

THE ROLE OF INTUITION IN DECISION-MAKING AND ECONOMICS

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Implicit Laboratory Association (ImpLab) is a registered association aimed to foster research and facilitate debate on issues related to implicit cognition. The second annual Workshop of ImpLab was held in June 2007 at Budapest. Cognitive researchers, psychologists, physicists, entrepreneurs, economics and financial experts examined The Role of Intuition in Decision-making and Economics. Participants of the workshop discussed the latest scientific findings of how human intuitive, non-conscious processes could improve business decisions.

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Keynote Lectures

Economic Psychology and Behavioral Economics: Will the Two Paradigms Ever Match Each Other?

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In the last 20 years or so, two scientific disciplines have emerged, both investigating psychological features of economic behavior. Economic Psychology (e.g., Frei & Stutzer, 2007; Furnham & Argyle, 1998; Hunyady & Székely, 2003; Lea, Tarpy, & Webley, 1987), on the one hand, is a purely psychological discipline, aiming at describing features of economic behavior as exactly as possible. As this kind of behavior is apparently very far from purely rational, economic psychologists took it for granted that human behavior, as usual, is not at all rational, not even in the domain of economics.

Behavioral Economics (e.g., Camerer, Loewenstein, & Rabin, 2003; Diamond & Vartiainen, 2007), on the other hand, is a purely economic discipline that considers the well-established, profoundly mathematical models of economics as good starting points. This discipline aims at incorporating the findings of psychology into these models as much as possible, hoping to improve the predictive power of these models.

The most fundamental difference between these approaches is in assessing the role of rationality in human behavior. Most of the researchers of Economic Psychology vehemently criticize the standard models

of economics because they are based on the supposition that human economic behavior is inherently rational. The researchers of Behavioral Economics would answer to this criticism something like „it is similar as if you would criticize Newtonian mechanics, because it sets out from an object having no extension and still having a mass” (see Table 1). Of course, this is just a model, but a very fruitful model, as the last few hundred years proved.

Table 1

Comparison of Newtonian Physics and Economics

	Physics	Economics
Basic assumption	Dimensionless bodies	Fully rational people
Model condition	Arbitrary exactness in measurement	Purely rational decisions
Practical nuisances	Friction, air resistance, etc	Externalities, etc.
Major anomalies	The dual nature of light	Rationality + intuition
A common line of efforts	Looking for the conditions of equilibrium	

We know it from our experiences that every practical activity is highly intuitive. In the case of physics, intuition inevitably appears in the activity of engineers, while in the case of economics, it appears in the everyday activities of practicing economists.

Intuition is ubiquitous in the human thought process. Here are just a few instances of everyday features that are well-established observations of psychologists (not only economic psychologists), and definitely contradict the standard paradigm of economics:

- The same person may be inclined to buy a lottery ticket and an insurance at the same time. According to psychologists, we may be risk-seeking and

risk-avoiding at the same time. According to economists, the subjective utility function may be concave or convex, but not both at the same point (e.g., at the point of a few hundred thousand Euros, which is typically an expectation from a top prize in lottery, and the value of a house).

- The wording of the case can make a significant difference in our judgments and decisions (see the „vaccination paradox” and many other instances in Kahneman & Tversky, 2000).
- The „Mental Bookkeeping” (see examples in Thaler, 1994).
- Cognitive dissonances and many other psychological roots of our irrational behaviors (see Festinger & Carlsmith, and others reprinted in Hock, 1995 for spectacular examples on non-rational effects of money).

How can all these features be incorporated into the standard models of economics? Is Behavioral Economics in the strict sense, as we defined it above, possible?

The first breakthrough was Prospect theory (Kahneman & Tversky 1979; Tversky & Kahneman, 1992), for which Kahneman was awarded the Nobel Prize in 2002 (unfortunately, Tversky had passed away by then). Kahneman and Tversky were looking for a version of the subjective utility that is psychologically more plausible than the purely rational SEU (subjective expected utility) function used by economists:

$$\sum p_x u(x)$$

Kahneman and Tversky tried to distort this function as little as possible. In fact, they tried to match human behavior observed in several experiments with a

function that differs from the classical SEU function only in two aspects:

- The probability p_x is not linear, but distorted. The exact function between the objective and subjective probabilities was determined by extensive experimental work.
- The utility function is not an absolute function of x , but a function of x for which the zero point is always our actual position (or wealth).

With this model, not only the experimental results on human utility perception could be modeled at a very good precision, but it also became possible to replace the old SEU formula in the classical models of economics with this new one. In other words, there appeared a royal path for the behavioral economists to incorporate a purely psychological result in their models.

When this formula was built in the classical Capital Asset Pricing Model (CAPM)¹, it led to a significant success from both theoretical, and practical aspects. The most widely used consequence of the CAPM model, the capital market line (the so called „Base line theorem” – see Levy, De Giorgi, & Hens, 2003) remained valid also in this modified model, although the concrete location of this straight line has slightly changed. By this change, however, the model’s forecasting power increased, when it was checked against the stock market data of the last 30 years.

¹ The Capital Asset Pricing Model (CAPM) is used in finance to determine a theoretically appropriate required rate of return of an asset, if that asset is to be added to an already well-diversified portfolio, given that asset’s non-diversifiable risk. [Editor’s comment; source: Wikipedia, Retrieved on July 22th, 2007]

The equilibrium theorem of the CAPM model became invalid, but when it was proved that this is not causing a chaos, just a slight waving (Levy & Levy, 2002) then the theoretical economists also relieved. This way, in fact, the nature of the stock market equilibrium became even a bit more similar to the nature of biological equilibria, where also a slight permanent waving was found, instead of a stable equilibrium (Maynard Smith, 1982).

