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BACHELOR THESIS

Irrational Behaviour

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Academic Year: **2013/2014**

Declaration of Authorship

The author hereby declares that he compiled this thesis independently, using only the listed resources and literature. This thesis was not used to obtain another academic degree.

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Prague, May 15, 2014

Signature

Acknowledgments

The author is grateful especially to his consultant, Ing. Ivo Koubek, for his help, comments and suggestions.

Bibliographic record

VLACH, Tomáš. *Irrational Behaviour*. Prague, 2014. 69 p. Bachelor thesis (Bc.) Charles University in Prague, Faculty of Social Sciences, Institute of Economic Studies. Supervisor Ing. Ivo Koubek.

Abstract

This thesis questions the notion of rationally behaving individuals as an assumption of microeconomic and macroeconomic models. Its goal is to show that foundations on which the modern economics is built are not so much solid. Selected topics are discussed theoretically and subsequently confirmed empirically by existing research studies. Afterwards, they are extended by related findings and potential implications for human behaviour. The thesis contains examples of irrational behaviour in which it is possible to behave rationally as well as examples in which it is very difficult to do so. The results imply that irrationality is present in many different domains. Because the assumption of rationality is repeatedly violated, economic models are not able to properly describe and predict human behaviour.

Keywords	Irrationality; opportunity costs; loss aversion; self-control; procrastination; cognitive illusions
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Abstrakt

Tato teze zpochybňuje představu racionálně se chovajících jednotlivců jako předpoklad mikroekonomických a makroekonomických modelů. Jejím cílem je ukázat, že základy, na kterých je moderní ekonomie postavena, nejsou zase až tak pevné. Vybraná témata jsou diskutována teoreticky a následně potvrzena empiricky existujícími výzkumy. Poté jsou rozšířena souvisejícími zjištěními a potenciálními důsledky pro lidské chování. Teze obsahuje jak příklady iracionálního chování, ve kterých je možné chovat se racionálně, tak příklady, ve kterých je velice obtížné takto se chovat. Výsledky ukazují, že iracionalita je přítomna v mnoha různých oblastech. Protože předpoklad racionality je

opakovaně porušován, nejsou ekonomické modely schopné náležitě popsat a předpovídat lidské chování.

Klíčová slova	Iracionalita; náklady příležitosti; averze ke ztrátě; sebekontrola; prokrastinace; kognitivní iluze
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Bachelor Thesis Proposal

Author	Tomáš Vlach
Supervisor	Ing. Ivo Koubek
Proposed topic	Irrational Behaviour

Topic characteristics Modern microeconomic and macroeconomic theories and models are based, among others, on the assumption of rationally behaving individuals. It basically means that they know what is the best for them and behave accordingly to it. This thesis will demonstrate that, in reality, it does not have to necessarily be so and that there are many situations when people behave irrationally.

Hypotheses This thesis will discuss if economic agents behave irrationally, and if there is a wide range of domains which create space for irrationality. Finally, it will focus on concrete examples of irrationality which are, in some cases, difficult to overcome.

Methodology Fundamental terms and theory connected to given topic will be explained. Afterwards, examples of irrational behaviour will be introduced, and problems connected to the particular behaviour analysed.

Core bibliography

1. ARIELY, D. & S. JONES (2008): *Predictably irrational*. HarperCollins New York.
2. ARIELY, D. & S. JONES (2010): *The upside of irrationality: the unexpected benefits of defying logic at work and at home*, volume 159. Harper New York, NY.
3. KAHNEMAN, D. & A. TVERSKY (1979): "Prospect theory: An analysis of decision under risk." *Econometrica: Journal of the Econometric Society* pp. 263--291.
4. POHL, R. (2004): *Cognitive illusions: A handbook on fallacies and biases in thinking, judgement and memory*. Psychology Press.

5. TVERSKY, A. & D. KAHNEMAN (1991): "Loss aversion in riskless choice: A reference-dependent model." *The Quarterly Journal of Economics* **106**(4): pp. 1039--1061.

Author

Supervisor

Chapter 1

Introduction

Modern economic models are based on the assumption that individuals are rational. Schotter (2008) defines rationality as “the assumption that economic agents know what they like and behave accordingly [...]” (p. 27). Similarly, Kahneman *et al.* (1991) claim that “[...] behavior can be explained by assuming that agents have stable, well-defined preferences and make rational choices consistent with those preferences [...]” (p. 193). This thesis shows that, in many cases, individuals do not know what they like, and even if they know what is the best for them, they do not behave accordingly to it. Alternatively, their utility is not maximized. This kind of behaviour is treated as irrational, leading corresponding economic models to be no more consistent with reality. Hence, in order to properly describe and predict behaviour of economic agents, irrationality has to be implemented in microeconomic and macroeconomic models.

This thesis is aimed to discuss the following hypotheses:

1. Economic agents behave irrationally.
2. There is a wide range of domains which create space for irrationality.
3. In some cases, irrationality is difficult to overcome.

Although rationality represents only a little part of modern economics, it contains a very broad spectrum of topics which has to be described and taken in consideration in order to confirm the three above mentioned hypotheses. Most authors research demonstration of a particular irrational behaviour and limit their findings only to that behaviour. This thesis takes a broader view and summarizes related findings in one place.

The thesis is further divided into the following chapters. Chapter 2 serves as an introduction into irrationality and presents three concrete market situations

in which individuals fail to behave rationally. The goal of the chapter is not to describe all existing market situations similar to those three highlighted, but rather to show how irrationality works. Chapter 3 discusses money and the way how people think about it. Money is contained in most economic transactions, hence, understanding its psychology is crucial in explaining human behaviour. Chapter 4 is aimed to provide complex theory about another reason for irrationality - it covers human inability to sufficiently exert self-control. In Chapter 5, attention is paid to some examples of cognitive illusions, which do not enable individuals to behave rationally. Moreover, they are very hard to overcome. Similarly to the Chapter 2, not all cognitive illusions are described, but only some of them are mentioned in order to suggest that every individual is irrational per se. Finally, Chapter 6 concludes by summarizing the most important thoughts of the thesis.

Chapter 2

Three Market Traps

This chapter should serve as an introduction into the issues of irrationality. It is not aimed to describe all market situations in which economic agents fail to behave rationally, but rather to discuss three concrete situations in which people think that they evaluate and make choices among alternatives according to their true preferences. But, in reality, they suffer from an illusion which is caused by a particular market trap. It makes them behave in a way which does not optimize outcomes of their decision-making process.

Section 2.1 covers the asymmetric dominance effect, a trap used by sellers to influence consumers' preferences by introducing an additional alternative, which serves as a decoy. Next section discusses default options and offers the forced option as a solution to problems connected to them. In Section 2.3, attention is paid to the IKEA effect and its implications for managers and producers.

2.1 The Asymmetric Dominance Effect

The asymmetric dominance effect, also known as the decoy effect, is a method used by sellers to influence and change consumers' preferences by introducing an asymmetrically dominated alternative. Such an alternative “[...] is dominated by at least one alternative in the set but is not dominated by at least one other” (Huber *et al.* 1982, p. 90).

What this alternative does is that it makes the asymmetrically dominant option look more attractive. As a result, some individuals may change their preferences in favour of the asymmetrically dominant option. This change violates the regularity condition which requires that “[...] the addition of a new

alternative cannot increase the probability of choosing a member of the original set” (Huber *et al.* 1982, p. 90).

Ariely & Jones (2008) tested the decoy effect on a real-life example. They used an online advertisement which looked as depicted by Figure 2.1.

Figure 2.1: Online advertisement with a decoy

Economist.com	SUBSCRIPTIONS
OPINION	<p>Welcome to The Economist Subscription Centre</p> <p>Pick the type of subscription you want to buy or renew.</p> <p><input type="checkbox"/> Economist.com subscription - US \$59.00 One-year subscription to Economist.com. Includes online access to all articles from <i>The Economist</i> since 1997.</p> <p><input type="checkbox"/> Print subscription - US \$125.00 One-year subscription to the print edition of <i>The Economist</i>.</p> <p><input type="checkbox"/> Print & web subscription - US \$125.00 One-year subscription to the print edition of <i>The Economist</i> and online access to all articles from <i>The Economist</i> since 1997.</p>
WORLD	
BUSINESS	
FINANCE & ECONOMICS	
SCIENCE & TECHNOLOGY	
PEOPLE	
BOOKS & ARTS	
MARKETS & DATA	
DIVERSIONS	

Note: From now on, “Economist.com subscription” will be denoted as option *A*, “Print subscription” as option *B*, and “Print & web subscription” as option *C*.
Source: Ariely & Jones (2008)

Students participating in this experiment were supposed to pick one of the three presented options with a decoy in a form of option *B*. This option was asymmetrically dominated by option *C*, but was not asymmetrically dominated by option *A*. Hence, the decoy should make the asymmetrically dominant option, which, in this case, is option *C*, look more attractive. Results of the experiment supported this assumption: 16% of respondents picked option *A*, no one picked option *B*, and 84% of respondents picked option *C*.

Then, the experimenters conducted another experiment, but they removed the decoy. Thus, students had to decide as if they faced advertisement depicted by Figure 2.2.

This experiment should be more accurate in revealing their preferences

Figure 2.2: Online advertisement without a decoy

Economist.com	SUBSCRIPTIONS
OPINION	Welcome to
WORLD	The Economist Subscription Centre
BUSINESS	Pick the type of subscription you want to buy or renew.
FINANCE & ECONOMICS	<input type="checkbox"/> Economist.com subscription - US \$59.00
SCIENCE & TECHNOLOGY	One-year subscription to Economist.com.
PEOPLE	Includes online access to all articles from <i>The Economist</i> since 1997.
BOOKS & ARTS	<input type="checkbox"/> Print & web subscription - US \$125.00
MARKETS & DATA	One-year subscription to the print edition of <i>The Economist</i> and online access to all articles from <i>The Economist</i> since 1997.
DIVERSIONS	

Source: Ariely & Jones (2008)

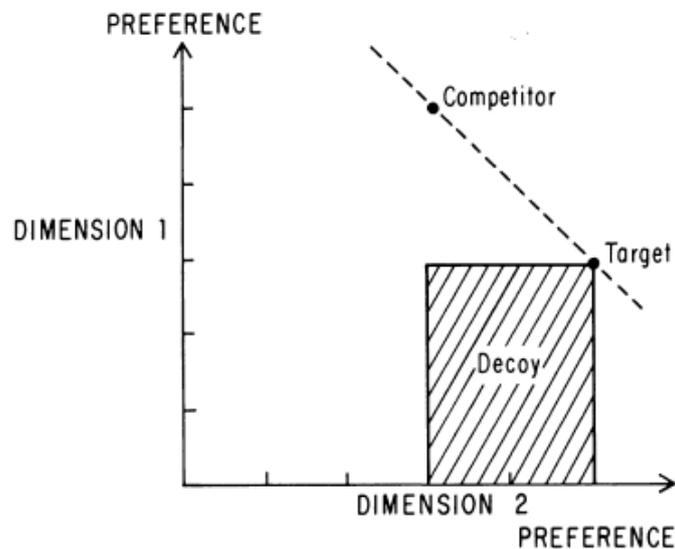
between option *A* and option *C* because no decoy in a form of option *B* was present. As soon as the asymmetric dominance effect was eliminated, 68% of respondents decided to pick option *A* and 34% of respondents option *C*.

Presented results could be used to disprove the assumption made by Coombs & Avrunin (1977). They assumed that individuals will, at first, delete alternatives which are dominated and, then, make decisions among remaining alternatives. Ariely & Jones (2008) showed that they do not have to necessarily do so.

Issues of the asymmetric dominance effect can be generalized by Figure 2.3.

Huber *et al.* (1982) denoted the option which is aimed to be made more attractive as “target” and the second original option as “competitor”. The competitor does not dominate the target because the target is better in dimension 2. By the same token, the target does not dominate the competitor because the competitor is better in dimension 1. Then, the decoy can be positioned in any place in the shaded area such that it is better than the competitor in dimension 2, but worse in dimension 1, and worse than the target in at least one dimension, but better in no dimension.

Figure 2.3: Placement of asymmetrically dominated decoy



Source: Huber et al. (1982)

The existence of the decoy effect can be explained by two arguments. Firstly, according to Parducci (1974), if the range of values of the dimension on which the target is inferior is widened, the difference on that particular dimension seems narrower. Secondly, different evaluation strategies may play an important role in decision-making process.

