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Studies of reference points in  
Prospect Theory  
The case of hedonic adaptation

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*There are two tragedies in life.  
One is to lose your heart's desire.  
The other is to gain it.*

George Bernard Shaw

# INDEX

<b>Introduction</b> .....	1
<b>Chapter 1 – Behavioral economics: a completely new paradigm or another field of neoclassical economics?</b> .....	3
1. Intellectual foundations.....	4
1.1. Classical and early neoclassical economics	
1.2. Postwar neoclassical theory	
2. Late neoclassical period.....	10
2.1. Institutionalists	
2.2. Macroeconomists	
2.3. An outlier’s view	
2.4. Old behavioral economics	
3. New behavioral economics.....	19
3.1. Foundations	
3.2. Prospect theory	
3.3. Thaler	
4. Latest directions.....	32
4.1. Neuroeconomics	
4.2. Affection and other heuristics	
4.3. Light paternalism	
5. Continuation or break with the past? .....	39
<b>Chapter 2 – Insights from behavioral economic research</b> .....	40
1. Methods followed by behavioral economics.....	41
1.1. Hypothetical choices	
1.2. Experiments with real outcomes	
1.3. Field research	
1.4. Process measures	
2. Empirical studies in behavioral economics.....	45
2.1. Behavioral microeconomics	
2.2. Behavioral macroeconomics	
2.3. Behavioral finance	
2.4. Behavioral game theory	
2.5. Further research	

3. Relevance for real economies.....	59
3.1. Advances in positive economics	
3.2. Advances in normative economics	
<b>Chapter 3 – Reference point adaptation: when frames change.....</b>	<b>63</b>
1. Studies on the reference point.....	64
1.1. Analysis in the static domain	
1.2. Analysis in the dynamic domain	
2. The case of hedonic adaptation.....	73
2.1. Describing the phenomenon	
2.2. An interesting study on hedonic adaptation	
2.3. Previous and subsequent research	
3. Frames, reference point and hedonic adaptation: a look on normative implications.....	89
<b>Chapter 4 – Testing for hedonic processes in the domain of security trading.....</b>	<b>90</b>
1. Describing the experiment.....	91
1.1. The questionnaires	
1.2. Computational methods	
2. Analysis of data.....	95
2.1. The intra-group analysis	
2.2. The inter-group analysis in the gain domain	
2.3. The inter-group analysis in the loss domain	
2.4. The separate case of problem 4	
3. Final discussion.....	102
3.1. Commenting the results	
3.2. Future research	
<b>Conclusions.....</b>	<b>106</b>
<b>Bibliography.....</b>	<b>109</b>
<b>List of websites.....</b>	<b>119</b>
<b>Appendix A.....</b>	<b>120</b>

## Introduction

Why is behavioral economics so interesting? In what consists the attraction of prospect theory? In the attempt of answering to these questions, my thesis follows a path describing behavioral economics from the more general theoretical issues to the analysis of a particular phenomenon considered by the exponents of such discipline.

Many authors have debated if it is right to consider behavioral economics as an autonomous branch in the economic literature or, rather, one of the possible theorizations that can support mainstream neoclassical models with its insights. As the development of the discipline suggests, it seems that both these points of view can be supported. Indeed, the central feature in both neoclassical and behavioral economic analysis is the individual. To be precise, the development of behavioral economics can be traced back to the confutation of the neoclassical expected utility model and its assumptions, which were blamed of not being capable of describing in an effective way the decision-making process of agents. Through the insertion of psychological foundations into the existing models, then, it was possible to improve their predictive and explanatory power.

If the contribution of behavioral economists had been limited to providing some psychological insights to mainstream neoclassical theories, there would have been no doubt about the exclusively supplemental nature of the discipline. However, the growing concern about the need for developing a radically new theory of decision-making under risk and uncertainty, took to the birth of Kahneman and Tversky's (1979) prospect theory. Such model represents the major example of the innovative power of behavioral economics.

Once developed a new theory, researchers started to verify if such model could make sense with real data. Hence, a series of investigations started to widespread, taking to the growth of specific sub-fields of behavioral economics, each focusing on different topics, like microeconomics, finance, or game theory. One of the common aspects among all these sub-fields is their approach toward empirical research, more concerned about the comprehension of decision-makers through a step-by-step process describing their choice path, rather than strictly following a series of procedures in order to guarantee "acceptable" results.