The Prospect theory became the first instance of results of Behavioral Economics, as defined in the strict sense above. However, for psychology, in order to become that useful for economics, its results should be formulated in a similarly abstract and exact form as was Prospect theory.

On the other hand, this may prove not just a one-way street. Psychology has always been involved in looking for conditions of mental balance. Behavioral Economics, as well as game theory, may also provide a strong mathematical model for psychology to help this effort (see Mérő, 1998).

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„I want to talk about it...” – Experiments and Psychology in Economics and Finance

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Abstract: In the following paper, I will introduce two basic concepts in economics (Supply and Demand model [S & D] and Efficient Market Hypothesis [EMH]) in the light of experimental economics and behavioral finance. I will argue that these non-mainstream approaches lead to a better understanding of economics.

Keywords: behavioral finance, economic efficiency, experimental economics, informational efficiency, overconfidence supply and demand model.

1. Introduction

A good theory in economics satisfies three conditions: First, it does not explain a triviality; it goes beyond the surface of a phenomenon. Second, it can be easily apprehended with an example or an anecdote. Third, it has to have some practical relevance and real consequences.

The S & D model and the EMH are good examples² to illustrate how experiments in research or in class and psychological aspects in the traditional framework could enrich the scientific thinking in economics and finance. The present paper examines these two good theories.

² Other „good” concepts: concept of comparative advantage, theory of transaction cost, Capital Asset Pricing Model.

2. Experimenting with the Supply & Demand model

Conducting experiments in order to illustrate or test an economic theory may seem to be odd in Hungary. There are only a very limited number of papers using experimental methodology in Hungarian economics journals. Surprisingly, it was almost 60 years ago when Chamberlin (1948) conducted the first market experiment in his economics class to show the impossibility of the perfect competition. Basically, he tested the S & D model with a weak market framework or “institution”, where the players had to negotiate the trades freely with each other without any structure. In his class experiment, (simplified version of the experiment of Holt, 2007) each seller was to sell a widget to buyers. There were 8 widgets/sellers and 8 potential buyers. The individual costs of producing the widget, and the values/reselling price were private information and determined by paying cards given to each player: ♥ and ♦ representing value → four cards with 10¢ and four cards with 4¢, and ♣ and ♠ representing cost → four cards with 2¢ and four cards with 8¢. The players could easily calculate their profits: sellers’ profit = contract price – cost ; buyers’ profit = value (reselling price) – contract price. In the first round trades occurred between 10¢ and 3¢ (Holt, 2007).

I made a seemingly little change in its setting when running a similar experiment with same costs and values at the ImpLab Workshop (held at Budapest, 2007). During the two minutes experiment, the highest bid and lowest ask prices and the contract prices were displayed on the blackboard. The prices were lined through if an outstanding bid or ask was accepted. With this better market institution, there were 4 trades between 4¢ and 6¢, and they

were much closer to the price of 6¢³, which is the theoretical equilibrium price predicted by the standard S & D model. The equilibrium price (EP) plays an important role in economics, providing the optimal choice⁴ and leading to the highest level of economic efficiency. Economists measure this efficiency with the total aggregated profit after summing up all subjects’ profits. As I paid the profit in chocolate (¢), I gave 26 pieces of chocolate, which were slightly less than the maximum possible theoretical number (32¢) when each trade would have occurred at 6¢⁵. This price implies that four potential sellers with the highest cost (8¢) and the four potential buyers with the lowest value are driven out of the market. Consequently, EP is often called clearing price, as manufacturers can produce goods at relatively high costs or resell goods at relatively low prices⁶.

³ It is interesting to note that the reason that three out of the four trades were made below the EP might be intuitively explained by the fact that people act as buyers more frequently than as sellers in every day life. We seem to be “better” (more experienced) buyers than sellers on average as highlighted by James C. Cox at the Workshop on Experimental Economics in Bratislava on the 9th July 2007.

⁴ Some who are not educated or socialized to be economists may have other notion of the optimal solution, for instance, when all the goods in the market are sold and bought. It is possible that the buyers with value of 4¢ meet the sellers with cost of 2¢, while the buyers with value of 10¢ trade with sellers with cost of 8¢. In this theoretical case the total number of chocolate won by the participants would have been 16, which is usually considered as the worst scenario in terms of economic efficiency.

⁵ The difference between the max profit (32¢) and actual profit (26¢) is called dead-weight loss (6¢), because no one could earn it.

⁶ Note that you can achieve 32¢ with other contract prices, but they may not “clear” the market.

During the experiment at the ImpLab workshop, the subjects were better informed (they could see the bids/ask and contract prices), the contract prices were closer to the EP than in the original game when sellers/buyers had little information on others' trading. The institution used here is called double auction (showing the highest bid and lowest ask prices). This provides more information to the players and it leads to a more efficient economic outcome. Experimental economics gives a clear and lively illustration how the market works, in some cases near the theoretical equilibrium.

Hitherto, there has been no need to talk about the psychological or behavioral dimension, as the theory of economics worked well. However, in other cases, if the information is more of a determining factor, it can matter how the players perceive, interpret or misinterpret information and it can affect the economic wealth. This may be the narrow gap in the discipline of economics, where the ideas of psychology (the behavioral studies) step in. In the next section, I will give an example for this from the field of the financial market that is considered, quite rightly, a perfect market.