2.2 Default Options

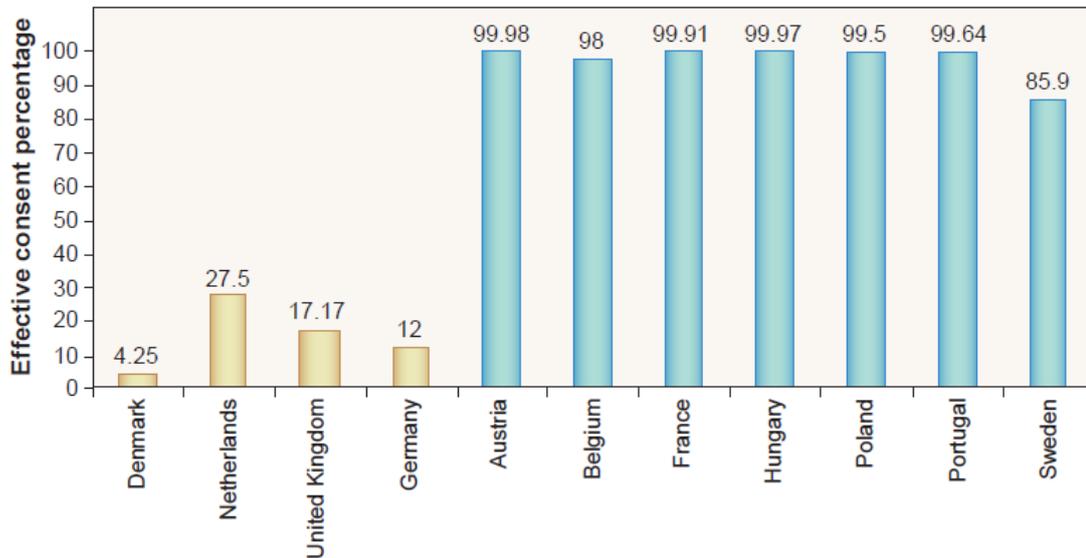
Default options, or defaults, are problem settings which can cause people not to decide according to their preferences. When facing a decision, a decision-maker can be presented with either an opt-in default option or an opt-out default option.

Opt-in defaults are options in which an individual disagrees with an introduced statement unless he decides to explicitly state his or her agreement. On the contrary, opt-out defaults are options in which an individual agrees with an introduced statement unless he decides to explicitly state his or her disagreement.

An example how default options influence human decisions is, e.g., a decision

regarding organ donations. Outcomes of such decisions are summarized in Figure 2.4.

Figure 2.4: Effective consent rates, by country



Note: In Denmark, Netherlands, the United Kingdom, and Germany, opt-in default options were used. In remaining countries, opt-out default options were used.

Source: *Johnson & Goldstein (2003)*

In Figure 2.4, one can see that some countries such as Austria or France dispose of very high rates of their inhabitants willing to donor organs after they die. On the other hand, in countries such as Germany or Denmark, these rates are significantly lower. But, in reality, the data do not necessarily reflect their true preferences. They based their decision on the setting of the organ donation form. Hence, the reason for these differences is caused by whether the form contained the opt-in or the opt-out default option.

Low values of effective consent percentage rates are caused by opt-in default options, which do not presume consent. Such an option can be set as follows: “Check the box if you are willing to become an organ donor.”

High values of effective consent percentage are caused by opt-out default options, which presume consent. Such an option can be set as follows: “Check the box if you are not willing to become an organ donor.”

The same pattern of behaviour have been observed in other areas such as insurance (Johnson *et al.* 1993), and pensions (Madrian & Shea 2000).

The reason why people irrationally fall prey to decision illusions caused by default options and are not able to reveal their true preferences is because they like taking the path of least resistance and sticking to status quo. It means that they avoid assigning to something because it could require further decision-making.

The problem of unrevealed preferences could be solved by so-called forced choice, which requires an active decision. An example of such choice applied on the example with organ donations could be as follows: “Decide whether you want to become an organ donor or not, and let us know.” When there is no default option, people cannot stick to status quo because there is none, and are forced to reveal their true preferences and make a choice according to them.

2.3 The IKEA Effect

The IKEA effect is referred to as “[...] the increase in valuation of self-made products” (Norton *et al.* 2011, p. 2). It got its name after the manufacturer from Sweden which produces goods which need to be assembled. There are several explanations for the existence of the IKEA effect. Firstly, Festinger (1962) claims that the increase in valuation is caused by so-called effort justification - the higher level of effort is put into a goal, the higher value is assigned to it. Secondly, Franke & Schreier (2008) suggest that co-creation leads to unique products whose possession increases owner’s utility. Next, Franke *et al.* (2009) argue that being engaged in the creation of a product enables the co-creator to influence attributes of the product so that it fits his or her taste, which results in higher valuation of the product. Moreover, co-creators can get utility from being engaged in the process of creation if it is enjoyable (Franke & Schreier 2010). Finally, Mochon *et al.* (2012) have empirically shown that higher valuations are caused by creators’ need to demonstrate their competence, which results from successfully assembled products and can improve creator’s mood, but the mood itself does not affect their valuations.

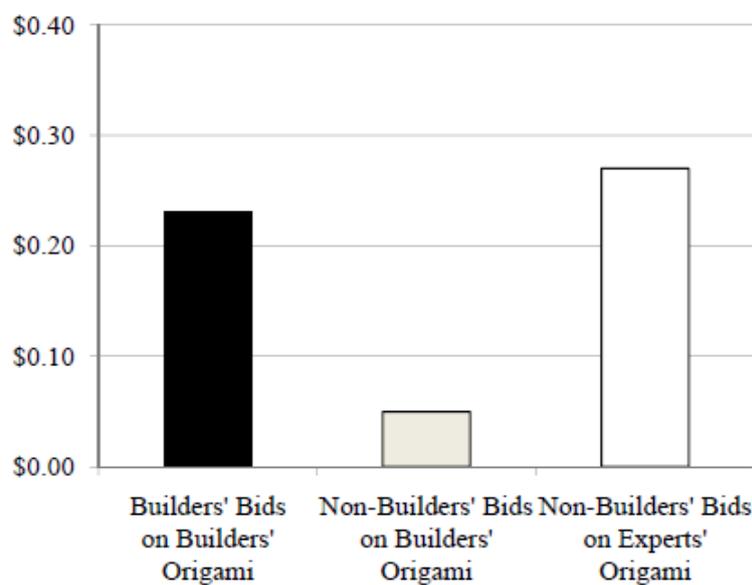
In an experiment by Norton *et al.* (2011), the authors confirmed that the IKEA effect is present when engaging in creation of, at first, utilitarian products. They asked randomly chosen participants (“builders”) to assemble IKEA boxes

using instructions and then to announce their reservation price - how much they would bid for keeping the box. Each from other randomly chosen group of participants (“non-builders”) was asked to announce the reservation price as well, but he or she was evaluating an IKEA box which was already assembled.

As expected, the mean reservation price for builders was \$0.78 and for non-builders \$0.48 (this difference is significant, $p < .05$), which confirmed the IKEA effect for utilitarian products.

Then, they found the same pattern for hedonic products. First group of participants (“builders”) was randomly assigned to make origami using instructions and to announce reservation prices. Second group of participants (“non-builders”) was randomly assigned to announce reservation prices for builders’ origami products. Finally, third group of participants (“additional non-builders”) was randomly assigned to announce reservation prices for origami products made by experts. Mean reservation prices are to be found in Figure 2.5.

Figure 2.5: Mean reservation prices for different groups of participants



Note: Mean reservation price for builders’ bids on builders’ origami is \$0.23, for non-builders’ bids on builders’ origami it is \$0.05, and for non-builders’ bids on experts’ origami it is \$0.27. The difference between the first two groups is significant, $p < .01$.

Source: Norton et al. (2011)

As one can see, the IKEA effect caused builders to value their amateur

products almost as high as non-builders valued experts' products. Moreover, the experimenters provided some evidence that builders really thought that their creations had the value they assigned to it.

In further experiments, they showed that the IKEA effect is different from the endowment effect, which will be in more details discussed in the next chapter, and from the increased valuation caused by touching an object, as found, e.g., by Peck & Childers (2003). Most importantly, they emphasized that the presence of the IKEA effect is conditional on successful completion of the product.

The IKEA effect has several interesting applications and implications for producers. If they find a way how to involve consumers in a part of the production process, the consumers will probably be willing to offer more for purchase of the final products, which allows the producers to increase prices. Norton *et al.* (2011), however, found that although consumers are willing to pay more for products in whose production they participated, they are rather unwilling to participate in the production process.

Furthermore, the IKEA effect can contribute to the sunk cost effect, which leads producers to invest money into projects that are going to fail (e.g., Biyalogorsky *et al.* 2006), and to the "Not-Invented-Here" bias, which leads producers to reject projects which were not developed in his or her firm although they can be significantly better (e.g., Ariely & Jones 2010). The foundation for the contribution lies in what was already mentioned, the producers really think that their projects and ideas are better than others'.

Chapter 3

The Psychology of Money

Money is present in financial transactions people make every day. Hence, money influences human behaviour. In this chapter, the psychology of money is explained.

When thinking about money, human decisions are results of a phenomenon termed mental accounting. It is an internal process of dividing money into groups - mental accounts - based on how they were earned and how they will be spent, and matching them with consumption of particular products. Research studies have shown that people treat money differently based on in which account they placed it, which violates the principle of fungibility (Thaler 1999). In other words, money from one mental account cannot be substituted by money from another account.

Section 3.1 describes how people should think about money, thus, in terms of opportunity costs. Next section follows up with present-bias. Further sections discuss how people actually think about money. Concept of loss aversion is topic of Section 3.3, pain of paying of Section 3.4. In Section 3.5, attention is paid to relativity of monetary amounts and its examples. Finally, the last section covers special attitude to zero price.

3.1 Opportunity Costs

When buying a product, rational people should analyze costs and benefits of the product. Furthermore, they should think about costs in terms of opportunity costs. Opportunity cost is “the cost of engaging in any activity or the opportunity forgone by choosing that particular activity” (Schotter 2008, p. 94). For instance, opportunity cost of buying product *A* is product *B* which would be

bought if product A was not purchased.

The question is if people really are rational in the sense that opportunity costs come to their mind when deciding whether to buy a particular product or not, as, for example, Okada & Hoch (2004) suppose. Frederick *et al.* (2009) showed that people do not automatically think about money in terms of opportunity costs.

They conducted a research study, in which participants were randomly assigned to either first or second condition. Those assigned to the first condition faced a decision how to manage \$14.99 - either to buy a DVD for the same price, or not to buy the DVD. Those assigned to the second condition faced an equivalent decision, but with a different wording. They had the same amount of money, which could be either used to buy the DVD for the same price, or to “keep the \$14.99 for other purchases” (p. 555).

The latter wording was used in order to remind them that the money can be used to buy something else, i.e., they were reminded about opportunity costs of the purchase of the DVD. As a consequence, purchase rate went down from 75% to 55% (this difference is significant, $p < .05$). It suggests that people do not take opportunity costs in consideration automatically.

Furthermore, they showed that consideration of opportunity costs not only decreases purchase rates but also causes consumers to buy products that are cheaper if the price difference is explicitly stated.

Altogether, people who do not use concept of opportunity costs to evaluate costs of a purchase are irrational because they buy higher amount and more expensive products.

3.2 Present-Bias

To understand the following topic, a technicality has to be defined. In this subsection, continuously compounded discount rates will be used. Such a rate is given by the following formula:

$$c = \frac{1}{t} \ln \left(\frac{w_t}{w_0} \right),$$

where c is continuously compounded discount rate, t is number of periods for discounting, w_t is amount of money received after t periods, and w_0 is amount of money deposited in period 0.

The reason for application of this formula is based on its use by Thaler (1981) describing present-bias. Moreover, Munshi (2014) recommends its use as well because it is widely applicable.

A problem arises when thinking about money in terms of opportunity costs. Samuelson (1937) introduced the exponential discounting model with the exponential discounting function, which is defined as:

$$f_E(t) = \exp(-rt),$$

where t is a number of time periods from today ($t = 0$), and r is the individual (implicit) discount rate. At the moment of evaluating opportunity costs using this implicit rate, r should be the same for all time periods. This function reflects the Samuelson's assumption about individual period-to-period discount rates being constant. In the next lines, its validity is shown.

The period-to-period discount rate is:

$$\frac{f_E(t+1)}{f_E(t)} = \frac{\exp[-r(t+1)]}{\exp(-rt)} = \frac{\exp(-rt) \exp(-r)}{\exp(-rt)} = \exp(-r),$$

which is constant independent of t , and different for each person with different individual discount rate.

It also means that the c has to be constant as well. If $w_t = \frac{w_0}{\exp(-rt)}$, then:

$$c = \frac{1}{t} \ln \left(\frac{\frac{w_0}{\exp(-rt)}}{w_0} \right) = \frac{1}{t} \ln \left(\frac{1}{\exp(-rt)} \right) = \frac{1}{t} \ln (\exp(rt)) = \frac{1}{t} (rt) = r.$$

People with constant c are said to be rational and time consistent.

But, as shown, e.g., by Thaler (1981), human implicit discount rates depend on the amount of time periods from the moment of evaluating. In other words, when a person tries to evaluate opportunity costs of a purchase, c is high for near future (low t), but significantly lower for remote future (high t). People

with non constant c are said to be irrational, time inconsistent, and suffering from present-bias. In other words, they give higher weights to events occurring earlier in time. Such people would, e.g., select \$1 tomorrow instead \$2 in two days, but they would wait to obtain \$2 in a year and two days instead of \$1 in a year and one day.

He asked several students to indicate which amount of money would make them indifferent between obtaining \$15, \$250, or \$3000 now and waiting 3 months, 1 year, or 3 years. In Table 3.1, median responses for particular amounts with corresponding continuously compounded discount rates are mentioned.

Table 3.1: Present-bias

Amount in \$	Equivalent amount in \$ in		
	3 months	1 year	3 years
15	30 (277)	60 (139)	100 (63)
250	300 (73)	350 (34)	500 (23)
3000	3500 (62)	4000 (29)	6000 (23)

Note: Continuously compounded discount rates rounded to nearest whole per cent are written in parentheses.