Although the majority of researchers have conducted positive (that is, descriptive) analyses, rather than providing new insights at the normative level, the recent interest on arguments like light paternalism has marked the beginning of an increasing concern about the normative potential of behavioral economic models.

The most characteristic element of prospect theory is the value function, in which the reference point plays a prominent role. Indeed, agents do not evaluate outcomes looking at their overall utility – as predicted by neoclassical models –, but rather at their position with respect to a given reference point. If an outcome stands above the reference point, it belongs to the gain

domain; on the contrary, if such outcome stands below the reference point, it belongs to the loss domain. This distinction is necessary to express agents' loss-aversion, so that their reactions toward a gain or a loss are different. To reflect loss-aversion, the value function is S-shaped – with a kink at the reference point – and steeper for losses than for gains.

The concept of reference point is strictly connected to that of frame. As already highlighted, while expected utility theory states that individuals evaluate outcomes only on the basis of the utility attached to them, prospect theory postulates that also the context (i.e. the frame) in which such outcomes are presented is relevant. Hence, the reference point gives a hint on how frames affect decision-makers' choices.

Depending on whether we consider a single initial frame or various changing frames, we can distinguish between static and dynamic analyses of the reference point. While static investigations have the aim of detecting which is the initial reference point of individuals and how they formed it, dynamic inquiries focus on the evolution in time of such reference point. Among the studies in the dynamic domain, some interesting results have been introduced using the concept of hedonic adaptation. Such phenomenon has been particularly considered by Arkes, Hirshleifer, Jiang and Lim (2008), whose work inspired subsequent research by other behavioral economists.

With the aim of verifying the findings of such researchers, I developed my own experiment, based on two questionnaires that investigated reference point adaptation to gains and losses in the domain of security trading. While the majority of results were congruent with those of Arkes and colleagues (2008) – confirming that people follow some principles of mental accounting theory, acting as hedonic maximizers –, a few of them needed to be analyzed with more attention, in order to understand their discrepancies with respect to the study of the authors.

## Chapter 1

### **Behavioral economics: a completely new paradigm or another field of neoclassical economics?**

The term “behavioral economics” started to be used in the early ‘50s (see Johnson, 1958; Boulding, 1958) and, nowadays, it refers to the attempt to increase “the explanatory and predictive power of economics by providing it with more realistic psychological foundations” (Camerer and Loewenstein, 2003).

Behavioral economics is often seen as having emerged in reaction to the notion, held by many neoclassical economists, that social and behavioral science should avoid reference to entities (like cognitive and affective states) that cannot be directly observed. By contrast, Camerer and Loewenstein (2003) suggested that the basic assumption of the discipline does not imply a complete rejection of the neoclassical approach, based on utility maximization, equilibrium, and efficiency. In fact, they argued, the neoclassical approach “provides economists with a theoretical framework that can be applied to almost any form of economic [...] behavior, and it makes refutable predictions”.

It should be interesting, then, to detect if behavioral economics represents a natural development of mainstream neoclassical economics or, instead, a radical revolution distancing from “tradition”. In the following chapter, trying to understand which of the two visions describes best the role of this discipline, I will make a review of its history – following the scheme proposed by Agner and Loewenstein (2006) – and, subsequently, make some considerations about the issue.

## 1. Intellectual foundations

Before going deep into the subject, it is worthy to inspect the origins of behavioral economics starting from an analysis of modern economics. Following Mandler's (1999) path, modern economics history can be divided into three main periods: classical, early neoclassical, and postwar neoclassical.

This classification is one of the many possible. It may be criticized, but in my opinion it provides a quite complete overview of the genesis of the discipline. In particular, the work of Mandler is remarkable because he looked for the vision of the individual provided by authors belonging to different schools of economic thought. Only after this analysis, we can focus on the theoretical development that took to the "official birth" of behavioral economics as conceived nowadays.

### 1.1. Classical and early neoclassical economics

Normally, we are taught that classical and neoclassical economists (18<sup>th</sup>-19<sup>th</sup> centuries) had a "homo oeconomicus" vision of the individual. Theorists like Smith and Ricardo are ascribed to consider agents as being rational and strictly self-interested actors, who have the capability of making judgments on the aspirations and purposes they have about themselves, as well as on the external events in which they occur.