3. Financial wealth and overconfidence

The financial or stock markets have unique features why one can argue that they are textbook-examples for theoretically perfect market. Many players are competing with each other: they are chasing information related to the securities (high level of liquidity with many information incorporated in prices); benefits or profits can be easily calculated (cash-ins and cash-outs); entry and transaction costs relatively low. Eugene Fama (1965) tested three levels of information efficiency (weak, medium,

strong) of the US stock markets in his PhD dissertation. He found no evidence for biased mispricing of stocks. In other word, the prices reflected relevant information.

This “good” concept is called the Efficient Market Hypothesis (EMH). The EMH implies that this strong informational efficiency also leads to the highest level of economic efficiency, and in theory, the fierce competition of stock markets drives out the players who are irrational or whose decisions are not optimal (similarly to the S & D experiment). The EMH became the main tenant of the modern financial theory in the mid 70s. However, 20 years later, studies showed that players in the stock market do not always behave rationally and they do not “die out” even in the long run (e.g., Barber & Odean, 2001). Psychological aspects have some impacts on the economic efficiency or the financial profit.

Brad M. Barber and Terrance Odean (2001) published their seminal paper of this new field of Behavioral Finance. They aimed to explain the stock market anomalies with psychological, behavioral patterns of the market players. In the rational world of EMH, irrational players lose money and they cannot prevail. The analysis of about 30,000 households' brokerage accounts showed a rather different picture (Barber & Odean, 2001).

Figure 1. Own figure with data from Barber and Odean (2001).



A comparison of the monthly turnover⁷ of men and women (blue bars in Figure 1) indicated that men tended to trade more frequently than women on average according to the results of Barber and Odean (2001). This significant difference could be explained on the ground of rational behavior only if men could achieve a better performance. On the contrary, in their returns⁸, men performed significantly worse than women (included the effect of brokerage fees). Barber and Odean (2001) concluded that men tend to be more overconfident⁹ than women¹⁰ when trading in a stock market. In addition, despite men lose more money they do not exit the market. These results clash the EMH.

3. Concluding remarks

We have seen two examples that illustrate how an alternative methodology (experiments) and another science (psychology) could change how to teach or to do research in economics. In the first case, we saw that markets can work very well in a market situation. If there is a good market institution (e.g. double auction), the players' behavior is consistent with the standard economic theory, trades occur near the EP, hence it

leads to higher level of economic efficiency. The second example should convince traditional economists that psychology matters, even in a stock market, which is considered as textbook example for perfect and well functioning market.

Finally, I doubt that the two sciences (i.e., economics and psychology) would become more open to each other. Even behavioral economists are not interested in a deeper understanding of psychological aspects. For instance, they focus on whether the overconfidence deteriorates the financial performance or not. They remain materialist, efficiency- or money-oriented economists.

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⁷ Monthly turnover in percentage shows the fraction of the portfolio that was replaced in every month on average.

⁸ Own-benchmark abnormal returns are the average household percentage monthly abnormal return calculated as the realized monthly return for a household less the return that would have been earned had the household held the beginning-of-year portfolio for the entire year (in Table II of Barber & Odean, 2001)

⁹ See the following video illustrating overconfidence:

<http://www.youtube.com/watch?v=YOSv7xsGp24>

¹⁰ Some intuitive explanations on the single vs. married dimension were partly discussed in the ImpLab Workshop, note that Barber & Odean (2001) found it less significant.

Short Papers

Nonconscious Thinking

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According to the Cambridge English dictionary, intuition is defined as „[...] an ability to understand or know something immediately without needing to think about it, learn it or discover it by using reason”. The notion that this *immediate apprehension* (Rorty, 1967) and inferential reasoning are two different means of human cognition is long established in philosophy. However, its empirical understanding did not start in until very recently. The object of this article is to highlight the main principles of the theories of intuition.

According to the *Unconscious Thought Theory* (UTT), intuition is a feeling based on unconscious past experience (Dijksterhuis & Nördgren, 2006). This accumulated knowledge is often called as *implicit knowledge* (Reber, 1992), which signifies the absence of awareness of its contents. Distinguished from the other two ways of problem solving – *rational-incremental* and *sudden insight* (Reber, Ruch-Monachon, & Perrig, 2007) – intuition emerges from no deliberate processes of thinking without relying on insufficient amount of information either. This unconscious memory is thought to consist of all relevant aspects of the problem learnt from previous experience. Based on empirical research, the authors of UTT proposed six principles characterizing the cognitive process behind intuition.

The Unconscious-Thought Principle refers to the dissociation of the modes of thought according to the presence or absence of the focus of conscious attention in the process. *The Capacity Principle* declares that the conscious thought is constrained by limited capacity while unconscious thought does not suffer from these capacity constraints. Dijksterhuis (2004) found that when the participants of the experiment were presented with considerable amount of information about four hypothetical apartments the group which had three minutes thinking (conscious thinkers) performed worse when asked to choose the best one than the group which received a diverted attention task during that three minutes (unconscious thinkers). *The Bottom-Up-versus-Top-Down Principle* explains that the conscious thought has a top-down and inherently hierarchical structure. The increased schema use leads to more heuristic-like and stereotypical thinking. In contrast, the unconscious thought slowly integrates information in a form of distributed bottom-up processing. *The Weighting Principle* says that the relative importance of the various attributes involved in a problem-solving situation is naturally weighted. Experimental data of Wilson et al. (1993) supported this claim when they found that when participants had to choose one poster out of five either by thinking about them for 9 minutes or receiving a distraction task for the same time, the latter group were happier with their choices when asked about it a few weeks later. *The Rule Principle* proposes that only conscious thinking can follow strict rules, unconscious processing can only conform to rules. *The Convergence-versus-Divergence Principle* concerns non-conscious processes such as creativity where the way of thought is more divergent than conscious thought and memory which work with a focused attention of awareness.