Source: Thaler (1981)

Such discounting behaviour is described by the hyperbolic discounting model¹ (e.g., Loewenstein & Prelec 1992) with the hyperbolic discounting function, which can be defined as:

$$f_H(t) = (1 + rt)^{-\gamma},$$

where t and r have the same meaning as by the exponential discounting function, γ is a positive constant.

Some authors (e.g., Cropper & Laibson 1998) describe the time inconsistency with the quasi-hyperbolic discounting function with discount factors $\{1, \beta\delta, \beta\delta^2, \dots, \beta\delta^t, \dots\}$, where δ is equal to e^{-r} , r and t have the same meaning as in previous models, and β is a positive constant. This model supposes the discount rate for the first period to be lower than period-to-period discount rates for other periods, which are assumed to be constant as in the exponential

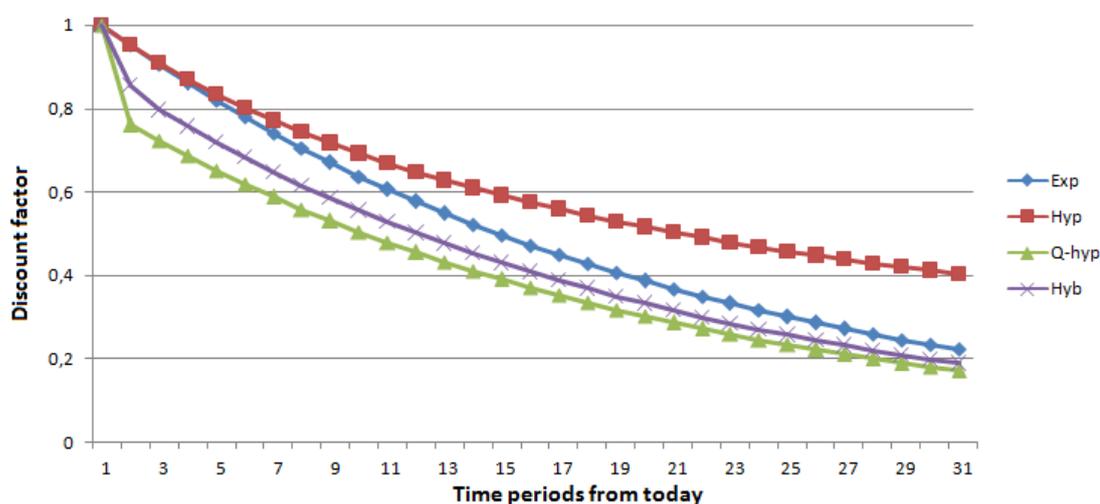
¹It has to be mentioned that Farmer & Geanakoplos (2009) came with several conditions under which the hyperbolic discounting model is rational and the exponential discounting model irrational.

discounting model.

Chark *et al.* (2011), however, in controlled experiment,² empirically rejected hyperbolic discounting for very remote future, and constant period-to-period discount rate beyond the first period as assumed in the quasi-hyperbolic model. They suggested the hybrid discount function with discount factors $\{1, \beta_1\delta, \beta_1\beta_2\delta^2, \dots, \beta_1\beta_2\delta^t, \dots\}$, which can reflect human behaviour more precisely.

In Figure 3.1, one can see shape of all mentioned discounting functions for selected coefficients.

Figure 3.1: Discounting functions



Note: “Exp” stands for the exponential discounting function, “Hyp” for the hyperbolic discounting function, “Q-hyp” for the quasi-hyperbolic discounting function, and “Hyb” for the hybrid discounting function. Position of curves depends on selected coefficients; in this figure, $r = .05$, hence, $\delta \approx .95$, $\gamma = .99$, $\beta = .95$, $\beta_1 = .90$, and $\beta_2 = .98$.

Source: Author

To sum up, previous sections described how rational people should think about money - in terms of opportunity costs. Nevertheless, it also showed that,

²They controlled for issues which occurred in previous experiments, including transaction costs, and innovatively for additivity in time, which causes subadditive time discounting. It means that “[...] discounting over a delay is greater when the delay is divided into subintervals than when it is left undivided” (Read 2001, p. 5).

in ordinary life, they do not spontaneously do so, and if they do, they suffer from present-bias.

So, if people do not use the concept of opportunity costs, there should be other concepts describing their attitude towards money.

3.3 Loss Aversion

The concept of loss aversion suggests that consumers give higher weight to a loss than to an equivalent gain. This is not rational because, in absolute terms, the same gain or loss should be perceived as equivalent.

It is one of the most important outcomes of the prospect theory (Kahneman & Tversky 1979). This theory was suggested to replace expected utility theory, which does not fit empirical results and thus is not able to correctly describe or predict human behaviour.

There are 4 features of human behaviour which are caused by loss aversion: the endowment effect, the status quo bias, improvements preferred to trade-offs, and greater importance of a difference between two losses than the same difference between two gains. These consequences were confirmed by various experiments implying that human behaviour really shows some signs of loss aversion.

The endowment effect is a behavioural pattern which describes that once people become owners of an object, they start valuing it more than before (Thaler 1980). To see how people were influenced by the endowment effect, experiment conducted by Kahneman *et al.* (1990) is mentioned.

They randomly assigned mugs to first group of experiment participants (“the sellers”), who became owners of those mugs. Then, these participants were asked to determine the minimal price for which they were willing to sell the mug. The researchers found out that the median value was \$7.12 in one experiment and \$7.00 in second experiment. Second group consisted of those who were not assigned with mugs and were asked to choose a price for which they would be indifferent between obtaining a mug or money (“the choosers”). This time, the median value was \$3.12 and \$3.50, respectively. There was also third group of participants who were not assigned with mugs, but were asked to determine the maximal price for which they were willing to buy the mug (“the buyers”). Their median value was below the value of choosers suggesting that they behaved similarly to them than to sellers. It implies that trade

would be low not because of buyers' unwillingness to pay, but because of sellers' unwillingness to sell their objects.

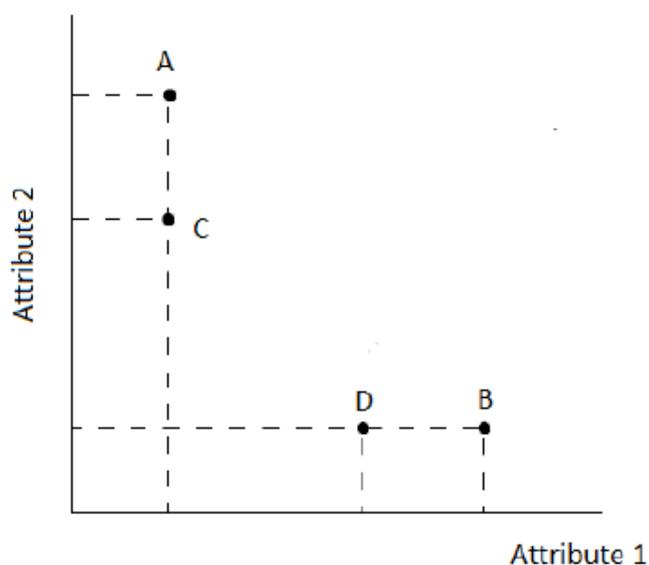
In other words, sellers evaluated a loss they would receive if they lost the mug, and choosers evaluated a gain from potential acquisition of the mug. Hence, the coefficient of loss aversion can be calculated. For the first experiment, its value is $\frac{7.12}{3.12} \approx 2.28$, and for the second experiment it is $\frac{7.00}{3.50} = 2$. Thus, empirical evidence suggests that people suffer from losing an object approximately twice as much than they benefit from getting the object.

The status quo bias refers to behaviour when people are less willing to trade objects once they acquire them. It follows from the endowment effect - if a person owns something, she values it more, and does not want to lose it. Hence, she sticks to the status quo. This bias was also subject of several experiments, one of them is mentioned below.

Knetsch (1989) designed the experiment in following way. He gave each from the first group of students a decorated mug and each from the second group of students a large bar of Swiss chocolate. Then, he presented students from the first group with the object that was given to students from the second group and vice versa. Afterwards, he informed them that they can trade their object for the second one. Because the objects were assigned at random and both groups had the same number of students, 50% of students should participate in the exchange. Despite that, he found out that only approximately 10% of students decided to do so, which confirmed the theory of the status quo bias.

Third consequence of loss aversion makes people select improvements over trade-offs. Suppose a person owns a product labelled as C in Figure 3.2 with two positive attributes. This person has to decide whether she wants to change the product C for either product A or product B . By selecting A , she acquires a product which is in comparison with product C better in attribute 2 and equivalent in attribute 1. Hence, this decision is referred to as an improvement. On the other hand, by selecting B , she acquires a product which is in comparison with product C better in attribute 1, but worse in attribute 2. Hence, this decision is referred to as a trade-off. Similar situation occurs when owning product labelled as D . Selecting B is improvement and selecting A is trade-off. Experiments confirmed that people, if they decide to select a different product at all, are more likely to select improvements implying that they value decrease in one attribute more negatively than they appreciate increase in other attribute.

Figure 3.2: Improvement versus trade-off



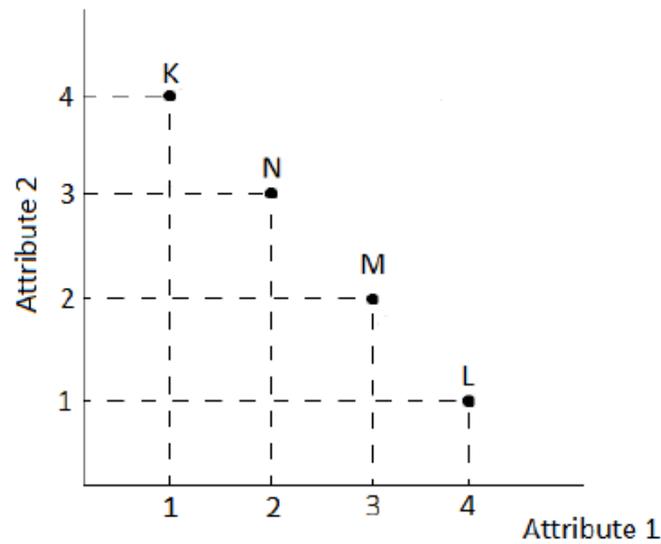
Source: Author

Finally, fourth consequence of loss aversion can be viewed as a generalization of the previous one. In this case, a decision-maker faces two choices, but both of them are trade-offs with the same difference. Theory suggests that he or she will select the option which disposes of lower loss. Suppose a person owns a product labelled as L in Figure 3.3 with two positive attributes. This person has to decide whether she wants to change the product L for either product M or product N . By selecting M , she acquires a product which is in comparison with product L better in attribute 2 by 1 unit, but worse in attribute 1 by 1 unit as well. On the other hand, by selecting N , she acquires a product which is in comparison with product L better in attribute 2 by 2 units, but worse in attribute 1 by 2 units as well. Similar situation occurs when owning product labelled as K . Selecting N is improvement in attribute 1 by 1 unit, but worsening in attribute 2 by 1 unit. Selecting M is improvement in attribute 1 by 2 units, but worsening in attribute 2 by 2 units. Experiments confirmed that people facing this situation, if they decide to select a different product at all, are more likely to select the product with lower worsening, i.e., they select M over N when owning L , and N over M when owning K .

It is worth stressing and crucial to understand that both the loss aversion and all its consequences play a very little role in classic market transactions.

And the reason is that buyers do not see the money they pay for a product as a loss and sellers do not see the sold product as a loss. Nevertheless, an aversion to a loss will very probably affect final users of products (Kahneman *et al.* 1991).

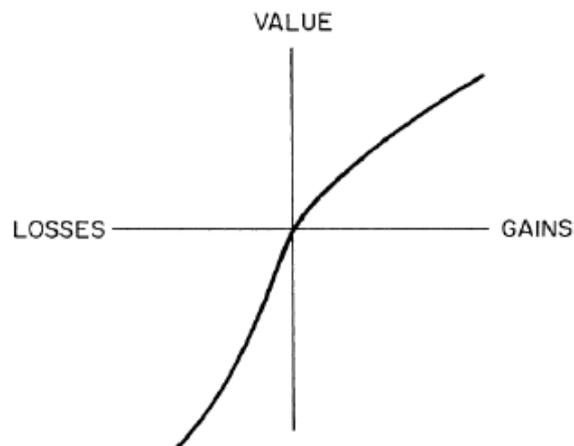
Figure 3.3: Trade-offs between equivalent losses and gains



Source: Author

The concept of loss aversion can be depicted by value function v presented in Figure 3.4.

Figure 3.4: Value function



Source: Tversky & Kahneman (1991)

Based on Tversky & Kahneman (1991), the value function can be described as:

- asymmetric
- S-shaped
- concave above a reference point
- convex below a reference point

Any gain or loss is evaluated relatively to a reference point. In Figure 3.4., it is the intercept of axes. It can be moved, together with the whole value function, either up (e.g., by gaining money), or down (e.g., by losing money) along the vertical axis. It means that if a person gains, e.g., €20, the corresponding value based on the original value function will be, e.g., 20, and the new value function will be created as a parallel shift of the original value function to a new reference point with value 20. Similarly, if a person loses €20, the corresponding value based on the original value function will be approximately -40 , and the new value function will be created as a parallel shift of the original value function to a new reference point with value -40 .

To sum up, loss aversion causes people to give higher weight to losses than to gains, to start valuing own objects more, and to prefer current states. Furthermore, because of loss aversion, indifference curves are not reversible³ and can cross each other as shown by Knetsch (1989). Unfortunately, concept of loss aversion cannot be applied to classic market transactions.