As Mandler (1999) noticed, the above interpretation of agent's behavior does not completely describe the thought of classical and early neoclassical economists. Probably because they are interpreted on the light of modern neoclassical economics, there is common misunderstanding on their conception of human psychology, considered too much "simple". In contrast to what it is usually asserted, these economists had an idea of human nature – and, thus, decision-making – inspired by developments in psychology, which was to some extent sophisticated. For instance, consider Smith's thought about the nature of human purposes:

"How selfish soever may be supposed, there are evidently some principles in his nature, which interest him in the fortune of others, and render their happiness necessary to him, though he derives nothing from it except the pleasure of seeing it." (Smith, 1759)

Similarly, looking at people's rationality, or utility-promoting behavior, he wrote:

"How many people ruin themselves by laying out money on trinkets of frivolous utility? What pleases these lovers of toys is not so much the utility, as the aptness of the machines which are fitted to promote it. All their pockets are stuffed with little conveniences [...] of which the whole utility is certainly not worth the fatigue of bearing the burden." (Smith, 1759)

Even though Smith did not have a theory of decision in the modern sense, these quotes at least prove that he had a pretty complex vision of human nature.

Many authors argue that Smith – together with his contemporary David Hume – has identified and discussed some of the phenomena that nowadays are subjects of interest in behavioral economics. As Ashraf, Camerer and Loewenstein (2005) noticed, Smith's work is fulfilled with intuitions that forecast the concepts of loss aversion, overconfidence, social preferences, and more.

Early neoclassical economics is well represented by the work of Jevons, Pareto and Fisher. These economists built their theories on the basis of hedonic psychology, that is, “an account of individual behavior according to which individuals seek to maximize pleasure and minimize pain” (Agner and Loewenstein, 2006). As Jevons wrote:

“Pleasure and pain are undoubtedly the ultimate objects of the Calculus of Economics. To satisfy our wants to the utmost with the least effort [...] in other words, to maximize pleasure, is the problem of Economics.” (Jevons, 1871)

Early neoclassical economists were inspired by the considerations of Bentham (1823), who claimed that pain and pleasure act like “two sovereign masters” that influence people's thoughts and actions. These economists considered utility in terms of conscious experience like pleasure or happiness:

“Utility [arising from any commodity] must be considered as measured by, or even as actually identical with the addition made to a person's happiness.” (Jevons, 1871)

Mandler (1999) noticed that the hedonic foundation of early neoclassical economics – in particular the assumption that people maximize pleasure – gives at least three advantages. First, hedonics implies deliberation, as individuals weigh the pleasure and pain that would result from various actions and choose the one they perceive as leading to the greatest balance of pleasure over pain. Second, hedonics provides a rationale for some important assumptions, like the completeness and transitivity of the preference relation, and – previously assuming separability and diminishing marginal utility – the convexity of indifference curves. Third, the early neoclassical definition of rational deliberation allows for the description of irrational (or “incorrect”) behaviors. As Loewenstein, O'Donoghue and Rabin (2003) explained, hedonic psychology entitles people to act irrationally because, for example, they fail to properly anticipate the pleasure resulting from certain actions, or because they fail to take future pleasure into account in their decisions.

Looking at the general considerations about welfare, early neoclassical economists are defined “utilitarians”. Among them, we can list Pigou, Edgeworth, Sidgwick and Marshall.

Utilitarians believed that welfare or utility could be aggregated across individuals, and that one state was superior to another if total welfare was greater in the former than in the latter.

These economists based their theories on conscious experience<sup>1</sup>, so that many principles of hedonic psychology could be explained through their introspective self-evidence alone<sup>2</sup>. Agner and Loewenstein (2006) argued that the commitment to introspection, together with the belief that introspection supported the principles of hedonic psychology, took utilitarian economists to think that it made no sense to explore alternative methods to confirm the adequacy of their theories. This tendency, however, was not only present in economics; as Gardner (1985) underlined, the scientific method used by many researchers at that time was introspection.

## 1.2. Postwar neoclassical theory

With the appearance of behaviorism<sup>3</sup> – marked by the publication of an article by Watson in 1913 –, a new approach towards introspection and mental states started to widespread. Gardner (1985) suggested that behaviorists favored two propositions. First, researches interested in a science of behavior had to use exclusively “public methods of observations”, that could be applied and quantified by any scientist. Second, they needed to focus only on behavior, avoiding “topics as mind, thinking, or imagination and such concepts as plans, desires, or intentions”. These two propositions are present in the writings of the postwar neoclassical economists as well.

