confront and depend on. The weaknesses in over-rationalization are not only that opportunities are driven away, but also that the possible benefits of risk-seeking behaviour are seen too narrowly or are not seen at all.

Benefits from risk-seeking behavior are seen too narrowly.

Opportunities are valuable in the sense that they bring flexibility into the operations of the firm; if a firm already holds the opportunity to invest in a factory by owning a site for it, then it does not have to wait until the last moment for the opportunity to realize and go by unexploited. New ventures may invest in opportunities when they explore novel fields of scientific applications by research and product development. These investments do not yield value as such, but they are valuable since they contain the opportunity for something of greater value, such as killer applications in the near future. When one firm pushes these killer applications to the markets, they gain a leading edge and confront competition only if the competitors themselves have developed similar opportunities, or if they are fast to imitate. According to Luehrman, firms typically value opportunities formally only at the point when they mature and the investment decision can no longer be deferred (1997, p. 136); this behaviour suggests that firms mostly rely on DCF based methods that take a negative stand on opportunities.

Value of Options

Understanding investment science is beneficial for studying everyday human decision making too, since there exist analogies between them. Both firms and individuals confront not only strategic long-term benefiting investment opportunities, but also smaller, everyday situations where it is useful to understand the logic of value creation, or in the human and more general case, *utility* creation. Often firms as well as human beings tend to get rid of future uncertainty that is mostly constructed by the variability in the future positions. As has been acknowledged in the Nobel prize winning work of Fisher Black and Myron Scholes (1973), influenced also by Robert Merton and Stewart Myers, the variability in the investment alternative is valuable. There is a positive correlation between investment's volatility and return. What Black and Scholes did in

their work was that they showed analytically why variability is indeed valuable and should not be discounted away.

A financial option is a right but not an obligation to exercise a transaction, selling or buying, for a financial asset in a marketplace. Consider a situation in which you hold the right to buy an asset at a predetermined price q at a predetermined date t. The actual price of the asset is thus p_t, so that the value of the option is nonnegative if and only if $q > p_t$, and zero otherwise (here transaction costs are assumed negligible). There is a certain probability by which this inequality will hold true, that is characteristic of the nature of the asset – shares for high tech firms are more volatile than government bonds. The future value of the option is thus contingent on the variability of the underlying asset at the date in which the option can be exercised.

Now consider that the underlying asset is not a financial asset but a right to gain a control right for some real asset, such as a factory. This right is called a real option, and it could stand for an ownership contract of a vacant lot and a right to hire a construction workforce for some pre-determined cost, for example. Consider that a firm can first acquire a right to build a factory (acquire a vacant lot), and then some time later exercise that right (build the factory on the lot). Consider that without the factory a firm can make a profit P, and with the factory, a profit Q. There is an opportunity to fulfil a market need with a product from this factory at some time in the future. The price of a European call option, that the real option represents, is determined by knowing the prices of first stage and second stage expenditures, the net present value of an underlying asset, risk-free interest and time to expiration. In this example these variables are the price of the site contract, the price of building the factory, net present value of profit B, risk-free interest of government obligations (for example), and the time it takes for a competitor to fulfil the market opportunity. Logically, this option is worthwhile executing if its value exceeds that of not executing the option.

Traditional methods would only look at the total costs, the cost of buying the ownership contract for the lot and the cost of building a factory on it, thus neglecting the option-like nature of the situation. With real options thinking, managers can extend their judgement for possibilities that need not be executed if things go wrong. If a competitor filled the market opportunity first, the factory need not be built and the option would not be exercised. The pertinent part of this judgement is a positive attitude towards possibilities that are contingent on the variability of alternatives, the unfolding and uncertain future.

From Options Analysis to Options Thinking

Economic theory provides us with a readily applicable framework of option-like instruments that give the decision maker a possibility to value different investment alternatives. When the future is highly uncertain, it simply pays to have a broad range of options open. In options valuation flexibility is rewarded, whereas in the neoclassical methods, flexibility is given a risk measure that is penalized in the valuation to the present.