So, if it is not loss aversion that substitutes opportunity costs in deciding whether to buy an object or not, what other concept could do so? Next section offers a more possible answer.

3.4 Pain of Paying

Because people are not able to take opportunity costs in consideration automatically and loss aversion cannot be applied to classic market transactions, there should be another explanation for why people do not always buy what they

³Reversibility means that “[...] if an individual owns x and is indifferent between keeping it and trading it for y , then when owning y the individual should be indifferent about trading it for x ” (Kahneman *et al.* 1991, p. 196).

like even though they have resources for the purchase. And the explanation for deterring their spending might be called the pain of paying.

Rick (2013) defines the pain of paying as an emotional distress, which is caused by spending money. Because this distress is created immediately when buying a product, it overcomes the problem connected with opportunity costs - their need to make decisions across time. The immediacy ensures more accurate trade-offs between costs and benefits because one does not have to discount across different time periods.

Although the pain of paying can serve as a proxy for opportunity costs, it has several drawbacks causing some people to behave irrationally, i.e., in this case, spend less or more than they would ideally like to spend. Rick *et al.* (2008) created so called “Spendthrift-Tightwad” (ST-TW) scale by using questionnaires to measure differences in human habits to spend and thus experience pain of paying. Based on their sample of 13,327 respondents, they distinguished between three types of consumers, whose characteristics can be summarized in Table 3.2.

Table 3.2: Types of consumers based on experienced pain of paying

Type of consumer	Experienced pain of paying	Deviation from ideal spending	Proportion in sample
Tightwads	high	spend less	24.37%
Spendthrifts	low	spend more	15.35%
Unconflicted consumers	moderate	spend close to it	60.28%

Source: Author, based on Rick et al. (2008)

Furthermore, they tested hypotheses about spending behaviour when the pain of paying is changed.

Since spendthrifts are predisposed to experience low pain of paying, they should not be particularly influenced by changes in the pain of paying. On the other hand, one can expect tightwads⁴ to change their spending habits as a reaction to a change in amount of experienced pain of paying because they are

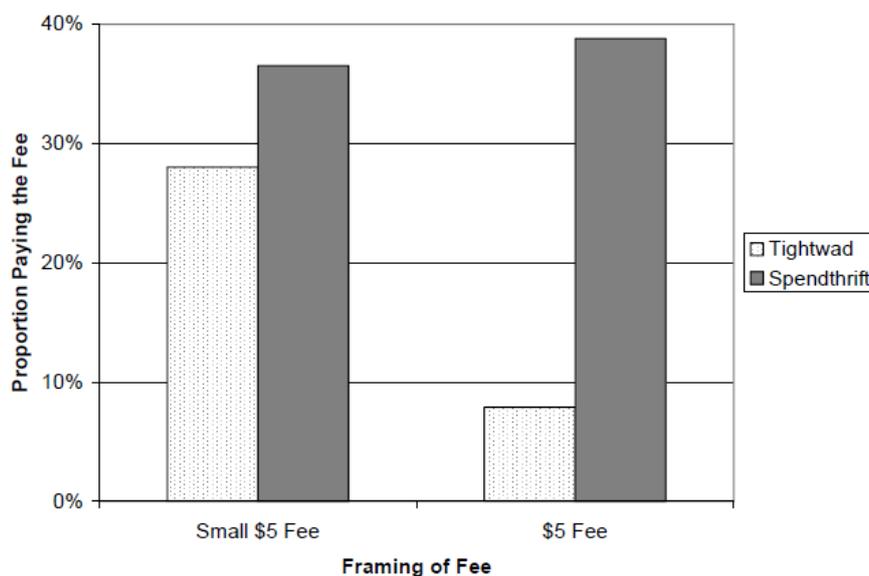
⁴The concept of tightwaddism is very similar to the concept that Lastovicka *et al.* (1999) called frugality. Experimental evidence provided by Rick *et al.* (2008) shows that while tightwaddism is related to a pain of paying, frugality is caused by a pleasure of saving.

predisposed to experience high pain of paying.

The pain of paying can be decreased by increasing the distance from cash money, i.e., paying with a credit card, using internet banking, using chips instead of money (gambling house), paying in advance (prepaid hotel), etc.

Rick *et al.* (2008) decided to decrease the pain of paying by framing an amount of money as “small”, which occurred to be successful in its goal. As one can see from Figure 3.5, the decreased pain of paying caused tightwads to be significantly more willing to pay the fee. Moreover, spendthrifts were almost insensitive to the description of the fee.

Figure 3.5: Proportion willing to pay fee



Source: Rick *et al.* (2008)

Hence, when situational factors decreased the pain of paying, tightwads started behaving in a similar way as spendthrifts.

The pain of paying can be increased by decreasing the distance from cash money, i.e., paying with cash, paying at the moment of consumption or after it, seeing money flowing away when consuming (gas station), etc.

Based on results of previous experiment, one can expect that when situational factors increase the pain of paying, the difference between spending

habits of tightwads and spendthrifts will be higher.

To describe pain of paying and spending habits both of tightwads and spendthrifts more properly, many research studies have been conducted. Next, the most important findings, including those already mentioned, are listed.

1. Tightwads carry less debt and save more money than spendthrifts (Rick *et al.* 2008).
2. Differences between spending of tightwads and spendthrifts are lowest when the pain of paying is low (Rick *et al.* 2008).
3. Differences between spending of tightwads and spendthrifts are highest when the pain of paying is high (Rick *et al.* 2008).
4. Differences between spending of tightwads and spendthrifts are lower among females than among males (Rick 2008).
5. Differences between spending of tightwads and spendthrifts are unlikely to be caused by differences in income or age (Rick 2008).
6. Pain of paying is not a simple function of price (Rick 2008).
7. Tightwads are more likely to automatically think about money in terms of opportunity costs (Frederick *et al.* 2009).

By connecting the second and the fourth statement, one can argue that females experience lower pain of paying than males. A possible explanation could be based on study by Faber & Christenson (1996). They found out that some buyers go shopping in order to improve their mood and that this behavioural pattern is more likely to occur among females. Hence, Rick (2008) suggests that benefits of this “retail therapy” decrease the influence of pain of paying on females.

3.5 Relativity

People evaluating money in relative terms rather than in absolute terms have already been characterized by the value function where the reference point had the prominent role. This section presents examples of situations when individuals make decisions based on relativity.

In one experiment, conducted by Tversky & Kahneman (1981), one group of subjects faced choice *A*:

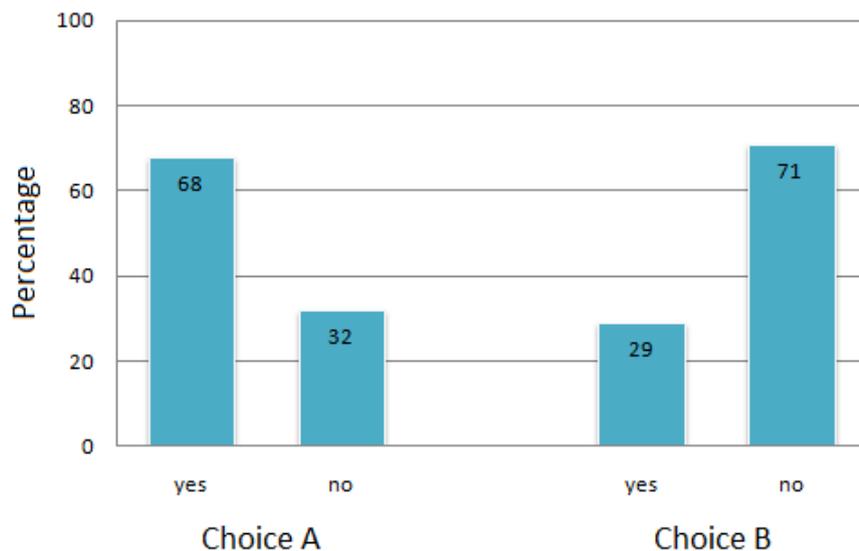
“Imagine that you are about to purchase a jacket for \$125, and a calculator for \$15. The calculator salesman informs you that the calculator you wish to buy is on sale for \$10 at the other branch of the store, located 20 minutes drive away. Would you make the trip to the other store?” (p. 457)

The other group of subjects faced choice *B*, which had the same setting, but with different monetary amounts:

“Imagine that you are about to purchase a jacket for \$15, and a calculator for \$125. The calculator salesman informs you that the calculator you wish to buy is on sale for \$120 at the other branch of the store, located 20 minutes drive away. Would you make the trip to the other store?” (p. 457)

In Figure 3.6, results for each choice are to be found.

Figure 3.6: Relativity problem



Source: Author, based on Tversky & Kahneman (1981)

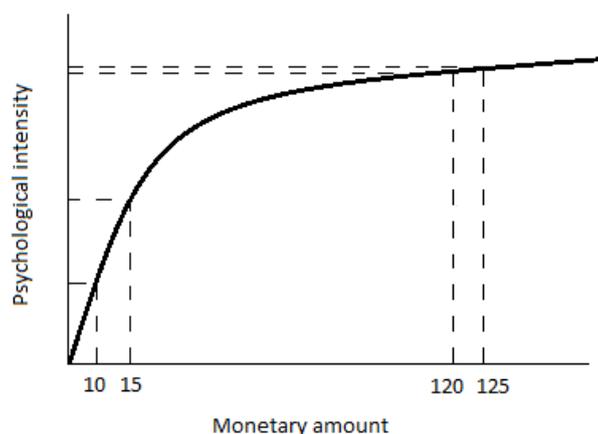
Although both choices allow each subject to save \$5, the results are different

among both choices. The reason why majority of subjects in choice *A* (68%) is willing to make the trip and save \$5 is because this amount means saving one third of the original price which, in relative terms, looks like a very attractive option. On the other hand, only (29%) in choice *B* is willing to do so because saving \$5 is, in this case, equivalent to only four per cent of the original price.

Thus, thinking about money in relative terms is clearly irrational because opportunity costs of saving those \$5 are the same in both cases regardless its relative share on the original price.

The phenomenon when the same difference between two monetary amounts is perceived higher when the monetary amounts are low whereas it is perceived lower when the monetary amounts are high is referred to as the Weber-Fechner law (e.g., Thaler 1999), depicted by Figure 3.7.

Figure 3.7: Depiction of the Weber-Fechner law



Note: This figure depicts the Weber-Fechner law applied on experiment by Tversky & Kahneman (1981) from the beginning of this section. Monetary amounts are counted in dollars.

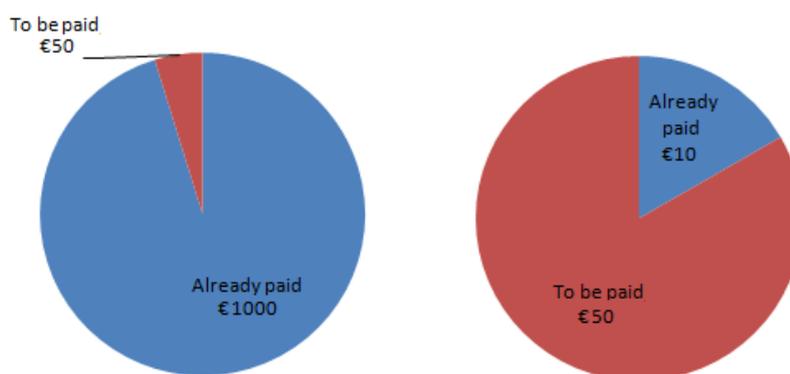
Source: Author

As one can see from Figure 3.7, psychological impact of the difference between 10 and 15 dollars is higher than between 120 and 125 dollars. Hence, the Weber-Fechner law is described by diminishing returns of psychological impact.

Another example when people think about money in relative terms is when they consider an additional payment. For example, if a person has just paid for her new luxurious boots €1000, she will probably accept a special offer to

buy pumps for €50 because it requires to pay only one twentieth of what she has already paid. On the other hand, if she has just paid for her new slippers €10, she will probably reject a special offer to buy the pumps for €50 because it requires to pay five times more than what she has already paid.

Figure 3.8: Relativity of additional payments



Source: Author

Although both €50 are the same in absolute terms, they are perceived differently in relative terms, as depicted by Figure 3.8.

3.6 The Zero-Price Model

As shown in the very first section of this chapter about opportunity costs, people have difficulties in correct evaluation of costs of a purchase. This section follows up with the zero-price model which suggests that when the price of a product is zero, evaluating benefits can be a problem as well.

When facing a choice between buying one of two different products, X and Y , and buying nothing, the product with higher net benefit based on cost-benefit analysis should be purchased. Assuming linear utility of money, net benefit can be defined as the difference between value of the product for the consumer (V_X or V_Y) and its price (P_X or P_Y). Three possible situations can occur.

1. Both products yield positive net benefits ($V_X > P_X$ and $V_Y > P_Y$). Then, X is purchased instead of Y if the purchase of X yields higher net benefit, i.e.:

$$V_X - P_X > V_Y - P_Y,$$

and Y is purchased instead of X if the purchase of Y yields higher benefit, i.e.:

$$V_Y - P_Y > V_X - P_X.$$

2. Only one product yields a positive net benefit. Then, this product is purchased.
3. Both net benefits are negative. Then, a rational individual decides to purchase nothing.