The passage from early to postwar neoclassical theory, even though inspired by earlier works (e.g. Pareto, 1906), took place from the mid-1930's to the mid-50's. Taking the distance from any kind of psychology, postwar neoclassical economists rejected the notion that economics should make reference to conscious states, and the idea that introspection was a scientifically acceptable means to explore those states. These economists were motivated by a variety of considerations, among which we can count the methodological criticisms of logical positivism in philosophy, behaviorism in psychology, and operationalism in physics. Moreover, some economists were disappointed that early neoclassicism was not so successful in generating theories with predictive power<sup>4</sup>.

Then, postwar neoclassical economists based their discipline on firmer methodological ground, but trying to improve the predictive power of their theories. According to their view (also

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<sup>1</sup> Pigou (1920) wrote: “The elements of welfare are states of consciousness and, perhaps, their relations.”

<sup>2</sup> This can be seen, for example, in what Cairnes (1888) wrote: “The economist starts with a knowledge of ultimate causes. He is already, at the outset of his enterprise, in the position which the physicist only attains after ages of laborious research”. The reason, the author continues, is that: “we have, or may have if we choose to turn our attention to the subject, direct knowledge of these causes in our consciousness of what passes in our own minds.”

<sup>3</sup> A psychological theory that demands behavioral evidence for any psychological hypothesis. (Stanford Encyclopedia of Philosophy, 2000)

<sup>4</sup> As Hutchison (1938) remarked: “It is possibly very encouraging for the economist to hear that compared with the natural scientist the psychological method saves him “ages of laborious search”, but it is curious and a pity that this huge start has not enabled him to formulate any considerable body of reliable prognoses such as the natural sciences have managed to achieve.”

called “ordinalism”), the basic assumption is that people have preferences:

“All that is assumed [...] is that different goods have different uses and that these different uses have different significances for action such that in a given situation one use will be preferred before another and one good before another.” (Robbins, 1932)

In brief, a person’s preference ordering just represents his or her ranking of the available options, nothing more, nothing less<sup>5</sup>.

Agner and Loewenstein (2006) noticed that by using “preference” rather than “utility” as the fundamental concept, these economists explicitly intended to free economics of its connections with psychology. On the other side, however, they underlined that postwar economists did not reject that people can be motivated by pleasure, pain and/or other mental states<sup>6</sup>. Arguing that issues like motivation, preference formation and choice were outside the field of reference of economics, postwar economists chose to “remain agnostic” about them. As an example, consider what Robbins wrote:

“Why the human animal attaches particular values in this sense to particular things, is a question which we do not discuss. That is quite properly a question for psychologists or perhaps even physiologists.” (Robbins, 1932)

Mandler (1999) underlined that ordinalism is more “general” than classical and early neoclassical economics, due to its agnosticism about the psychological foundations of human behavior. Hence, while early neoclassical economists made assumptions about individual psychology (for instance, how feelings of pleasure and pain change as a result of consumption) and deduced the properties of preference (e.g. the assertion that preferences must be transitive), postwar neoclassical simply treated the transitivity of preferences as axiomatic.

Ordinalist economists considered utility in a different way; in their view, it became an index or a measure of preferences satisfaction. In Mandler’s words:

“An agent’s ordinal preference for option  $x$  over  $y$  indicates the relative ordering of the options and not that  $x$  delivers some specified multiple of  $y$ ’s pleasure or even that pleasure is the motivating factor. Indeed, contemporary economics relinquishes any attempt to specify the motives underlying choice. Preference itself is now the primitive element of consumer theory; there is no

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<sup>5</sup> As Wicksteed (1910) expressed it: “By a man’s “scale of preferences” or “relative scale”, then, we must henceforth understand the whole register of the terms on which (wisely or foolishly, consistently or inconsistently, deliberately, impulsively or by inertia, to his future satisfaction or to his future regret) he will, if he gets the chance, accept or reject this or that alternative.”