Amram and Kulatikala (1999) note that real options are not merely a way of modelling and analyzing opportunities, but more so a way of thinking. They propose that real options thinking has three components that the manager, or, in general, a decision maker, might appreciate:

(1) *Options are contingent decisions*, that allow the decision maker to first see how events will unfold, and then make the decision

(2) *Real options are aligned with financial options*, that provide a financial market conceptual framework and concepts to value complex payoffs

(3) *Investment can be designed to fit the option framework*, so that not only can the firm take onto account of e.g. the uncertainty, but also to benefit from the uncertainty in the best possible way

Options methods also allow the construction of multiple scenarios in a tree-like manner. This scenario building allows also judgment of periods in which a firm has to incur losses in order to benefit in the future. Therefore, options valuation is naturally employed in such instances as venture financing or research and development projects.

Flexibility in decisions is given high value in real options research. Dias and Ryals (2002) agree with earlier developers of real options theory that flexibility matters, in their case in brand management. Geppert and Roessler (2001) also credit the worthiness of flexibility, in product line engineering. In effect, flexibility gives a chance to exploit variability of the decision alternative that indeed adds value for the option. With the financial options sketching of the decision situation, this flexibility can prove to be even more worthwhile than it on first sight may seem to be.

Luehrman (1998) claims that options thinking can provide an active style of managing opportunities and strategies for business executives. He gives an example of a tomato gardener, who manages a garden of tomatoes in an unpredictable climate. A tomato garden produces tomatoes during the summer season period. A gardener thus needs to pick the tomatoes just at the right time for sale, but this right time is contingent on the environment, most notably on the climate. There naturally are all kinds of tomatoes on a given time in the garden, those that are ripe and less ripe, thus needing decisions that either go to a category "pick now" or "pick never". Luehrman describes how a passive gardener would manage their tomatoes: visit the garden only at the last day of the season and pick those that are ripe ("pick now" category) and throw away the rotten tomatoes ("pick never"). Another gardener, active only on weekends, visits the tomatoes weekly and picks those that are ripe and does not let squirrels eat them. Fully active gardeners maximize their revenue from the crop, try their best not letting squirrels eat any of the tomatoes or not letting any go rotten.

A tomato garden can be seen as a portfolio of options. Luehrman defines two metrics for option valuation: value per cost (if smaller than 1, cost is more than value, if greater, vice versa) and volatility (how much change can occur before the decision must be made). These metrics are illustrated in option space, FIGURE 1.

In the top of the option space one has the possibility of exercising the option *now or never*. In the tomato garden, this situation occurs either because we are at the end of the season, or because there is no uncertainty in the garden conditions (no squirrels, no bad crops infecting good crops). If the tomatoes are in this condition, and ripe, they should be picked for sale. If value per cost is near zero, and volatility near zero, the tomatoes are bad and the option to pick them is not exercised. If the value per cost is over one and volatility higher, there is a possibility that the tomatoes either get worse or better, so there are much more options for the gardener to do for the tomatoes: pick now, pick tomorrow, or the day after that, etc. The tomatoes are picked "maybe now or probably later". Thus, a harvesting decision that an active gardener makes for tomatoes is contingent on the tomatoes' condition and the uncertainty of the crop that time brings; more time, more possibilities for the tomato gardener to grow a good tomato. Being aware of contingencies between uncertainty and time allows you to think in real options terms, and thus, as the FIGURE 1 depicts, gives more value to your options. Being aware of your valuable options makes you a better gardener.

Being aware of your options makes you a better gardener.