There is still little empirical research behind this dissociation and these assumptions, but the initial findings suggest that under special circumstances – when the complexity of the problem is greater and the solution does not require one to follow strict rules – the hint of intuition may predict better outcome than the conscious decision which may be based only on those few items that the system is able to recall and deal with. The questions of when and how we can take advantage of our intuitive abilities; whether these abilities differ by individuals; in what way we can measure them and apply them to real life situations are still not answered, but the developed methodology behind these initial studies enable us to regard intuition more than a mystical phenomenon.

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Is It Worth Being an Informed Trader?

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Abstract: We present an experimental and simulated model of a multi-agent stock market. Studying the effect of cumulative information on the performance of traders, we find a non monotonic relationship of net returns of traders as a function of information levels.

Particularly, averagely informed traders perform worse than the non informed and only traders with high levels of information (insiders) are able to beat the market. These results could give a possible explanation why, on average, professional fund managers perform worse than the market index (Cowles, 1933; Jensen, 1968; Malkiel, 2003).

Keywords: agent-based models, cumulative information, experimental economics, stock market, value of information.

1. *Outline of the model*

The model is based on a cumulative information system. Ten traders with different information levels trade a risky asset (stock) and a risk free bond (cash) on a continuous double auction market. The information level refers to the forecasting ability of future dividends to be paid on the shares (initially generated as a random walk). The information setup is as follows: Trader I0 is trading random, trader I1 knows the dividend for the end of the current period, trader I2 knows the dividends for the current and the next period, ..., trader I9 for the current and the next eight periods, out of which they make up their estimated present value of the stock.

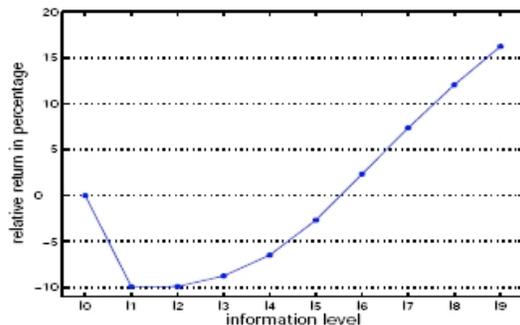
The results of the experiments, carried out by two of us (J. Huber & M. Kirchler) showed that the performance (net return) of traders is a non monotonic function of their information level. This result is in agreement with phenomena often seen in real world markets. For a detailed description of the model and the results see Huber, Kirchler, and Sutter (in press) and Tóth, Scalas, Huber, and Kirchler (2007).

In case of the simulations the informed traders (I1-I9) act as strict fundamentalists (for more details on the strategies see: <http://www.phy.bme.hu/~bence/details/strat.html>). The simulation framework is an asynchronous (continuous time) agent based model.

2. Results of the simulations

The final return of traders relative to that of the whole market can be seen in Figure 1. The results are in good agreement with the experimental results, we get a curve we call J-curve: Agents having average level of information (I1-I5) perform worse than the completely uninformed random agent (I0).

Figure 1. Returns of traders relative to the market in percentage, as a function of information. One can see that having average level of information is not necessarily an advantage.



The reason for this phenomenon can be interpreted in the following way: traders having no forecasting ability trade randomly and cannot be exploited by other traders. At the same time, traders having average forecasting horizon but believing in the information they possess, can be exploited by better informed traders, insiders. It is important to stress that while heterogeneous beliefs of agents are necessary for trading, we were able to reproduce the J-curve by implementing fundamentalist strategy. Thus it is enough to assume that traders use the information they possess to get the non monotonic

relationship of net returns of traders as a function of information levels.

These results can give a possible explanation for a puzzling real life phenomenon. Most of the professional fund managers on stock markets perform worse on the long run than the market itself (i.e. they get lower returns than a random trader would get in the same period). The possible cause for this bad performance can be seen from our results: most of the professional fund managers are not insiders neither completely uninformed. They fit into the middle of our curve. Traders taking random decisions can outperform them on the long run, receiving the market return.

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Female Intuition: A Creative Prognosis

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Global economy relies essentially on team work – consequently its value system puts an ever higher emphasis on emotional intelligence, the willingness to co-operate, on empathy, care for others, and indeed, on intuition. Female intuition has become proverbial in everyday language because its importance has been shown by centuries of collective experience - it is far more than a simple feature of naïve psychology or common sense. What we generally mean by this is sensitivity to minor details, a perceptiveness to fine resonances.

Female intuition has the potential to yield information which can support decision-making. Such information appears as a complementary element, an added value,

even in cases when the decisions themselves are made by men. Thus it can play a decisive part in the creative prognosis regarding the future of any particular organisation. A typical example is a contemporary process in business life, referred to as co-opetition. Competition and co-operation are here blended to yield an alloy in which intuition can also play a great part, depending on the people skills of the competing organisational cultures.