<sup>6</sup> Hicks (1946) wrote: “Now of course this does not mean that if any one has any other ground for supposing that there exists some suitable quantitative measure of utility, or satisfaction, or desiredness, there is anything in the above argument to set against it.”

need to peer into agent's psyches." (Mandler, 1999)

In brief, if for person  $p$  the utility of  $x$  is greater than that of  $y$ , it means only that  $p$  prefers  $x$  over  $y$ . Utilities have nothing to deal with pleasure, pain or any other psychological or motivational state. However, postwar economists differ in the notion of "preference". According to some authors (like Samuelson, 1948) preferences are identified with observable choices. According to others (like Robbins, 1932) preferences are not identified with observable choices, though closely connected to them. In fact, choices mirror preferences in the sense that they have the same properties, so that choice data can be used to deduce preference orderings.

Ordinalism implicated some changes with respect to welfare economics. As Agner and Loewenstein (2006) underlined, preference satisfaction accounts – according to which, as the words suggest, welfare is a matter of preference satisfaction – took the place of mental state accounts of welfare – according to which welfare is a matter of happiness and pleasure. Furthermore, the utilitarian welfare criterion was abandoned in favor of the "Pareto criterion".

Considering agents  $A$  and  $B$ , who are given an initial allocation of goods, a change to a different allocation that makes agent  $A$  better off without making  $B$  worse off – and vice versa – is defined a "Pareto improvement". Consequently, an allocation is defined "Pareto efficient" (or "Pareto optimal") when no Pareto improvements can be made. An interesting aspect of Pareto efficiency is that it does not give any judgment on the distribution of resources among the individuals of an economic system. This means that a Pareto efficient allocation may not correspond to the most socially desirable option.

Extending the above definition to nations, one state is considered superior to another if at least one individual is better off and nobody is worse off in the former than in the latter. As Mandler (1999) noticed, the Pareto criterion allowed economists to give economic advices without the need of aggregating utilities or making interpersonal welfare comparisons.

But even though realizing that the Pareto criterion is very strong (for example, few changes in economic policy are Pareto improvements), postwar neoclassical economists have proposed a series of weaker conditions (or auxiliary assumptions). Typically, these concern the objects of preference, the characteristics of the budget set, and the properties of the preference ordering. For example, in the case of choice among lotteries – which is the model for many decision theory problems – a common assumption is that people's subjective probabilities equal actual probabilities and that utilities are defined over wealth. Similarly, considering intertemporal choice, the standard assumption is that individuals maximize the sum of utilities over time, discounted in the same way as financial markets discount cash flows.

Ordinalism has methodological implications, too. In fact, as a result of the rejection of introspection, postwar neoclassical economists believed that the only acceptable method to collect information about preferences is to study market transactions or other observable choices<sup>7</sup>.

In summary, postwar neoclassical economics represents a clear break with the classical and early neoclassical tradition. Trying to make the discipline more consistent with the current methodological strictures and to improve the predictive power of the theory, postwar theorists aspired to disjoint all the connections with psychology and hedonic. As a result, they achieved a very general theory, which has no relation with human behavior. At the same time, however, several advantages of early neoclassical theory were lost. First, since it did not consider deliberation, postwar theory could not say anything about how preferences are formed. Second, as a consequence, this theory did not provide any theoretical basis for the assumptions underlying the preference account of behavior<sup>8</sup>. Third, looking at the connection between economics and psychology, ordinalists lost the theoretical means to describe irrational behavior; so, if we need to consider behavior inside the theory, that behavior must be rational. By the same token, since welfare or wellbeing is understood as the satisfaction of the person's preferences, the theory necessarily describes any voluntary action as promoting his or her welfare or wellbeing.

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<sup>7</sup> This belief was shared with the behaviorists: "[...] everything important in psychology [...] can be investigated in essence through the continued experimental and theoretical analysis of the determiners of rat behavior at a choice point in a maze." (Tolman, 1938)

<sup>8</sup> "Lacking psychological foundations, the axioms of preference theory instead persist as primitives, unexplained and unjustified." Mandler (1999)

## 2. Late neoclassical period

Although the theory of postwar neoclassical economics was predominant in that period, still there were some economists that underlined the importance of inserting more psychological foundations in their studies. The reason is that they were convinced that putting psychological insights in their theories would help them to do better economics.

In this section, I will examine some of these authors, following the classification scheme proposed by Agner and Loewenstein (2006): institutionalists, macroeconomists, an outlier, and “old” behavioral economists.