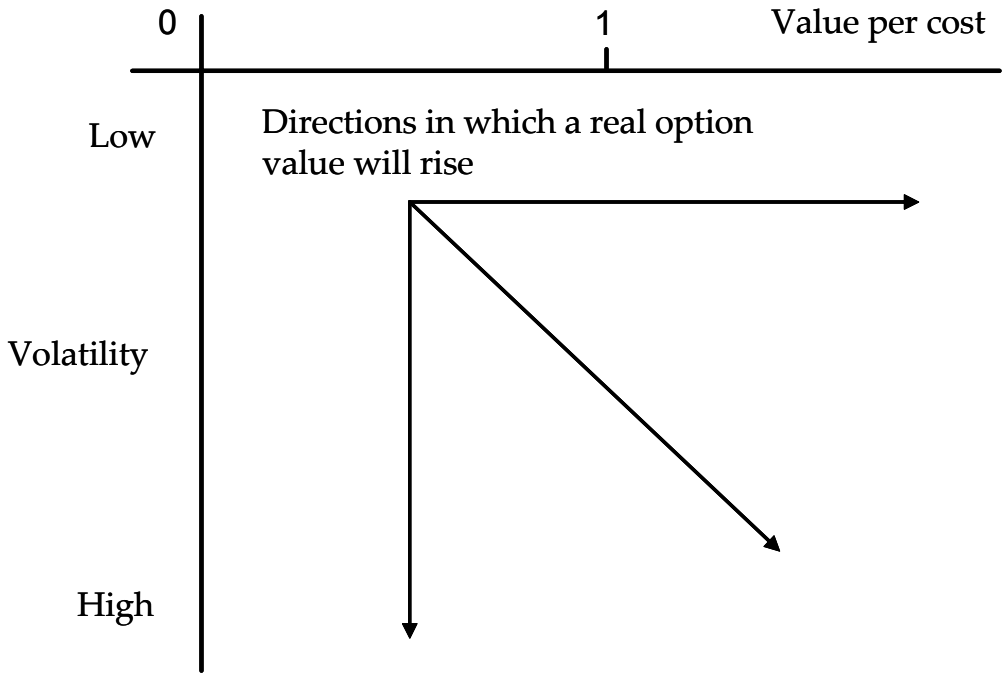

FIGURE 1. Options space, adopted from Luehrman (1998); the value of a real option will be highest when both the value per cost relationship is over unity and volatility is high.

Systems Intelligence: Thinking about Life-Oriented Options

Many aspects in human decisions and actions point towards risk-minimizing, opportunity-destroying behaviour. This statement is confirmed by the several contradictions that exist in the current strands between the fields of economics and psychology. Economists and psychologists have not arrived to an agreement how the real made decisions in the psychological sense are 'rational' in the economical sense. Individuals are apt to discount their future alternatives to the present, and think this logic is 'rational'. Even if one thinks that he makes non-myopic decisions, his logic may be poor since flexibility, contingencies, rights and obligations may not be intuitive concepts, visible at the time of the decision. Often, one can hear that an investment is profitable since it pays itself back fast. When one must select from several investment alternatives, the payback period method is biased, since it does not take the time value of money or other inputs into account. The popularity of payback period method may be due to the fact that the human being is risk-averse, and sees uncertainty in the far future less desirable than uncertainty in the near future. Another explanation might be that people prefer 'liquidity', or degrees of freedom in their lives, since again, uncertainty is not often given value.

Situations where one has rights that are not obligations are ubiquitous in everyday life of humans. Consider, for example, the following situations (adopted from Amram and Kulatikala 1999, pp. 10–11).

- It may be worthwhile to wait until the future reveals itself; of course, usually there is a cost to waiting, but the trade-off between waiting for more information and taking action now may be significant. With a neoclassical investment attitude, one may only consider the situation to be 'invest now or do not invest at all'. One considers it valuable to wait for investing in e.g. when one decides to 'sleep it over', acknowledging that it is not good to make the decision now if there is a possibility to postpone making it. When future information is appreciated, a *waiting-to-invest option* is acquired, and patience is considered valuable.