Co-opetition puts the emphasis on hitting the right balance between competition and co-operation: the phrase refers to a desired state where the tangible result is the improvement of relationships on the interpersonal and organisational level alike. Naturally, even female intuition needs to be inspired by co-operation with men: it is the fruit of a state of balance.

In our days there are innumerable NGOs offering assistance to women but almost all of them, similarly to measures taken by central government, put the emphasis on the inequality of opportunities. Indeed, it is vital to stress discrepancies in opportunities but it is also crucial to offer novel methods that exploit genuine female values in a natural way and which allow not only women but the entire society to profit from them. Female intuition based on the experiences of women and communicated by women is one of these values.

From early childhood onwards, the socialisation process prepares boys for completely different roles than girls (Buda, 1985). In the case of girls empathy, care, altruism, self-sacrifice and adaptation to others become leading values, while in the case of boys parents tend to reward assertive, career-centred, powerful, rational, competitive, firm and independent behaviour forms. By the beginning of the 21st century our societies have become extremely complex. This

means that female roles have also become highly complex, causing women to face a very difficult predicament. At the same time more and more participants of business life are also beginning to stress the importance of female values in the development of organisations, in the building and maintenance of relationships as well as in communications. This is not done in opposition to the traditional value system but with the aim of forging a value from the differences of the two attitudes. At the same time, successful women usually move along male trajectories: if women do reach the top ranks of organisational hierarchies at all, they usually follow the male models in behaviour and attitudes, leaving little room for their own feminine qualities (Kovalainen, 1990). In a process like this, female intuition can easily get lost.

Relying on a complex, network-centered approach, which is increasingly gaining ground today, we would like to point out the existence of a different value system which is based primarily on empathy and co-operation. This usually develops on the broadest, bottom-most layers of the organizational hierarchy from the interactions of female networks.

Research & Development (R&D), innovation and basic research are turning more and more into team work where female values are increasingly in demand. These are the values that may be exploited by mapping out informal networks and offering support to these networks and relationships. Women's networks have always existed but by making the existence of these structures conscious we can enhance their effect and, at a later stage integrate the values they generate, including intuition, on a higher level.

It would be highly beneficial if the leading symbol of organisational hierarchy, the ladder, was replaced by the web. We

would win far more than an entire dimension. The networking activity of women acquires extreme importance in the light of latest research on weak bonds (Csermely, 2006) both in industry and research. In the innovative, knowledge-intensive situations of R&D, which also requires a high degree of co-operation, women's activities appear as unique and competent. Over a certain degree of complexity the organisation itself and the interactions between organisations automatically generate the need for female values. This need results in intuition which may be of use even in a market context overarching organisations.

This is illustrated by the following example – a statement of the European Commission concerning women's networks (in the context of fishing, land cultivation and diversification) dating from 2004. 'Women, owing to their position, are particularly well suited to offer information concerning the effect of the execution of joint agricultural policy on society and the economy and the impact that the structural transformation has had on the sectors in question ... Women's networks offer not only mutual support to each other but also contribute significantly to the economic and social development of communities dependent on fishing...'

Beyond male role models, male society actually enforces expressly paternal attitudes over women. This has its consequences with regard to the hierarchy: women's low competence in dealing with attitudes of dominance and hierarchy can block development on the level of the entire overall system which itself partly works through feedback mechanisms. By raising awareness to the increasing role of social intelligence on the level of the entire organisation, and by acknowledging the significance of

network-building on the level of the entire society, we are bound to accelerate the integration of values related to female intuition.

To quote, somewhat freely, the well-known words of Valeria Dienes (1915), the reason to give women the franchise is not because they are the same as men but because they are different – for instance in terms of their perspectives. Although these differing perspectives do not necessarily yield profits on a strategic level (although today there is evidence of this, too), they have an inspiring impact which supports integration, synergy and healthy intuition.

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Intuitive Decision-making in a Repeated Beauty Contest Game

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Abstract: This paper summarizes the first findings of our experiment on a modified version of repeated Beauty Contest Game (BCG). First, we present the trends of mean guesses. Second, we distinguish five types of strategies our subjects had pursued during the 10 rounds.

Keywords: Beauty Contest Game, behavioral game theory, qualitative analysis, repeated game.

In a basic Beauty Contest Game¹¹ (BCG) introduced by Moulin (1986) each of the participants individually and simultaneously has to choose a number in

¹¹ Also called Guessing Game.

a given interval (e.g., [0,100]). The winner is who chooses the closest number to the $2/3$ of the mean of all guesses¹². This game is dominance solvable (Nagel, 1995), which means that firstly we can eliminate the numbers greater than $2/3 \times 100$, and secondly the numbers greater than $(2/3)^2 \times 100$, etc., until zero is reached. The winner receives a fix amount of money. If the BCG is played as a one-shot game, contrary to its game theoretical solution (Nash-equilibrium), the mean usually falls between 20-30. In a repeated BCG the mean always reaches zero in the fourth or fifth round (Camerer, 2003).

In our experiment¹³ we played a repeated BCG with two modifications: interval was [1,10,000], and the winner of each round won the amount in Hungarian Forint (HUF) that he or she had guessed in a given round. The latter change in incentive had a significant impact on how the participants played the repeated BCG. First, we will show the tendency of mean guesses and their distribution during the 10 rounds. This is followed by the qualitative summary in which we distinguish five types of strategies the participants pursued.

1. Mean guesses and the distribution of guesses over the 10 rounds

There were 46 participants (30 male & 16 female) in this paper and pencil experiment. Half of the participants had some background in economics.