If prices of both products are decreased by the same amount ($\alpha > 0$, $P_X > \alpha$, $P_Y > \alpha$), following situations can occur.

1. Both products yield higher positive net benefits ($V_X > P_X - \alpha$ and $V_Y > P_Y - \alpha$). Individuals who were willing to purchase X do not change their decision because

$$V_X - (P_X - \alpha) > V_Y - (P_Y - \alpha)$$

is equivalent to

$$V_X - P_X > V_Y - P_Y.$$

The same logic can be applied to those who were willing to buy Y implying that decision to buy either of those products should remain unchanged because benefits did not change and costs decreased. In other words, no one should switch from product X to product Y , and vice versa.

2. The product yielding the net benefit before the price decrease is still purchased regardless of whether the other product started yielding net benefit or not.
3. If both net benefits are still negative ($V_X < P_X - \alpha$, $V_Y < P_Y - \alpha$), no purchase will take place. But, individuals with $V_X - P_X > V_Y - P_Y$ will switch from buying nothing to the purchase of X if the purchase starts yielding a positive net benefit:

$$P_X > V_X > P_X - \alpha.$$

Individuals with $V_Y - P_Y > V_X - P_X$ will switch from buying nothing to the purchase of Y if the purchase starts yielding a positive net benefit:

$$P_Y > V_Y > P_Y - \alpha.$$

Hence, there is no possibility to change the demands for X or Y among those who decided to buy a product before the price decrease. The only possibility to increase demand for both products is to attract some individuals, who bought nothing before the price decrease, with a sufficiently high α . But, when considering the zero-price model, the both statements show to be incorrect as soon as the price decrease is equal to the lower original price.

Without loss of generality, let the lower price be P_X . Then, given $\alpha = P_X$, the new prices are 0 and $P_Y - P_X$. What in reality happens is that people not only start perceiving the decrease to the zero price as a decrease in costs but they also assign to the zero price an intrinsic value causing benefits of the “purchase” of X to increase, e.g., by β . It can cause some individuals to switch from purchasing Y to purchase X if

$$V_Y - P_Y > V_X - P_X$$

is transferred into

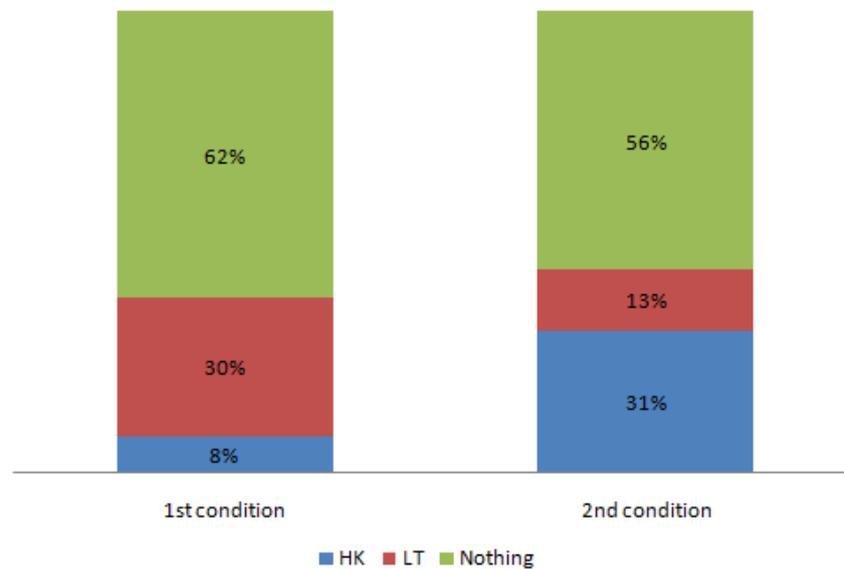
$$V_Y - P_Y < V_X + \beta - P_X.$$

The increase in demand for X and decrease in demand for Y caused by a change in their prices leading to the price of X is equal zero and the price of Y is equal to $P_Y - P_X$ is called the zero-price effect.⁵

This effect was empirically supported in a series of experiments consisted of real transactions with controlled transaction costs conducted by Shampaner & Ariely (2006). They placed into a cafeteria two new chocolate products - Hershey’s Kisses (“HKs”) and Lindt truffles (“LTs”). In the first condition, one HK was priced at ¢1, one LT at ¢14. In the second condition, both prices decreased by ¢1, hence, one HK was priced at ¢0, one LT at ¢13. Customers who did not buy neither of these two products were labelled as “nothing”. According to the standard cost-benefit model, decrease in both prices should increase demand for both products. On the other hand, the zero-price model supposes the demand for the free product to increase and demand for the second product to decrease. Figure 3.9 summarizes results based on 232 customers who participated in this experiment.

⁵For simplicity’s sake, linear utility of money was assumed. Although the utility of money is most likely concave (Kahneman & Tversky 1979), conclusion about the zero-price model is still valid. Moreover, Shampaner & Ariely (2006) showed that the zero-price effect is not caused by the concavity itself.

Figure 3.9: Zero-price effect



Note: The figure depicts how many per cent of customers chose particular option. In the first condition, HK was priced at ¢1, LT at ¢14. In the second condition, HK was priced at ¢0, LT at ¢13.

Source: Author, based on Shampaner & Ariely (2006)

The proportion of customers purchasing HK significantly increased from 8% to 31% ($p < .001$) while the proportion of customers purchasing LT significantly decreased from 30% to 13% ($p < .001$) once HK was made free. Hence, the experiment supported the zero-price model.

The same authors showed that the model might hold for more expensive products as well, and that the zero-price effect is not caused either by odd prices or by the asymmetric dominance effect - buying nothing is weakly dominated by the free product - both have same costs, free product offers higher benefit.

Furthermore, they suggested that the zero-price effect could be caused by affect. It is a concept when options with no costs are perceived more positively than options with the same difference between costs and benefits but nonzero costs. Moreover, this affect is used when making decision.

Chapter 4

Self-Control

Baumeister *et al.* (1994) define self-control as “[...] any effort by a human being to alter its own responses” (p. 7). Without self-control, as it will be shown, one’s responses will not necessarily copy his or her true preferences. Hence, not exerting self-control is irrational.

How people are unaware of visceral factors is discussed in Section 4.1. The next section covers procrastination and offers two ways of self-control that can help with it. Section 4.3 pays special attention to a topic concerning predictions about one’s future life based on his or her ability to exert self-control in childhood. Finally, in Section 4.4, influence of excessive self-regulation¹ on human ego is described.

4.1 Visceral Factors

Visceral factors (or “passions”) are emotions (e.g., sadness, happiness, fear), drive states (e.g., hunger, sexual arousal), and feeling states (e.g., pain) that cause people to behave in a certain way (Loewenstein 2000). Because of visceral factors, people change their preferences. For example, thirst increases their preference for water. But, according to Sen (1973), preferences should be stable in short-term. This contradiction implies that in a visceral state, people’s behaviour is in disharmony with their true preferences, thus, they do not behave rationally.

To see how a visceral factor, namely sexual arousal, changes human preferences, following research study conducted by Ariely & Loewenstein (2006)

¹In this thesis, terms self-control and self-regulation are interchanged as in many other papers on this topic. It is worth stressing that some authors (e.g., Tangney *et al.* 2004) distinguish between these terms.

can be considered. They asked several heterosexual men, aged mostly from twenty to thirty, to answer questions regarding their present decisions and preferences. The questions consisted in assigning a number by each respondent to each question denoting probability with which a situation mentioned in the question could occur (0 - very unlikely, 100 - very likely) or to which extent a respondent agrees with mentioned statement (0 - totally disagree, 100 - totally agree). The questions were divided into three parts - sexual preferences, willingness to act immorally, and willingness to take risks. After answering these questions, they were asked to get excited using erotic material and answer the same questions, now in a state of sexual arousal. In Table 4.1, Table 4.2, and Table 4.3, one can see some selected questions, average results both in nonaroused and aroused state, and corresponding percentage changes.

Table 4.1: Rating sexual preferences

Question	Nonaroused	Aroused	Percentage change
Can you imagine being attracted to a 12-year-old girl?	23	46	100*
Can you imagine having sex with a 40-year-old woman?	58	77	33*
Can you imagine having sex with a 50-year-old woman?	28	55	96*
Can you imagine having sex with a 60-year-old woman?	7	23	229*
Can you imagine having sex with a man?	8	14	75
Would it be fun to get tied up by your sexual partner?	63	81	29*
Would it be fun to tie up your sexual partner?	47	75	60*
Can you imagine getting sexually excited by contact with an animal?	6	16	167*

Note: An asterisk (*) indicates that the percentage changes are different from zero, $p < .05$.

Source: Ariely & Loewenstein (2006)

Although this was an empirical proof only for sexual arousal, one can assume

Table 4.2: Rating willingness to act immorally

Question	Nonaroused	Aroused	Percentage change
Would you take a date to fancy restaurant to increase your chance of having sex with her?	55	70	27*
Would you tell a woman that you loved her to increase the chance that she would have sex with you?	30	51	70*
Would you encourage your date to drink to increase the chance that she would have sex with you?	46	63	37*
Would you keep trying to have sex after your date says “no”?	20	45	125*
Would you slip a woman a drug to increase the chance that she would have sex with you?	5	26	420*

Note: An asterisk (*) indicates that the percentage changes are different from zero, $p < .05$.

Source: Ariely & Loewenstein (2006)

Table 4.3: Rating willingness to take risks

Question	Nonaroused	Aroused	Percentage change
Birth control is the woman’s responsibility.	34	44	29
A condom decreases sexual pleasure.	66	78	18*
A condom interferes with sexual pleasure.	58	73	26*
Would you always use a condom if you didn’t know the sexual history of a new sexual partner?	88	69	22*

Note: An asterisk (*) indicates that the percentage changes are different from zero, $p < .05$.

Source: Ariely & Loewenstein (2006)

that the same logic holds for other states. So far, beside sexual arousal,² it has been shown for example for hunger (Read & Van Leeuwen 1998), thirst (Van Boven & Loewenstein 2003), curiosity (Loewenstein *et al.* 1998), fear (Van Boven *et al.* 2005), heroin craving (Giordano *et al.* 2002), cigarette craving (Sayette *et al.* 2008), and pain (Read & Loewenstein 1999). It has some interesting consequences - if one wants to raise money for, e.g., people with lack of drinking water, he or she will probably raise more by asking thirsty people. And that is also a reason why people watching television are asked to donate

²It is worth stressing that the mentioned research study by Ariely & Loewenstein (2006) is one of many empirical proofs for a change in human preferences caused by sexual arousal. One of the first proofs concerning this visceral factor was provided by Loewenstein *et al.* (1997).

money to children in problems immediately after seeing them in an unhappy situation.

Following subsections summarizes effects of two basic states in which a person can be. It will be convenient to denote a state when one is not under the influence of visceral factors as a “cold” state (e.g., not sad, not happy, not hungry, etc.), and a state when one is under the influence of visceral factors as a “hot” state (e.g., sad, happy, hungry, etc.).

If experimenters from the previous research study asked participants when they were in a cold state (i.e., not sexually aroused), to predict how they would answer the questions if they were in a hot state (i.e. sexually aroused), an interesting pattern would occur. According to Loewenstein (2000), people have difficulties in imagining themselves in a hot state, and are very likely to underestimate the effects of visceral factors on their present and future behaviour.

Applied to the research study, they would probably assign to each question a number that would be between the value for nonaroused state and aroused state. These misjudgements are called cold-to-hot empathy gaps.

By the same token, when people are in a hot state, they have problem to imagine themselves in a cold state, and are very likely to overestimate the duration this state (Gilbert *et al.* 2004). Furthermore, they underestimate the extent to which they are influenced by visceral factors (Loewenstein 2005). For example, people think that they will be devastated from a breakup for a very long time, but they stay upset for a shorter period. Or, they predict that the feeling of happiness will last very long, but it dissipates much more quickly. These misjudgements are called hot-to-cold empathy gaps.

Regarding predictions in a cold state or in a hot state, people can be divided into two groups. Those who are not able to admit that their decisions, behaviour, or preferences could differ from the predicted ones are called naive. Those who are able to take visceral factors in account are called sophisticated.

To sum up, on the one hand, some visceral states (e.g., pain, thirst, etc.) give people important information about what has to be done (e.g., visit doctor, drink water, etc.), but on the other hand, other visceral states (e.g., anger,

sexual arousal, etc.) can cause people behave irrationally (e.g., hurt someone or commit a sex crime). So, there is a need to suppress effects of some visceral states, and it is self-control that can help to do so.

4.2 Procrastination

An individual tries to save money, but he purchases a new trendy shirt. He promised himself that he will lose weight, but he could not resist the last piece of chocolate. He said that he will do his best and exercise every day, but suddenly many other much more interesting activities occurred. Finally, he stated that he will study regularly, but he kept putting it off until tomorrow. These are examples of someone who is procrastinating - postponing long-term goals and personal development, which goes with it in exchange for immediate joy.

This is no big news that people procrastinate. And the explanation is very similar to the one in previous section - in a cold state, they give promises to themselves about their future performance, but they are not able to follow them in a hot state. It is important not to interchange procrastination for laziness - if one is a procrastinator, he or she feels uncomfortable inside when procrastinating, which cannot be stated about a lazy person when doing nothing. Because the basis of empathy gaps has been already explained, instead of presenting an experimental proof of existence of procrastination, much more interesting and helpful will be to find out how to make people avoid procrastination. And that is the topic of following two subsections.