- Follow-on actions that derive from the actions we take now are valuable: investing in a learning opportunity is an example of such an action that gives one the future possibility to be ready to grasp the opportunity. Folk wisdom such as 'reading is always worthwhile' are examples of such logic, which is the case of a *growth option*. Often it appears to be worthwhile to invest attention into possibilities that the environment offers.
- Flexibility towards different scenarios is often rewarded. If one is uncertain about his near future, it may be worthwhile to create flexibility through 'alternate emplacements', opportunities that are realizable if things go wrong with the initial planning. Firms often hire people with multiple and versatile skills and who could be used also in other tasks than on jobs that their core skills require, or people with a proven capability to learn new skills fast so they could be used in new opportunities; this is an example of an attitude towards future uncertainties that acknowledges the value of these alternate emplacements.
- When considering whether or not to enter into new situations, a person may calculate the costs of failure due to external causes. If a married couple has entered into a phase where they begin considering a break-up, it is valuable to understand that often the cost of investing a little more effort into the relationship even if the break-up seems very probable is not great since one has an *exit option*, the possibility to call it off if they are not successful in their tryout. One then recognizes the fact that regret about trying again is acceptable.
- By staging investments, one can learn about the environment and gain better information from it. One can thus use a *learning option* that teaches the decision maker how to structure the resource usage for better success. *Action research* (see Reason and Bradbury 2004) also reflects the learning attitude and in part applies options thinking.

What systems intelligence basically claims is that one possesses the mental capability to choose their actions in such a way that productivity in their lives is attained by acting in a way that is not always apparent from their mental representation of the system at hand. Systems intelligence takes the position that action must follow now, from the acknowledgement of systemic effects of one's actions. Often individuals just have to rely on themselves and their capability to act. Sound confidence on the action mechanisms is often enough to produce good outcomes that satisfy the actor's objectives. Hesitation in the face of complex interaction mechanisms[2] may produce strong and delayed negative outcomes through amplifications and nonlinearities of the systemic environment.

Choices affect behaviour, and behaviour affects systems. If the superpowers during the cold-war era would have chosen otherwise, not to engage into arms race against each other, the world would probably look much different now. If you, the reader, would not have chosen to get up from the bed this morning, your own 'system of the day' would look much different. Choice behaviour of an individual is affected by his mental capabilities and his mental representations that the environment produces. There is clearly interconnectedness between the one's choices and one's presently active environment. Intelligent decisions that aim for the best outcomes may be significant determinants that shape the environment and also the decision making conditions. Options thinking provides a way of reflecting one's thinking about the uncertainties in one's environment.

[2] Hesitation can be pragmatically articulated as *lamenting of complexity*, the expression of helplessness when confronting situations that appear complex. It must be noted that, often the human misjudges the nature of complexity in their environment – the engine of an automobile may be termed complex in natural language although in reality it is simple and interrelationships between its parts are well-defined.

Prescriptions

What could be the prescription that studies in systems intelligence could give for the everyday decision maker? I strongly believe that the novel perspective that options thinking gives, provides us reasons to believe in alternative, sometimes irrational-appearing moves. Consider the following example.

> Peter, a twenty-something engineering student, is considering ways to spend his evening. He has a free ticket to a ball, but he also knows that an interesting TV-program is on air tonight. Therefore, he is to decide on two conflicting options: whether to stay at home all night (H) or go to the ball (B).
>
> As an economically rational decision maker, Peter implicitly discounts in his mind the utility of going to the ball. He knows that Lisa will probably be there, and in his wild imaginations he assigns another probability that he and Lisa will get out of the ball as a couple and live happily ever after. On the other hand, Peter considers a complementary event, that neither Lisa or any other interesting girl is present, and thus he has to spend the whole night at the ball all by himself or leave early; Peter is not a very optimistic person by nature, so he considers that the probability of finding Lisa is small and the probability of leaving early or empty-handed is high (although with the first intuition, Peter considered Lisa's appearance at the ball very likely). What comes to the other decision, staying home for the night, he considers it fairly valuable since he does not want to miss the newest episode of "Lost". Peter stays home for the night, since he sees the present value of option H more valuable than that of option B. A decision tree for Peter's decision is shown in FIGURE 2.