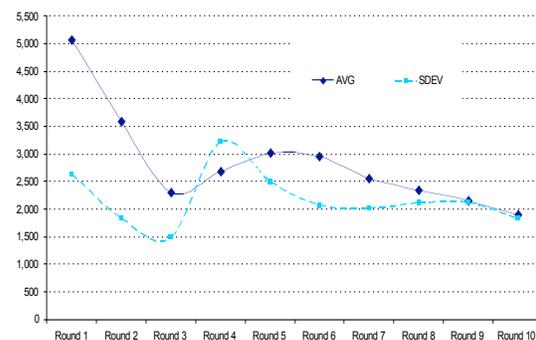
¹² This interval and fraction are the most typical ones.

¹³ I am very much indebted to Linda Dezsó for recruiting participants, I am also thankful for all participants (A01-A50) to take part in our experiment. I would like to thank Prof. Balázs Hámori for providing facilities for the experiment. I very much acknowledge the valuable remarks of participants in Implab Workshop 2007.

In Round 1 the mean of the participants' guesses was 5,048, which does not fall in the typical range of one shot BCGs. In my previous one-shot BCG experiments (Komáromi, 2006) I argued that the new features of this modified BCG lead to this shift of the range. The new range of expected mean guess is between 40 and 50, and in the qualitative summary below I will highlight its possible reason, which is linked to different strategies.

On Figure 1, we can observe a solid downward trend of mean guesses in the first three rounds (5,078; 3,584; 2,314), very similarly to the original version of BCG. However, in Round 4 the mean increased to 2,695, and bounced back to the level of 3,000 in Rounds 4 and 5.

Figure 1. Mean guesses over the 10 rounds.

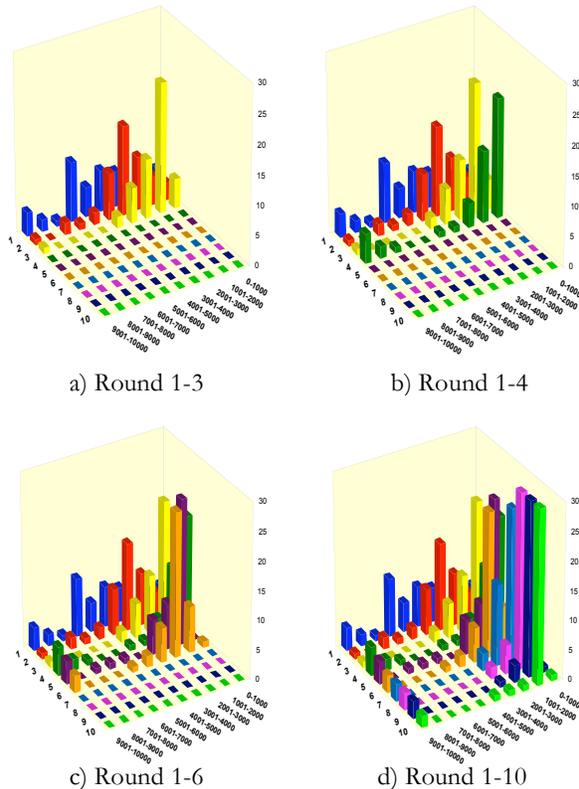


Notes: AVG = mean of all guesses; SDEV = standard deviation of all guesses.

As standard deviation doubles in Round 4, it shows that some participants switched to a different strategy in the same time. Figure 2b (see over) indicates that in this round some participants tried to manipulate the mean, and they chose numbers from the range of 7,000 to 10,000. Interestingly, the majority still followed the downward trend. As the mean in Round 4 increased in the following two rounds most of the participants guessed higher numbers on average, most of the guesses fell into the range of 2,000 to 3,000 (Figure 2c). In the

final three rounds we observed a slight downward trend, and the typical guesses were stabilized between 1,000 and 2,000 (Figure 2d).

Figure 2. Frequencies of the guesses in 10 rounds.



Notes: X axis: ranges between 0 and 10.000 (9.001 to 10.000; 8.001 to 9.000; ... ; 1.001 to 2000; 0 to 1000); Y axis: number of guesses in a given range; Z axis: rounds.

In the final rounds of an original repeated BCG, almost all the guesses are very close to 0, that is the unique Nash-equilibrium. Strictly speaking, 1 HUF is the Nash-equilibrium in our BCG. But it is clear that no participant would guess very small numbers because it is not worth winning such a small amount. On the other hand we may consider the mean of the last round as a minimum amount of money that can be accepted by an average participant. The unstable but well-apparent range of 1,000 to 2,000 is a

quasi-equilibrium based upon the participants' preferences.

2. Strategies in the 10 rounds

The participants were asked to fill in questionnaires in each round and explained how did they guess. We could distinguish 5 types of strategies pursued by our participants:

2.1 Iterating strategy with 2/3 rule

In Round 1 participants assumed that everyone's goal was to win the highest amount possible. They applied the 2/3 rule to find the appropriate level of thinking (one more level than the average to "beat the market"). They started their reasoning with 10,000 (the maximum amount), and calculated $2/3 \times 10,000$; or $(2/3)^2 \times 10,000$ or $(2/3)^n \times 10,000$, where n stands for the level of their reasoning. In later rounds the starting point was the mean guess of the previous round. This strategy dominated the first three rounds, and most of the participants with economics background used this kind of argument. This also explains why the typical mean in Round 1 is higher than in original versions of BCG, because the iterated best reply strategy (BRS) introduced by Nagel (1995) could be excluded. The reasoning of BRS starts with 50 ($100/2$) instead of 100. In our version the Iterating Strategy is very similar to its theoretical solution in game theory, as the iterated elimination of weakly dominated strategies starts from the upper bound of the interval.