4.2.1 Reward Substitution

The problem with human perception is that the negative consequences of not fulfilling one's long-term goals are discounted by time and do not seem so important today. For example, an individual keeps drinking alcohol because the moment when his liver will be beyond recovery is far away from today or he does not study now because his exam takes place next month. The concept of reward substitution offers a simple solution. It basically substitutes the immediate joy by an immediate reward for not yielding to the temptation. The benefit of the reward is hidden in its immediacy - one does not have to discount.

If an individual resisted the temptation and did not lit a cigarette, he should be rewarded with something he likes, except for cigarettes, e.g., to eat chocolate muffin or to watch his favourite TV series. Did he fail and smoked another

cigarette even though he wanted to stop smoking? He should be punished by not eating the muffin or by not watching the TV series.

The same attitude can be applied to many other different areas. One can think of politicians, who increase the public debt because they know that it will not be their responsibility to pay it off. The same problem arises when considering climate changes and global warming. These events are so distant in time from today that people are not able to imagine and do not take in consideration their negative consequences.

4.2.2 Self-Control Contracts

Another way how to solve the problem with procrastination are self-control or so-called Ulysses³ contracts. As the title indicates, a person enters into a contract in a cold state in order to prevent herself from misbehaving as soon as she gets into a hot state.

If an individual wants to study, but he knows that he will be tempted to sit in front of his computer and chat with his friends on Facebook, he should enter into a self-control contract by telling the password to his account to a friend he trusts, let him or her to change it, and convince them not to tell him the new password until the exam is over.

A person thinks that she will surrender and buy new shoes although she decided to save. Then she should take the advantage of being in a cold state now and do not take too much money when she decides to go shopping. If she pays with a debit card or a credit card, she can let her bank to set a limit cutting the maximal amount of money she can spent.

People sometimes buy a smaller package of chips instead of a larger package because of the possibility of eating it all and failing to stick to their eating plans. By that, they are making a self-control contract and maybe they do not even realize it.

If an individual is a poker player, then he definitely appreciates the possibility to block his account for certain time to avoid a loss after a big win or not to spend too many hours playing. This is another example of Ulysses contract.

³Roman name of Odysseus who let himself bind to a mast in order to hear the singing Sirens but not to follow them.

4.3 Marshmallow Test

Marshmallow test is one of many so called delay of gratification tasks, which are used to test human ability of self-control or resisting temptation. It takes place in a room without possibility to focus on anything else but the task. A subject is invited to the room where an experimenter presents him with two possible options, one marshmallow and two marshmallows. The subject is asked to pick which of these options he or she prefers. Then the experimenter tells the subject that he or she can either have the less preferred option right now or the preferred option. But to get it, he or she has to wait some time until the experimenter comes back. Then the experimenter makes sure that the subject understands the task and leaves a bell in the room, which the subject can ring to call the experimenter back if he or she does not want to continue with the task. In that case, the preferred option cannot be chosen, the less preferred can. Then the experimenter finally leaves the room.

After leaving the room the experimenter starts to measure how long does it take to the subject to ring the bell. If the subject does not ring the bell for a certain, set in advance, amount of time, the experimenter comes back and allows the subject to take the preferred option. The time for which the experimenter was outside the room is called the delay time. The higher the delay time, the better ability of self-control.

One of many studies concerning the marshmallow test was performed by Mischel *et al.* (1988). They wanted to find out whether a better ability of self-control exerted by preschool children has some implications for their future social abilities.

For the sake of the study, 95 children (42 boys, 53 girls) participated in marshmallow test. It had to be their first participation in such test, maximum delay time was set at 15 minutes, rewards were exposed and no strategies how to succeed were suggested. Their mean age was 4 years and 5 month and their mean delay time was 8 minutes and 51 seconds.

To find out information about their social status the California Child Q-Set⁴ was used. It is a set of 100 cards. On each card, there is a different character description of a wide range. After several years, experimenters sent these cards to parents of children participating in the marshmallow test. Parents were

⁴The CCQ was not the only source of information about the children, questionnaires were used as well. In this case, only results based on CCQ indices will be presented.

supposed to divide the cards into 11 stacks according to a certain criterion regarding their children, insert each stack in a separate envelope and send back. Experimenters awarded points to each character description based on in which stack the card with the particular description was placed. The mean age of children at the time they were assessed by their parents was 15 years and 10 month. From 95 parents that should evaluate their children, 67 of them used the CCQ to do so. To be more accurate, 32 boys and 35 girls were assessed by the CCQ. Based on these evaluations, experimenters came out with values of correlation coefficients between delay times and particular characteristics from the California Child Q-Set. Values of some of them can be found in Table 4.4.

Table 4.4: Correlation coefficients between delay time and selected characteristics

Characteristics	Correlation coefficient
Is verbally fluent, can express ideas well in language.	.47*
Is attentive and able to concentrate.	.42*
Is competent, skillful.	.41*
Is planful, thinks ahead.	.40*
Can be trusted, is dependable.	.23
Is considerate and thoughtful of other children.	.13
Is helpful and cooperate.	.18
Tends to be suspicious and distrustful of others	-.22
Is jealous and envious of others	-.23
Reverts to more immature behaviour when under stress.	-.34*
Appears to feel unworthy, thinks of self as "bad".	-.38*
Is shy and reserved, makes social contacts slowly.	-.42*
Tends to go to pieces under stress, becomes rattled and disorganized.	-.43*

Note: An asterisk (*) indicates that the correlation coefficients are different from zero, $p < .05$. Sexes are combined in this table because differences between boys and girls were very small.

Source: Mischel et al. (1988)

According to the values of correlation coefficients, one can claim that self-control at preschool age is a reliable precursor of an adolescent individual who is verbally fluent, can express ideas well in language, is attentive and able to concentrate, is competent, skilful, planful, and thinks ahead. Furthermore, he or she is less likely to revert to more immature behaviour when under stress, to feel unworthy, be shy and reserved, make social contacts slowly, and become disorganized. Such an individual is called ego resilient.

Mischel *et al.* (1988) have shown that ability of preschool children to exert self-control in self-imposed delay situation indicates their ego resiliency in future. But this is not the end of the story. These children are also more likely to have higher verbal and quantitative scores on Scholar Aptitude Test and are more successful in dealing with stress in adolescence (Shoda *et al.* 1990). Furthermore, they are seen more competent by others (Mischel *et al.* 1989) and the probability that they will use drugs is lower as well as the probability that they will be aggressive or have low self-respect (Ayduk *et al.* 2000).

4.4 Ego-Depletion

It is crucial to understand that self-control is important for regulating desires, resisting temptations, fulfilling long-term goals, and controlling emotions. Without self-control, people are far away from behaving rationally. In ordinary life, people face aspects mentioned above every day and that is why they have to exert self-control so often. Unfortunately, it has a negative consequence for them which is called ego-depletion.

Whenever people regulate themselves, an internal resource is used to do so. But every time they use this resource, they temporarily deplete it. Hence, human ability to exert self-control is limited. This phenomenon is termed ego-depletion.

What impact does the ego depletion have was subject of study of Baumeister *et al.* (1998). They found that self-control exerted on an initial task lowers ability of self-control on a subsequent task and also leads to passivity. Moreover, when one faces responsible decision-making, he or she depletes his or her ego as well and subsequent self-control is decreased.

Shown the existence of ego-depletion, researchers turned their attention toward its overcoming. Webb & Sheeran (2003) tried to figure out whether forming implementation intentions could be a solution. These are statements of following form: “Whenever situation *A* occurs, my response will be activity *B*.” Below, some examples of implementation intentions are stated.

- Whenever I get angry about someone, I will try not to be rude.
- Whenever I think of stopping dieting, I will go running.
- Whenever I think of stopping doing exercises, I will not watch a movie.
- Whenever I stop studying, I will not go playing PC games.

- Whenever etc.

And indeed, it was a solution. Not only that implementation intentions prevented ego-depletion, they managed to offset its effects after they occurred. Hence, risk of failure to exert self-control after depleting one's ego can be minimized by forming suitable implementation intentions.

Chapter 5

Cognitive Illusions

This chapter describes cognitive illusions, which are psychological phenomena causing people to subconsciously perceive and judge certain events differently from reality. Pohl (2004) sees them as systematic deviations which appear involuntary and are hard to avoid. Most importantly, they do not enable individuals to behave rationally.

Cognitive illusions can be divided into three groups: illusions of thinking, illusions of judgment, and illusions of memory. There are many authors who treat an illusion of one type as an illusion of other type. Since differences between the three types of illusions are negligible, it is possible to do so.

Illusions of thinking are cognitive illusions which limit human performance mainly because of relying on intuition rather than on application of normative rules. Illusions of judgment refer to biases in individual evaluations, which are caused by certain situational factors. Eventually, illusions of memory are connected to problems with encoding a memory trace and its subsequent recall.

The goal of this chapter is not to discuss all possible cognitive illusions because there are many of them, but rather to point out that there are psychological effects which may limit people in their effort to behave rationally. Hence, in this chapter, only the most robust and pervasive cognitive illusions are described.

5.1 Conjunction Fallacy

The conjunction fallacy is an illusion of thinking. This phenomenon describes human inability to think about probabilities and to properly apply the conjunction

rule. Specifically, the conjunction rule, which is defined as follows:

$$\Pr(A\&B) = \Pr(A) \times \Pr(B),^1$$

is violated by claiming that

$$\Pr(A\&B) > \Pr(A),$$

which cannot be true since

$$\Pr(B) \leq 1$$

implies

$$\Pr(A) \times \Pr(B) \leq \Pr(A),$$

which means that

$$\Pr(A\&B) \leq \Pr(A).$$

The same argumentation holds for conjunction fallacy in form of

$$\Pr(A\&B) > \Pr(B).$$

One experimental evidence for this fallacy was provided by Tversky & Kahneman (1983). They asked a group of participants to arrange certain statements from the highest to lowest in probability that the event in particular statement can occur. There were several statements but only three of them were used to test the conjunction fallacy. There was a short description of a situation so that the participants could rank the probabilities based on available information. The problem looked as follows:

“Bill is 34 years old. He is intelligent, but unimaginative, compulsive, and generally lifeless. In school, he was strong in mathematics but weak in social studies and humanities.”

And the three statements were:

“Bill is an accountant. (A)”

“Bill plays jazz for a hobby. (J)”

¹For events which are not independent, the conjunction rule is expressed as $\Pr(A\&B) = \Pr(A) \times \Pr(B | A)$, and all next inequalities have the same form, but $\Pr(B)$ is replaced by $\Pr(B | A)$.

“Bill is an accountant who plays jazz for a hobby. (A&J)” (Tversky & Kahneman 1983, p. 297)

Since the characteristics of Bill implies that he is more likely to be an accountant than play jazz for a hobby, the demonstration of the conjunction fallacy meant, in this case, to claim that $\Pr(A\&J) > \Pr(J)$. And, indeed, 87% of respondents have shown this pattern. In other setting with different person with different characteristics, 85% have felt prey to this fallacy.

The above mentioned authors explained the conjunction fallacy by representative heuristic. It means that, based on description of Bill, being an accountant is representative for this kind of person, implying that the conjunction of representative and unrepresentative characteristics (playing jazz for a hobby) is more plausible than being described by the unrepresentative characteristic only.

Yates & Carlson (1986) argued that the conjunction fallacy is caused by so-called signed summation, which is similar to the representative heuristic. People assign positive values of probabilities to events which are likely to occur and negative values of probabilities to events which are unlikely to occur. Hence, conjunction of a likely event (being an accountant) and an unlikely event (playing jazz for a hobby) is a sum of a positive and a negative number which is higher than the negative number itself.

There are many other explanations for this phenomenon. The real cause of the conjunction fallacy is up to be discovered, e.g., via brain imagining.

5.2 Anchoring Effect

Anchoring effect is referred to as an illusion of judgment causing people to subconsciously overvalue meaning of information in such a way that the information becomes anchor for future judgments and decisions.

Ariely *et al.* (2003) demonstrated the anchoring effect in the following way. They presented experiment participants with six products - a cordless trackball, a cordless keyboard, an average wine, a rare wine, a design book, and Belgian chocolates. Each respondent had to answer two questions. First of them, the comparative anchoring question, was to decide whether the respondent would buy each of those presented products if price of each product was, in dollars,

equal to last two digits of his or her social security number (SSN). Second of them, the absolute anchoring question, was to state maximum amount of money they would be willing to pay for each product.

According to the theory about the anchoring effect, the last two digits of their SSN should become an anchor for future judgments and bias their stated amount of money. Results, which confirmed the theory, are summarized in Table 5.1.

Table 5.1: Average stated maximum amount of money willing to be paid for each product sorted by intervals of last two digits of SSNs

Interval of last two digits of social security number	Cordless trackball	Cordless keyboard	Average wine	Rare wine	Design book	Belgian chocolates
< 00; 19 >	\$8.64	\$16.09	\$8.64	\$11.73	\$12.82	\$9.55
< 20; 39 >	\$11.82	\$26.82	\$14.45	\$22.45	\$16.18	\$10.64
< 40; 59 >	\$13.46	\$29.27	\$12.55	\$18.09	\$15.82	\$12.55
< 60; 79 >	\$21.18	\$34.55	\$15.45	\$24.55	\$19.27	\$13.27
< 80; 99 >	\$26.18	\$55.55	\$27.91	\$37.55	\$30.00	\$20.64
Correlations	.415	.516	.328	.328	.319	.419
Significance level	$p = .0015$	$p < .0001$	$p = .014$	$p = .0153$	$p = .0172$	$p = .0013$

Note: Row called “Correlations” indicates correlations between the last two digits of SSN and stated maximum amount of money participants were willing to pay for each product.