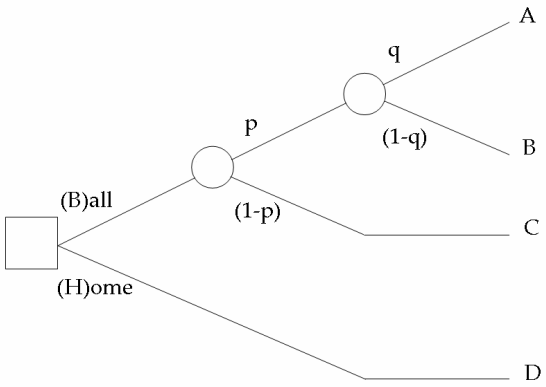

FIGURE 2. Peter's decision tree.

> If Peter was a systems intelligent options thinker, he would consider the ticket to the ball as a right but not an obligation. Let's consider the possibility that Peter went to the ball but left early since Lisa didn't arrive. He lost 60 minutes from his evening as a transaction cost (and first 10 minutes of "Lost"), and the value of the option B proved to be zero. On the other case, if Lisa came to the ball and they fell for each other, the value of B proved to be enormous. Now, the true value of the option B lies in the set $[0 - c, \eta - c]$, where c denotes the transaction cost (a two-way bus ticket, for example) and η an enormous value. The opportunity costs in both options are the missed utilities of the conflicting option.

In life, the cost of exercising opportunities is often very small. The system-determining decision variable in the preceding example is the transaction cost of exercising the opportunity. The agent has already acquired a right to take an action, so either taking or *not* taking the action is virtually cost-free. The transaction cost, the cost that follows from taking the transaction from exercising the right is often smaller than people think. In the case described, the exercising incurs a small

cost, for example a bus ticket, and an opportunity cost of not doing something else. But, in the face of the possible gains that exercising the option could produce, these 'costs' are materially very insignificant, and for the most part matter on a psychological level. A demand is in place for critical reassessment of psychological costs.

The environment, understood as a system that generates some outcomes of action-decisions and hides some, is not only affected by one person's action, but also by the actions between several people. We organize our actions in different forms, cooperate and defect, aim for joint gains or zero-sum exploitation of another's resources, et cetera. One purpose of rationality studies in economics and philosophy has always been to understand just why humans cooperate, when it may be seemingly more worthwhile for one individual alone to defect when others are willing to cooperate. If kin relationships between individuals, and emotions towards others, are excluded from the study of rationality, it very well may seem like the human being is not rational at all when considering such an achievement as the welfare state.

Cooperative action contains vast amounts of potential that could be released by minimal interventions and exploitation of options. Consider negotiations, for example. Negotiating parties can aim at common benefits but still try to keep their preference information private within themselves to the hilt. The dilemma is often that it would benefit both parties if they could somehow settle to a cooperative outcome, but since it can be lucrative for the other party to *defect* while the other cooperates, neither suggests cooperation. This leads to interaction where the parties only take minor steps towards cooperative outcomes and may soon end up in a solution that is not the best for either of them, while the best option that would benefit both remains unexploited. A review of finding jointly improving directions in multiple-party negotiations is given by Ehtamo and Hämäläinen (2001).

What if the negotiating parties, instead of marginal iterative steps, could find rights that are not obligations in the negotiation arena? Communication and the actual interaction in negotiation, after all, play a major role.[3] Hostile attitude of party *A* towards party *B* may make *B* believe that *A* is more apt to defect any suggestion that *A* provides for the cooperative aim. Most people acting in the role of *B* would answer this behaviour with hostility, thus leading into a 'spiral of revenge' where cooperation could only be dreamt of. But what if *A* started the negotiation with a smile and warm friendliness, and some brief small talk questions about *B*'s family?