2.2 Guess the trend strategy

The participants with this strategy in Round 1 tried to guess whether the mean would be above or below 5,000. Later their reference point was the previous mean, and tried to predict if the tendency was continuing or reversing. They did not use the 2/3 rule, but very often they

described very briefly how they estimated the absolute change of the mean for the following round. This kind of strategy was mainly used in the last 4-5 rounds.

2.3 *Kamikaze strategy*

According to this strategy a participant deliberately intended to manipulate the mean guess by choosing a large number (typically 10,000 or 9,999) or sometimes a very low number too.

2.4 *Random & Fix point strategies*

There were two other strategies: *Random* strategy when random numbers were chosen without any further reasoning, and *Fix Point* strategy when participants chose their date of birth, or an “interesting” number (i.e. date of Napoleon’s fall).

Only 3 out of the 46 participants mentioned that they had learnt or heard BCG before our experiment, but none of them had been involved in playing BCG even in a one-shot game. Without any information or experience, there is no doubt that much intuition was needed for playing our BCG. We believe that the Iterating Strategy and the Guess the Trend strategy led to the most intuitive decisions. Although there are several, sometimes very contradictory definitions for intuition, we use the approach by Medawar (1969, p.3) in order to illustrate an intuitive decision-making: “*thinking up or hitting on a hypothesis from which whatever we may wish to explain will follow logically*”. In our view, intuition complements the gaps in our knowledge. In a sense, it is a creative process that enables us to start moving along a learning curve. But it does not necessarily mean that our guess could be the closest of the 2/3 of the mean, but surely we will have a better understanding of a game, or generally speaking a situation we often get involved in.

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May Intuition Be Productive in Organizational Context?

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Abstract: A century ago Henry Ford implemented Frederick Winslow Taylor’s scientific management techniques to maximize the output of the assembly line. He trained his workforce to support fine-tuned machinery. Innovative companies nowadays intend to capitalize on their workforces’ creative capabilities, such as intuition. The Japan Kaizen quality system gives the opportunity even to assembly line workers in today’s car factories to use their intuition in order to heighten the quality of work and its products. The philosophy of ISO, the leading European quality management system, states that the way employees work can be channelled firstly through their hands; secondly through their brain, and thirdly through their soul. On the societal level, intuition may be enhanced by disciplines that tolerate diversity and facilitate understanding among diverse groups of people.

Keywords: corporate culture, creative economy, intuition, learning organization, productivity, risk, trust.

Intuition is usually defined as a creative moment - which is not to measure, but for pleasure. My experience taught me otherwise: I believe that intuition can play a role in increasing productivity.

1. When one makes a decision based on intuition that could save time.

2. When thinking formally or algorithmically, one might develop thoughts in an evolutionary way. Contrary to that, thinking heuristically or

analogically one might develop revolutionary thoughts.

As intuition may not be forced, letting intuition flow requires environments that highly appreciate creative thinking and resemble the environment of games which have room for spontaneity.

Many of us are not socialized or conditioned to detect intuition. We may either fear or neglect it. The Meyers-Briggs Type Indicator, based on C. G. Jung's work (Jung, 1988 / 1994) on the 4 basic functions of consciousness (thinking, feeling, perception and intuition) is widely used across organizations such as Microsoft for putting together diverse groups with members who represent different basic functions of consciousness. One needs to have knowledge of and experience on the different functions of consciousness in order to differentiate and to detect intuition.

It is however important to realize that intuition can be misleading as well as useful in a specific situation. A researcher for example can afford the time to investigate and prove the verity of one's intuition.

On the other hand a business negotiator pressurized by time may only use trial and error techniques to verify intuitive thoughts. At any organizational situation the source of intuition may differ from the person utilizing it. The decision on using the other's intuition will depend on two criteria:

1. TRUST in the colleague and the colleague's intuition;
2. RISK taking ability (personal) and possibility (sufficient resources).

On the personal level, it is a question of socialization whether intuition is a legitimate function of the person from the viewpoint of society. If not, than the person may receive facilitation from a psychologist, coach or supervisor. Inevitably, the person needs to be devoted and absorbent in the theme intuition is applied for.

On the corporate level, the business culture and regulations are the main facilitators or opposing forces of creativity and intuition. In case the enterprise is burdened by too many unnecessary rules, there is no room for creativity or intuition.

If an enterprise developed and disseminated unique services or products then its culture must have been entrepreneurial by letting creativity and intuition flow. Hence, the culture of such enterprise should emphasize creative achievements, and take into account long term interests of its employees. A good example is Google, the dominant web search company, where employees are encouraged to spend a significant amount of their working hours on "private" projects that are not part of their official duties.

On the social level intuition may be facilitated by the disciplines of the creative society and the knowledge based on such economy that tolerates diversity and facilitates understanding amongst diverse groups of people.

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The Role of Anticipation as a Mediator of Intuition in Consumer Decisions

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Abstract: According to Thaler and Shefrin (1981), we suppose that a considerable part of consumer behavior can be associated with the phenomenon of self-control. We state that one of the implicit assumptions of this model is not definitely sound. Consumer decisions may be less likely to be influenced by rational logical processes modeled with economic instruments than by emotions based on experiences that can be revealed by psychological methods.