Source: Ariely et al. (2003)

Based on results, the lower the respondent’s number created from two last digits of his or her SSN, the lower the maximum amount of money he or she would be willing to pay for each product, and vice versa. Hence, participants did not decide according to either their preferences or cost-benefit analysis, but their judgments were rather influenced by the anchoring effect.

The anchoring effect is not only strong, as shown by the above mentioned experiment, but also pervasive. Anchoring occurs even if the anchors are extreme (e.g., Chapman & Johnson 1994), chosen at random (e.g., Mussweiler & Strack 2000) or research participants were informed about the potential effect of the anchor and instructed to adjust their judgments accordingly (Wilson *et al.* 1996).

Tversky & Kahneman (1974) tried to explain this phenomenon by so-called insufficient adjustment. They claimed that an anchor becomes a starting point

and people adjust this starting point in order to make a judgment. This adjustment is, however, insufficient.

On the other hand, e.g., Chapman & Johnson (1999) argued that people, rather than adjust a starting point, test whether the anchor itself could be their best judgment. The starting point is easily remembered and becomes information that can be accessed later when making judgments. This approach is called selective accessibility.

5.3 Mere Exposure Effect

The mere exposure effect suggests that the more is an individual exposed with a stimulus, the more positively this individual values the stimulus. This holds, however, only to some extent. If the number of exposures is too high, liking of the stimuli decreases. This latter pattern is called the overexposure effect.

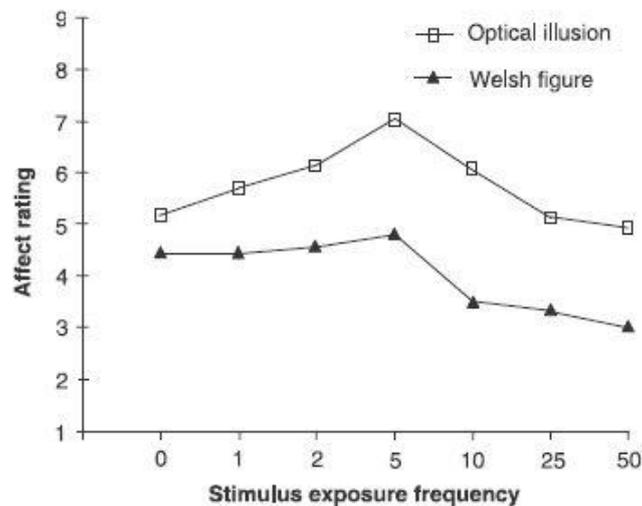
Bornstein *et al.* (1990) confirmed this illusion of judgment by presenting research participants with several drawings at different frequencies. Participants were presented with simple drawings (“Welsch figures”) and visual illusions (“optical illusions”) and were asked to determine how much they like them on 9-point rating scale. Results are to be found in Figure 5.1.

The experiment showed that participants liked more drawings that were complex than those that were simple ($p < .0001$). Liking for a drawing was increasing through five first exposures of the particular drawing and decreasing onward. The effect of exposure frequency was significant as well ($p < .0001$).

Stang (1974) concluded that the mere exposure effect reflects the so-called two factor model. This model suggests that if the frequencies are small, learning plays the main role in increasing liking. If the frequencies are high, however, learning dissipates, and boredom occurs, which leads to decrease in liking.

The mere exposure effect has a wide range of applications. Bornstein (1989) showed its influence on election, Janiszewski (1993) on advertisement.

Figure 5.1: Stimulus exposure frequencies with related affect ratings



Note: The higher the value of affect rating, the more a participant liked a drawing.

Source: Pohl (2004)

5.4 Hindsight Bias

Hindsight bias falls into the category illusions of memory. The principle of this illusion consists in encoding of a memory trace which can be barely retrieved in its original form once new information related to the memory trace has been received. In most cases, retrieval of the original memory traced is biased towards the new information. Fischhoff (1975) refers to this phenomenon as “knew-it-along effect”.

Hindsight bias is tested by asking respondents to answer dozens of difficult questions. After some time, during which they were not allowed to look for correct answer or discuss the questions with someone else, they are presented with correct answers and asked to recall their original answers, this is called the experimental condition. To rule out the possibility that repeated thinking leads to improvement of estimates, some respondents are asked to recall their original answers without being informed about correct answers, this is called the control condition. The time period is usually one week. Examples of such questions are listed below.

- “How many different kind of insects inhabit the Antarctic?”

- “What is the weight of a regular tennis ball (in grams)?”
- “How old was Martin Luther King when he was shot?”
- “How often on average does the heart of a mouse beat in one minute?”
- “In what year did Leonardo Da Vinci paint the “Mona Lisa”?”

(Pohl 2004, p. 502)

Then, from standardized answers the so-called shift index is computed in order to measure the hindsight bias and to find out by how much, in terms of standard deviation, the research participants alter their original estimates towards the correct answer. Values of shift index are summarized in Table 5.2.

Table 5.2: Shift indices for different experiments

Conducted by	Shift index for the experimental condition	Shift index for the control condition
Pohl & Hell (1996)		
Experiment 1	.22	.01
Experiment 2	.21	.01
Pohl (1998)		
Experiment 1	.14	.01
Experiment 2	.11	-.02
Experiment 3	.20	.01
Pohl <i>et al.</i> (2003a)	.28	.04

Note: If the value of shift index is, e.g., .20, it says that recalled answers were biased one fifth of a standard deviation closer to correct answers. Negative value of shift index can be explained as increased distance from correct answers after recalling the original answers.

Source: Author, based on Pohl (2004)

Results have shown that, on the one hand, when the correct answers were not shown, participants were on average very close to recall their original answers. On the other hand, however, as soon as they were informed about the correct answers, the hindsight bias caused them to overestimate their original estimates towards correct solutions.

Pezzo (2003) found the same pattern when examining individuals' basketball game predictions. After the match, they were sure that they would have

successfully guessed the winner.

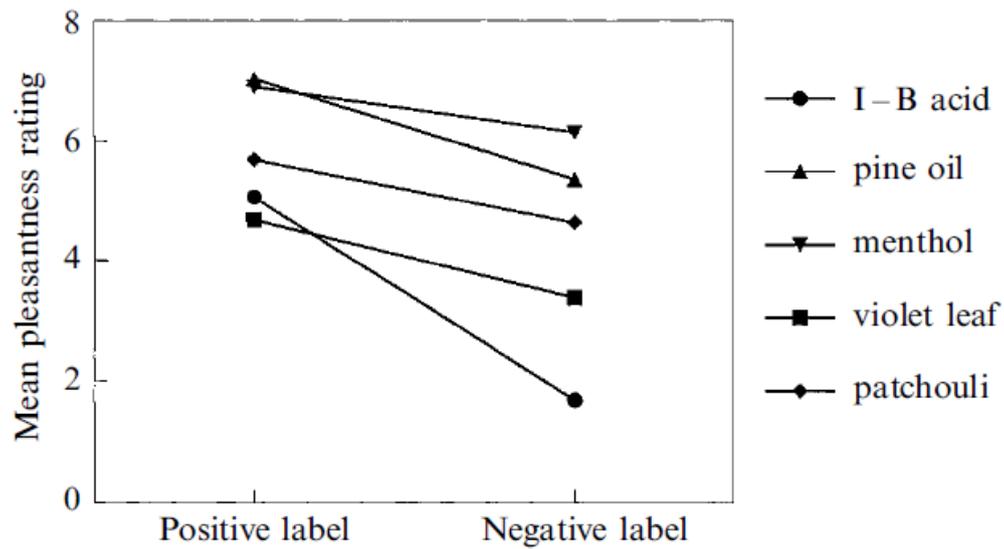
Fischhoff (1975), Hell *et al.* (1988), and Tversky & Kahneman (1974) explain the hindsight bias by claiming that people are not able to ignore the correct answer.

5.5 Effects of Labelling

This cognitive illusion can be classified as an illusion of judgment as well as an illusion of memory. The effects of labelling describe how a label affixed to an impulse can influence judgment of the impulse or memories on it.

Herz & von Clef (2001) demonstrated these effects by presenting experiment participants with five different odours. In the first session, some odours had a positive label (e.g., fresh cucumber), and some odours had a negative label (e.g., vomit). The participants were asked to rate each odour on a 9-point scale (1 = extremely unpleasant, 9 = extremely pleasant). In the second session, one week later, odours which previously had a positive label were labelled negatively and vice versa. The same participants were, again, asked to rate the odours on the same scale. In Figure 5.2, mean rating for each odour based on its label is summarized.

Figure 5.2: Odour ratings for pleasantness based on its label



Source: Herz & von Clef (2001)

Not only that a majority of participants thought that they sniff a different odour, they were influenced by its label. The mean rating of an odour with a positive label was in all cases higher than mean rating of the same odour with a negative label. The results suggest strong labelling effects.

These effects were experimentally supported for the recall of colour and pictures. Moreover Pohl *et al.* (2003b) showed that judgment of taste are influenced by labels as well.

Effects of labelling are in most cases explained by claiming that label is a suggestion. This suggestion helps an individual to partially solve his or her problem with uncertainty because it provides some information. But, on the other hand, it does not enable the individuals to decide solely according to their true preferences.

Chapter 6

Conclusion

The main goal of the thesis was to show that irrationality is a very serious problem influencing many decisions of economic agents and to suggest that creating an economic theory with the reliance on rationally behaving individuals does not have to lead to a proper description of reality. To reach this goal, three hypotheses were discussed.

Firstly, the hypothesis that economic agents behave irrationally can be seen as true from the point of view that, in each conducted experiment, there were lots of individuals behaving in the way that economic models would not predict. On the other hand, since not all agents acted irrationally, there is a possibility that irrationality is not pervasive, but widespread. Moreover, behaving irrationally in one experiment does not imply that the same individual would behave irrationally in another experiment. Hence, the hypothesis cannot be fully confirmed. The outcome rather is that many irrationally behaving economic agents can be found.

Secondly, the number of examples from very different areas suggests that the wide range of domains which create space for irrationality is reality. Selected market traps have shown that valuations, comparisons, and decisions are very likely to be subject for occurrence of irrationality. Similarly, market transactions involving money serve as a sphere where being rational is very difficult. Adding self-control to this group cannot be a surprise, individuals face situations which require self-control every day.

Finally, the chapter about cognitive illusions not only helped to support the second hypothesis, but also became the basis for confirming the third hypothesis that, in some cases, irrationality is difficult to overcome. If the subconscious mind causes people to behave irrationally, there is little space for solving this

problem. Even if economic agents are warned about potential situations leading to irrational behaviour, they cannot influence their subconscious mind.

On the other hand, there are also cases in which people can be helped to move closer to behaviour defined as rational. For instance, by stressing that decoys should be ignored, or by reminding them how important is thinking about money in terms of opportunity costs, how to overcome procrastination using concepts of reward substitution or self-control contracts, how to avoid ego-depletion with implementation intentions, etc.

The question is how, in world with so much space for irrationality, to create a proper economic theory which accounts for the fact that there are many irrationally behaving economic agents who, in some cases, can change their behaviour and behave more rationally, but, in other cases, this change is not possible.

Final note is about finding a common source in brain which is responsible for certain groups of irrational decisions. There definitely is a progress, but because brain imagining is so expensive, many questions are left unanswered.

Bibliography

- ARIELY, D. & S. JONES (2008): *Predictably irrational*. HarperCollins New York.
- ARIELY, D. & S. JONES (2010): *The upside of irrationality: the unexpected benefits of defying logic at work and at home*, volume 159. Harper New York, NY.
- ARIELY, D. & G. LOEWENSTEIN (2006): "The heat of the moment: The effect of sexual arousal on sexual decision making." *Journal of Behavioral Decision Making* **19(2)**: pp. 87--98.
- ARIELY, D., G. LOEWENSTEIN, & D. PRELEC (2003): "Coherent arbitrariness": Stable demand curves without stable preferences." *The Quarterly Journal of Economics* **118(1)**: pp. 73--106.
- AYDUK, O., R. MENDOZA-DENTON, W. MISCHEL, G. DOWNEY, P. K. PEAKE, & M. RODRIGUEZ (2000): "Regulating the interpersonal self: strategic self-regulation for coping with rejection sensitivity." *Journal of personality and social psychology* **79(5)**: p. 776.
- BAUMEISTER, R. F., E. BRATSLAVSKY, M. MURAVEN, & D. M. TICE (1998): "Ego depletion: is the active self a limited resource?" *Journal of personality and social psychology* **74(5)**: p. 1252.
- BAUMEISTER, R. F., T. F. HEATHERTON, & D. M. TICE (1994): *Losing control: How and why people fail at self-regulation*. Academic Press.
- BIYALOGORSKY, E., W. BOULDING, & R. STAELIN (2006): "Stuck in the past: Why managers persist with new product failures." *Journal of Marketing* **70(2)**: pp. 108--121.
- BORNSTEIN, R. F. (1989): "Exposure and affect: Overview and meta-analysis of research, 1968--1987." *Psychological bulletin* **106(2)**: p. 265.