Small choices, such as a smile or a handshake, matter.

The outcome of a negotiation is essentially dependent on the appearance of the negotiating setting, i.e. a negotiating system. And as we already know, the appearance of the negotiating system is dependent on choices, the behaviour that the negotiating parties address towards each other. Thus choices, even small ones such as a smile and firmness of handshake, matter. Time, or non-simultaneity of actions, matters too. After handshake comes a brief period of small talk before entering into the subject. If the handshake of *A* is non-eloquent, *B* might think that *A* is not motivated enough for the situation, and behaves accordingly, by skipping the warm small-talk, for example. By this action, *B* incurs a gesture of non-friendliness to *A*, and *A* gives a proper response; thus, the system of holding back in return is in place (as in Saarinen and Hämäläinen 2004). Myopic reactivity towards each other's actions takes over and longer-term gains are easily forgotten. Often it would be best to just 'keep cool'.

[3] The significance of communication settings in negotiations are acknowledged by most negotiation theorists, such as Raiffa (2002).

What is often dismissed in choice behaviour is the path-dependency of choices (see e.g. David 2001). How a choice is made at time *t* is dependent of choices made at previous times. With path-dependency it is also easy to explain such phenomena as the system of holding back. Path-dependency also gives us a motivation to explain the worthiness of options thinking in human-human choice behaviour; biases that choice behaviour often reflect, such as the system of holding back, appear as manifestations of path dependency.

Consider the simple act of positive attitude towards the other party in a negotiation setting. You always have a right to choose to act positively, e.g. shake hands with a smile and greet with warmth (even if this is not expected from you), regardless of the environmental factors, such as the 'mental atmosphere' of the situation. But only with thinking these acts in terms of options, one can appreciate their connection with the *possible* outcomes of all the decisions, the macrostructure that emerges from decisions on the micro scale.

Conclusions

The human mind is bounded when it comes to rational, utility-maximizing decisions. Knowing this, a scholar has to define what is meant by rationality, when rational judgement refers to individuals making good decisions. The relationship between rationality and optimality can lead to circular reasoning. Defining what good decisions are and how individuals naturally judge them is one way to approach the definition of rationality, and that has been the framework in this essay. Overall, the term rationality carries within itself possibilities for academic debates and different definitions, since it is not an absolute term, a physical constant, but dependent on so many assumptions. This relativity of the term rationality reveals the fallacy that one succumbs into when defining what it is – what is the point of defining something that in the end strongly depends on other assumptions?

The only sure thing in life is that nothing is sure. We are sure that human decision making takes place all the time all around us, but we are not sure about the rules that govern this action. We are sure that humans make choices, but we are not sure why some choices are more valued than others. The system that develops around the action hides its rules, and hinders our ability to see what *kind* of action and which choices would produce what kind of outcomes. There is no mathematical formula for optimal behaviour, since our minds are cognitively bounded to process such formulas. But, the human race still exists, and over thousands of years has done pretty well – there must be something in our minds that solve all the problems we face every day with our horribly bounded rationality! This essay has concentrated on approaching problems in the face of uncertainty and inherent dynamics of the system. Option analysis from investment science has been employed as an insightful method to appreciate the cognitively invisible alternatives that our mental models in place disable us to see.

One conclusion from exploring the options thinking method in everyday human decision making is that often traditional 'folk wisdom' is right. Just consider how old is the wisdom that the waiting-to-invest, or patience, option resembles. Patience is good, haste in front of uncertainty bad, just like our great grandfathers have taught us. This conclusion resembles a wider area of applicability that admitting of a behaviour-based intelligence that considers systems in a natural way gives. From the systems intelligence perspective, one can appreciate and even celebrate phenomena in human action that will otherwise go unnoticed.