### 2.1. Institutionalists

Among the earliest and most fierce critics of ordinalists were the institutional economists of the early 20<sup>th</sup> century, represented by Veblen, Mitchell, Clark, Commons and Davenport. These economists took their name from their interest on “institutions” under the light of psychology, as Mitchell (1910) explained:

“Institutions are themselves conceived as psychological entities – habits of thought and action prevailing among the communities under observation.” (Mitchell, 1910)

Commons (1934) defined an institution as a “collective action in control of individual action” and in “restraint, liberation, and expansion of individual action”, underlying that the human being is a “social animal”. Veblen (1899), instead, described institutions as “widely followed habits of thought and the practices which prevail in any given period”, highlighting their “faith-oriented” character. Combining these two definitions, Davenport (1914) denoted an institution as “a working consensus of human thought or habits – a generally-established attitude of mind and a generally-adopted custom of action as, for example, private property, inheritance, government, taxation, competition, and credit”.

Institutional economists rejected the hypotheses of rationality, stable preferences and equilibrium, while promoted those theories that emphasized bounded rationality and evolution of preferences. In particular, “traditional” institutionalism claimed that institutions can limit and shape tastes, expectations on the future, habits and motivations. In fact, if agents live and work in an institution, their view of the world will unavoidably be influenced by it. As a consequence, whenever the nature and/or purpose of an institution changes, also people’s perceptions within it will change, affecting the economy too. “New” institutionalism (also defined “institutionalist political economy”) remarked the evolutionary nature of institutions, declaring that economics cannot be separated from the social and political background in which it is enclosed.

While rejecting the insights of hedonist psychology in economics, according to which man is “a lightning calculator of pleasures and pains, who oscillates like a homogeneous globule of desire of happiness under the impulse of stimuli that shift him about the area, but leave him intact” (Veblen, 1898), institutional economists also believed that it would be a mistake for economics to fully ignore psychology:

“It was because hedonism offered a theory of how men act that it exercised so potent an influence upon economics. It is because they are developing a sounder type of functional psychology that we may hope both to profit by and to share in the work of contemporary psychologists. But in embracing this opportunity economics will assume a new character. It will cease to be a system of pecuniary logic, a mechanical study of static equilibria under non-existent conditions, and become a science of human behavior.” (Mitchell, 1914)

Through psychology, then, it became possible for institutional economists to generate economically relevant hypotheses. In fact, Veblen (1899) explained the capitalistic accumulation of wealth through “conspicuous consumption”, according to which the excessive expenditure on given goods is due to people’s tendency of displaying a higher social status<sup>9</sup>. The author also introduced the concept of “conspicuous leisure”, which expresses the set of activities that people do to assess and consolidate their social status. For example, to be considered a gentleman, an individual needed to study philosophy and fine arts; by the same token, to underline their high level of welfare, rich people had to travel to exotic places and bring souvenirs back. Clearly, the existence of conspicuous consumption and leisure show that the accumulation of richness cannot be explained by purely economic reasons, but also by psycho-sociological ones.

Clark greatly supported the necessity of using psychology in economic models. In particular, he focused on the process taking to a final equilibrium in individual and social choices, labeled as “economic guidance”. The author confuted the neoclassical theorization that agents value goods in terms of their marginal utility. As he explained, utility theory appears to be a possible interpretation of one phase of the economic guidance, namely “the static or the hedonistic phase of guidance by individual initiative”, which became less and less interesting for researchers:

“To the economic problems of a century ago this phase of guidance was supremely relevant, but for the problems of today it is the other phases of guidance that claim attention, if only because their principles are so little formulated and so completely unannexed.” (Clark, 1918a)

Then, Clark considered which psychological dynamic processes take to people’s choices and social efficiency. In particular, he detected the “principle of alternatives” and the “principle of

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<sup>9</sup> One of the most famous concepts introduced by this author is that of “Veblen goods” (also referred as “status symbols”), i.e. those goods whose desirability increases as their value and scarcity increase. Typically, they are socially-visible rather than ordinary-consumption goods.

standardization". For what concerns the former, the author sustained that economics needs to contribute to the search for social efficiency through the "study of the effect on individual economic efficiency of the various outside influences which society is capable of exerting or modifying" (Clark, 1918b). For what concerns the latter, Clark underlined that the behavior of agents very often is "standardized" to given choices that are generally (i.e. by the society) considered efficient, but that actually may not be the best for the individual and social welfare.