Keywords: analogous cogitative processes, digital cogitative mechanisms, intuition, self-control.

Breaking away with the former tradition (e.g., Jung, 1954/1991) that regarded intuition as mystical, Herbert Simon (1987) interpreted this phenomenon as an unconscious schema-recognition. He treated analysis and intuition as two fundamental and complementary parts in effective decision-making systems. It is important to emphasize that he did not consider intuition as an irrational process. The unconscious processing of information gained from earlier experiences and observations constitutes the foundation of intuitive processes (Simon, 1987). The justification of Simon's concept is confirmed by empirical evidence referring to the existence of implicit memory (e.g., Schacter, 1987).

Thaler and Shefrin (1981) introduced self-control as a variable to describe irrational tendencies experienced in intertemporal consumer behavior by direct inspiration of contemporary psychological models. A considerable part of consumer behavior can be associated with the question of self-control.

According to Tibor Engländer (1999), two different viewpoints can be implied in problem-solving. In case of *efficiency criterion*, when the individual is stung into action, analogous cogitative processes take effect. Analogous cogitative mechanisms are characterized by extreme inaccuracy, but great reliability. That is, if a few possibly relevant impulses vanish during information processing, thereon the meaning of the information is distorting only to an insignificant extent. The nature of intuitive processes is also analogous.

Using the *adequacy criterion*, digital cogitative mechanisms come into action. As to probability processing, this means very accurate calculation. However, if only one relevant impulse failed then the meaning of the information is distorted to a significant extent during the information-processing. Engländer (1999) claims that both mechanisms play important roles in information-processing, they exist side by side.

The implicit assumption of the economic approach by Thaler and Shefrin (1981), used to model self-control problems in consumer behavior and supposing two different preference systems was that the two ego-parts were operated by the same mechanisms during the establishment and the operation of the preferential sequence.

Simon (1987), Engländer (1999) and the results of cognitive neuroscience, however, make it feasible that this is not

definitely sound. The decisions of the consumer stung into action are set to a great extent by automatically activating, analogous processes. This is less likely to be influenced by rational logical processes modeled with economic instruments than by emotions based on experiences that can be revealed by psychological methods. When there is an opportunity to consider and analyze, then there is a chance to apply digital, logical-rational processes.

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Let's Sleep On It: Is the Sleeping Brain Creative?

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The phenomenological correlate of sleep, the dreaming state of the mind is often interrelated with creativity. Anecdotal records report that several fascinating scientific discoveries and great artistic performances were antedated by a dream that helped the scientists or the artists to find the solution for a seemingly insolvable problem. Scientist like Kekulé, Loewi, Howe, Mendelejev, and such artists like Stevenson, Coleridge, Bergman, Fellini, Bunuel reported to gain creative insights from their dreams (Mazzarello, 2000; Maquet et al., 2004).

A recent study indicates (Schredl & Erlacher, 2007) that apart from the abovementioned “great minds” the so-called average population also report to gain creative insights from their dreams. According to the study these creative dreams facilitate the subjects in their creative activities, emotional concerns, work or thesis related problems, etc.

Wagner and his colleagues (Wagner, Gais, Haider, Verleger, & Born, 2004) were able to detect the abovementioned effect of sleep on creative insights. They used the experimental design of the Number Reduction Task (Thurstone & Thurstone, 1941), that had a hidden rule in it. Therefore subjects could improve their skills gradually by increasing response speed across task blocks, or by gaining insight into the hidden rule, and consequently abruptly shorten the necessary time to finish the sequence. According to the results of the study more than twice as many subjects gained insight into the hidden rule (at retesting) after sleep as after wakefulness. This effect was independent of the possible effects of fatigue or diurnal influences. The authors suggest that sleep, by restructuring existing memory representations facilitates extraction of explicit knowledge, and thus leads to novel and flexible behaviors.

The highly creative state of the dreaming brain can partly be explained from a neuropsychological perspective. In REM sleep, while we experience visually vivid and emotionally arousing dreams, the temporally deactivation of the serotonergic Raphe nucleus and the noradrenergic Locus Coeruleus can be detected. This down regulation of monoamines leads to the decrease of sign/noise ratio, to the dysfunction of selective attentional processes, and to the pause of the blockade of irrelevant inputs. The altered chemical regulation of the brain calls forth a divergent, hiperassociative state of the mind, that can support the flexible, “fluid” mental processes (Walker, Liston, Hobson, & Stickgold, 2002, Stickgold, Scott, Rittenhouse, & Hobson, 1999).

Another important aspect of the dreaming brain is its decisive visual nature. Neurological findings suggest that the

route of dreams advances from thoughts to images, creating a special mental state of visual thinking (Solms, 1999). This metaphorical cognition facilitated by the association enhancing, chemical milieu is beneficial for the juxtaposition of several thoughts, emotions, or distant analogues.

The dreaming brain is also an emotional brain, underlined by the intense functioning of frontolimbic structures (Maquet et al., 2005). We propose that the dreaming brain can gain creative and novel insights to different problems by sensitively detecting the conscious and non-conscious emotional aspects of the various situations.

In summary we can say that the dreaming state of the mind can be beneficial for the creation of novel thoughts and for the facilitation of creative insights by its special neurobiological alterations, that influence the sleeping cognition. Furthermore the favourable effects of the dreaming cognition can be induced artificially by different dream incubation techniques, increasing the possibility that the sleeping brain will work on the problem that remained unsolved at waking.

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