References

AMRAM M. AND N. KULATIKALA. 1999. *Real Options: Managing Strategic Investments in an Uncertain World*. Boston, MA: Harvard Business School Press.

BLACK F. AND M. SCHOLES. 1973. The pricing of options and corporate liabilities. *Journal of Political Economy*, vol. 81, no. 3, pp. 637–654.

CLEMEN R.T. 1996. *Making Hard Decisions: An Introduction to Decision Analysis*. Belmont, CA: Wadsworth Publishing Company,.

DAVID P.A. 2001. Path dependence, its critics and the quest for 'historical economics'. In *Evolution and Path Dependence in Economic Ideas: Past and Present*, P. Garrouste and S. Ioannides, eds., Cheltenham, England: Edward Elgar Publishing.

DIXIT A. AND R. PINDYCK. 1994. *Investment Under Uncertainty*. Princeton, NJ: Princeton University Press.

DIAS S. AND L. RYALS. 2002. Options theory and options thinking in valuing returns on brand investments and brand extensions. *Journal of Product and Brand Management*, vol. 11, no. 2, pp. 115–128.

EHTAMO H. AND R.P. HÄMÄLÄINEN. 2001. Interactive multiple-criteria methods for reaching pareto optimal agreements in negotiations. *Group Decision and Negotiation*, vol. 10, pp. 475–491.

GEPPERT B. AND F. ROESSLER. 2001. Combining product line engineering with options thinking. *Proceedings of PLEES'01: Product Line Engineering.*

HÄMÄLÄINEN RAIMO P. AND ESA SAARINEN. 2006. Systems intelligence: A key competence in human action and organizational life. *Reflections: The SoL Journal*, vol. 7, no. 4, pp. 17–28. Reprinted in *Systems Intelligence in Leadership and Everyday Life*, Raimo P. Hämäläinen and Esa Saarinen, eds., 2007, Espoo: Systems Analysis Laboratory, Helsinki University of Technology.

Keeney J. and H. Raiffa. 1976. Decisions with Multiple Objectives. New York: Wiley.

LUEHRMAN T.A. 1997. What's it worth? A general manager's guide to valuation. *Harvard Business Review*, May-June.

LUENBERGER, D.G. 1998. *Investment Science*. New York: Oxford University Press.

RAIFFA H. 2002. *Negotiation Analysis: The Science and Art of Collaborative Decision Making*. Belknap Press.

REASON P. AND H. BRADBURY. 2004. Introduction: Inquiry and participation in search of a world worthy of human aspiration. In *Handbook of Action Research*, P. Reason and H. Bradbury, eds., London: Sage.

SAARINEN ESA AND RAIMO P. HÄMÄLÄINEN. 2004. Systems intelligence: Connecting engineering thinking with human sensitivity. In *Systems Intelligence: Discovering a Hidden Competence in Human Action and Organisational Life*, Raimo P. Hämäläinen and Esa Saarinen, eds., Helsinki University of Technology, Systems Analysis Laboratory Research Reports, A88, October 2004, pp. 9–37. Reprinted in *Systems Intelligence in Leadership and Everyday Life*, Raimo P. Hämäläinen and Esa Saarinen, eds., 2007, Espoo: Systems Analysis Laboratory, Helsinki University of Technology.

SENGE P.M., A. KLEINER, C. ROBERTS, R.B. ROSS, AND B.J. SMITH. 1994. *The Fifth Discipline Fieldbook*. New York: Currency Doubleday.

TVERSKY A. AND D. KAHNEMAN. 1974. Judgements under uncertainty: Heuristics and biases. *Science*, vol. 185, pp. 1124–1131.

VON WINTERFELDT D. AND D. EDWARDS. 1986. *Decision Analysis and Behavioral Research*. Cambridge University Press.

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