- BORNSTEIN, R. F., A. R. KALE, & K. R. CORNELL (1990): "Boredom as a limiting condition on the mere exposure effect." *Journal of personality and Social Psychology* **58(5)**: p. 791.
- CHAPMAN, G. B. & E. J. JOHNSON (1994): "The limits of anchoring." *Journal of Behavioral Decision Making* **7(4)**: pp. 223--242.
- CHAPMAN, G. B. & E. J. JOHNSON (1999): "Anchoring, activation, and the construction of values." *Organizational behavior and human decision processes* **79(2)**: pp. 115--153.
- CHARK, R., S. CHEW, & S. ZHONG (2011): "A direct experimental test of the hyperbolic discounting hypothesis." *Technical report, Working paper*.
- COOMBS, C. H. & G. S. AVRUNIN (1977): "Single-peaked functions and the theory of preference." *Psychological Review* **84(2)**: p. 216.
- CROPPER, M. L. & D. I. LAIBSON (1998): *The implications of hyperbolic discounting for project evaluation*. World Bank Publications.
- FABER, R. J. & G. A. CHRISTENSON (1996): "In the mood to buy: Differences in the mood states experienced by compulsive buyers and other consumers." *Psychology & Marketing* **13(8)**: pp. 803--819.
- FARMER, D. J. & J. GEANAKOPOLOS (2009): "Hyperbolic discounting is rational: Valuing the far future with uncertain discount rates." .
- FESTINGER, L. (1962): *A theory of cognitive dissonance*, volume 2. Stanford university press.
- FISCHHOFF, B. (1975): "Hindsight is not equal to foresight: The effect of outcome knowledge on judgment under uncertainty." *Journal of Experimental Psychology: Human perception and performance* **1(3)**: p. 288.
- FRANKE, N., P. KEINZ, & C. J. STEGER (2009): "Testing the value of customization: when do customers really prefer products tailored to their preferences?" *Journal of Marketing* **73(5)**: pp. 103--121.
- FRANKE, N. & M. SCHREIER (2008): "Product uniqueness as a driver of customer utility in mass customization." *Marketing Letters* **19(2)**: pp. 93--107.

- FRANKE, N. & M. SCHREIER (2010): "Why customers value self-designed products: The importance of process effort and enjoyment*." *Journal of Product Innovation Management* **27(7)**: pp. 1020--1031.
- FREDERICK, S., N. NOVEMSKY, J. WANG, R. DHAR, & S. NOWLIS (2009): "Opportunity cost neglect." *Journal of Consumer Research* **36(4)**: pp. 553--561.
- GILBERT, D. T., M. D. LIEBERMAN, C. K. MOREWEDGE, & T. D. WILSON (2004): "The peculiar longevity of things not so bad." *Psychological Science* **15(1)**: pp. 14--19.
- GIORDANO, L. A., W. K. BICKEL, G. LOEWENSTEIN, E. A. JACOBS, L. MARSCH, & G. J. BADGER (2002): "Mild opioid deprivation increases the degree that opioid-dependent outpatients discount delayed heroin and money." *Psychopharmacology* **163(2)**: pp. 174--182.
- HELL, W., G. GIGERENZER, S. GAUGGEL, M. MALL, & M. MÜLLER (1988): "Hindsight bias: An interaction of automatic and motivational factors?" *Memory & Cognition* **16(6)**: pp. 533--538.
- HERZ, R. S. & J. VON CLEF (2001): "The influence of verbal labeling on the perception of odors: evidence for olfactory illusions?" *PERCEPTION-LONDON-* **30(3)**: pp. 381--392.
- HUBER, J., J. W. PAYNE, & C. PUTO (1982): "Adding asymmetrically dominated alternatives: Violations of regularity and the similarity hypothesis." *Technical report, DTIC Document*.
- JANISZEWSKI, C. (1993): "Preattentive mere exposure effects." *Journal of Consumer Research* **20(3)**: p. 376.
- JOHNSON, E. J. & D. GOLDSTEIN (2003): "Do defaults save lives?" *SCIENCE-NEW YORK THEN WASHINGTON-* pp. 1338--1339.
- JOHNSON, E. J., J. HERSHEY, J. MESZAROS, & H. KUNREUTHER (1993): *Framing, probability distortions, and insurance decisions*. Springer.
- KAHNEMAN, D., J. KNETSCH, & R. THALER (1990): "Experimental tests of the endowment effect and the coase theorem." .

- KAHNEMAN, D., J. L. KNETSCH, & R. H. THALER (1991): "Anomalies: The endowment effect, loss aversion, and status quo bias." *The journal of economic perspectives* pp. 193--206.
- KAHNEMAN, D. & A. TVERSKY (1979): "Prospect theory: An analysis of decision under risk." *Econometrica: Journal of the Econometric Society* pp. 263--291.
- KNETSCH, J. L. (1989): "The endowment effect and evidence of nonreversible indifference curves." *The American Economic Review* pp. 1277--1284.
- LASTOVICKA, J. L., L. A. BETTENCOURT, R. S. HUGHNER, & R. J. KUNTZE (1999): "Lifestyle of the tight and frugal: theory and measurement." *Journal of Consumer Research* **26(1)**: pp. 85--98.
- LOEWENSTEIN, G. (2000): "Emotions in economic theory and economic behavior." *American Economic Review* pp. 426--432.
- LOEWENSTEIN, G. (2005): "Hot-cold empathy gaps and medical decision making." *Health Psychology* **24(4S)**: p. S49.
- LOEWENSTEIN, G., D. NAGIN, & R. PATERNOSTER (1997): "The effect of sexual arousal on expectations of sexual forcefulness." *Journal of Research in Crime and Delinquency* **34(4)**: pp. 443--473.
- LOEWENSTEIN, G. & D. PRELEC (1992): "Anomalies in intertemporal choice: Evidence and an interpretation." *The Quarterly Journal of Economics* **107(2)**: pp. 573--597.
- LOEWENSTEIN, G., D. PRELEC, & C. SHATTO (1998): "Hot/cold intrapersonal empathy gaps and the under-prediction of curiosity." *Unpublished manuscript, Carnegie-Mellon University, Pittsburgh, PA* .
- MADRAN, B. C. & D. F. SHEA (2000): "The power of suggestion: Inertia in 401 (k) participation and savings behavior." .
- MISCHEL, W., Y. SHODA, & P. K. PEAKE (1988): "The nature of adolescent competencies predicted by preschool delay of gratification." *Journal of personality and social psychology* **54(4)**: p. 687.
- MISCHEL, W., Y. SHODA, & M. I. RODRIGUEZ (1989): "Delay of gratification in children." *Science* **244(4907)**: pp. 933--938.

- MOCHON, D., M. I. NORTON, & D. ARIELY (2012): "Bolstering and restoring feelings of competence via the ikea effect." *International Journal of Research in Marketing* **29(4)**: pp. 363--369.
- MUNSHI, J. (2014): "A new discounting model for teaching finance." *Available at SSRN* .
- MUSSWEILER, T. & F. STRACK (2000): "Numeric judgments under uncertainty: The role of knowledge in anchoring." *Journal of Experimental Social Psychology* **36(5)**: pp. 495--518.
- NORTON, M., D. MOCHON, & D. ARIELY (2011): "The 'ikea effect': When labor leads to love." *Harvard Business School Marketing Unit Working Paper (11-091)*.
- OKADA, E. M. & S. J. HOCH (2004): "Spending time versus spending money." *Journal of consumer research* **31(2)**: pp. 313--323.
- PARDUCCI, A. (1974): "Contextual effects: A range-frequency analysis." *Handbook of perception* **2**: pp. 127--141.
- PECK, J. & T. L. CHILDERS (2003): "To have and to hold: the influence of haptic information on product judgments." *Journal of Marketing* **67(2)**: pp. 35--48.
- PEZZO, M. (2003): "Surprise, defence, or making sense: What removes hindsight bias?" *Memory* **11(4-5)**: pp. 421--441.
- POHL, R. (2004): *Cognitive illusions: A handbook on fallacies and biases in thinking, judgement and memory*. Psychology Press.
- POHL, R., M. EISENHAUER, & O. HARDT (2003a): "Sara: A cognitive process model to simulate the anchoring effect and hindsight bias." *Memory* **11(4-5)**: pp. 337--356.
- POHL, R. F. (1998): "The effects of feedback source and plausibility of hindsight bias." *European Journal of Cognitive Psychology* **10(2)**: pp. 191--212.
- POHL, R. F. & W. HELL (1996): "No reduction in hindsight bias after complete information and repeated testing." *Organizational Behavior and Human Decision Processes* **67(1)**: pp. 49--58.

- POHL, R. F., S. SCHWARZ, S. SCZESNY, & D. STAHLBERG (2003b): "Hindsight bias in gustatory judgments." *Experimental Psychology* **50(2)**: p. 107.
- READ, D. (2001): "Is time-discounting hyperbolic or subadditive?" *Journal of risk and uncertainty* **23(1)**: pp. 5--32.
- READ, D. & G. LOEWENSTEIN (1999): "Enduring pain for money: Decisions based on the perception and memory of pain." *Journal of Behavioral Decision Making* **12(1)**: pp. 1--17.
- READ, D. & B. VAN LEEUWEN (1998): "Predicting hunger: The effects of appetite and delay on choice." *Organizational behavior and human decision processes* **76(2)**: pp. 189--205.
- RICK, S. (2008): "When spendthrifts act like tightwads: Factors that reduce spendthrift/tightwad spending differences." *Technical report, Working Paper# 2008-04-13*. Pennsylvania, PA: University of Pennsylvania, Wharton School, Department of Operations and Information Management.
- RICK, S. (2013): "The pain of paying and tightwaddism: New insights and open questions." *Available at SSRN 2271900* .
- RICK, S. I., C. E. CRYDER, & G. LOEWENSTEIN (2008): "Tightwads and spendthrifts." *Journal of Consumer Research* **34(6)**: pp. 767--782.
- SAMUELSON, P. A. (1937): "A note on measurement of utility." *The Review of Economic Studies* **4(2)**: pp. 155--161.
- SAYETTE, M. A., G. LOEWENSTEIN, K. M. GRIFFIN, & J. J. BLACK (2008): "Exploring the cold-to-hot empathy gap in smokers." *Psychological science* **19(9)**: pp. 926--932.
- SCHOTTER, A. (2008): *Microeconomics: a modern approach*. Cengage Learning.
- SEN, A. (1973): "Behaviour and the concept of preference." *Economica* pp. 241--259.
- SHAMPANER, K. & D. ARIELY (2006): "How small is zero price? the true value of free products." *Technical report, Working paper series//Federal Reserve Bank of Boston*.

- SHODA, Y., W. MISCHEL, & P. K. PEAKE (1990): "Predicting adolescent cognitive and self-regulatory competencies from preschool delay of gratification: Identifying diagnostic conditions." *Developmental psychology* **26(6)**: p. 978.
- STANG, D. J. (1974): "Methodological factors in mere exposure research." *Psychological Bulletin* **81(12)**: p. 1014.
- TANGNEY, J. P., R. F. BAUMEISTER, & A. L. BOONE (2004): "High self-control predicts good adjustment, less pathology, better grades, and interpersonal success." *Journal of personality* **72(2)**: pp. 271--324.
- THALER, R. (1980): "Toward a positive theory of consumer choice." *Journal of Economic Behavior & Organization* **1(1)**: pp. 39--60.
- THALER, R. (1981): "Some empirical evidence on dynamic inconsistency." *Economics Letters* **8(3)**: pp. 201--207.
- THALER, R. H. (1999): "Mental accounting matters." *Journal of Behavioral decision making* **12(3)**: pp. 183--206.
- TVERSKY, A. & D. KAHNEMAN (1974): "Judgment under uncertainty: Heuristics and biases." *science* **185(4157)**: pp. 1124--1131.
- TVERSKY, A. & D. KAHNEMAN (1981): "The framing of decisions and the psychology of choice." *Science* **211(4481)**: pp. 453--458.
- TVERSKY, A. & D. KAHNEMAN (1983): "Extensional versus intuitive reasoning: The conjunction fallacy in probability judgment." *Psychological review* **90(4)**: p. 293.
- TVERSKY, A. & D. KAHNEMAN (1991): "Loss aversion in riskless choice: A reference-dependent model." *The Quarterly Journal of Economics* **106(4)**: pp. 1039--1061.
- VAN BOVEN, L. & G. LOEWENSTEIN (2003): "Social projection of transient drive states." *Personality and Social Psychology Bulletin* **29(9)**: pp. 1159--1168.
- VAN BOVEN, L., G. LOEWENSTEIN, & D. DUNNING (2005): "The illusion of courage in social predictions: Underestimating the impact of fear of embarrassment on other people." *Organizational Behavior and Human Decision Processes* **96(2)**: pp. 130--141.

- WEBB, T. L. & P. SHEERAN (2003): "Can implementation intentions help to overcome ego-depletion?" *Journal of Experimental Social Psychology* **39(3)**: pp. 279--286.
- WILSON, T. D., C. E. HOUSTON, K. M. ETLING, & N. BREKKE (1996): "A new look at anchoring effects: basic anchoring and its antecedents." *Journal of Experimental Psychology: General* **125(4)**: p. 387.
- YATES, J. F. & B. W. CARLSON (1986): "Conjunction errors: Evidence for multiple judgment procedures, including "signed summation"." *Organizational Behavior and Human Decision Processes* **37(2)**: pp. 230--253.