Also Mitchell (1928) tried to expand the purpose of economics beyond the situations of static equilibrium. In particular, he analyzed business cycles on the light of psycho-sociological changes, finding that "trade cycles were not accidental disruptions in the economy but were instead systematic fluctuations brought on by the changing economic organization of the economy together with its changing culture" (Medema, Mercurio and Samuels, 2000). In a previous work, centered on the role of money in an economic system, the author analyzed how the consciousness of psychology influenced the formulation of monetary theories in time. In his final considerations, Mitchell (1916) explained that a "Clear recognition of the role which money does play in economic life is more likely to broaden than to narrow the scope of economic theory". Notably:

"Economic life may be regarded as a process of making efforts and gaining satisfactions; or better, the activities of getting and using goods, of making and spending money, have a subjective aspect upon which attention may be focused." (Mitchell, 1916)

Commons (1934) focused the attention on the role of collective and corporate activities in the economy, underlying the presence of conflicts of interest among the various agents belonging to an economic system. Notwithstanding, it is in the interest of the community to solve its conflicts. In this attempt, the intervention of the government – which needs to follow the evolution of the society to better cope with its problems – is fundamental.

## 2.2. Macroeconomists

Psychological underpinnings can be traced also in the field of macroeconomics, in particular with reference to monetary and business cycle theories.

In the attempt to explain business cycle fluctuations in a "simple" way, Fisher (1928) introduced the concept of "money illusion", defining it as "the failure to perceive that the dollar, or any other unit of money, expands or shrinks in value". This economist suggested that money illusion contributes to business-cycle fluctuations because it prevents economic agents to see the real cause of such fluctuations (i.e. dollar instability), in such a way to conceal the importance of stabilizing the currency. As Agner and Loewenstein (2006) put it, the final result is that "money illusion makes business cycle fluctuations much more harmful than they otherwise would be".

Another macroeconomist interested into psychological foundations in its theories was Keynes, who wrote:

“[A] large proportion of our positive activities depends on spontaneous optimism rather than on a mathematical expectation, whether moral or hedonistic or economic. Most, probably, of our decisions to do something positive, the full consequences of which will be drawn out over many days, can only be taken as a result of animal spirits – of a spontaneous urge to action rather than inaction, and not as the outcome of a weighted average of quantitative benefits multiplied by quantitative probabilities.” (Keynes, 1936)

As we can see, the departure of Keynes from ordinalism takes two ways. First, he suggested that an agent’s actual behavior is not suitably described by the expected utility model. Second, he investigated on the motivations of economic behavior.

In more recent literature we can find many witnesses of the influence of psychological factors on phenomena analyzed in macroeconomics. For example, unemployment can be justified by the need for increasing individual productivity (see Darity and Goldsmith, 1996): providing employees a wage that is higher than the minimum possible – which could guarantee a job for everyone or, at least, a lower rate of unemployment –, they feel to be appreciated and put greater effort on their work.

Several macroeconomic theorists (see Woodford, 2007, or Brzezczynski and Kutan, 2010) proved that central banks (like the U.S. Federal Reserve and the European Central Bank) possess a powerful instrument to exert their monetary authority: announcements. In fact, without effectively coining new money or withdrawing it from the market, it is possible to change people’s behavior by simply affecting their expectations about future events<sup>10</sup>, for example announcing how much the inflation rate will increase in the following year. By the same token, investors will modify their plans if, instead of actually changing the interest rates, the central bank announces that in the following trimester the rate will change. The aim of such a instrument is to stabilize monetary markets through the control of agent’s behavior. Clearly, if there were no consciousness of the basic mental and psychological mechanisms that lead decision-makers to change their habits, announcements would make no effect on real economies. On the other side, central banks need to be aware that they cannot abuse of this “trick”, otherwise its effects will little by little vanish, since agents will lose faith in what banks declare – be it real or not.

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<sup>10</sup> This seems an extension of the concept of “adaptive expectation”: “[...] people form their expectations about what will happen in the future based on what has happened in the past. For example, if inflation has been higher than expected in the past, people would revise expectations for the future.” (Wikipedia, 2012)

### 2.3. An outlier's view

Back to the microeconomic field, from an initial conception of economics in the traditional welfare sense, Scitovsky (1976) switched to a greater consideration of behavioral psychology. In fact, he asserted that it was necessary to “observe behavior [...] in order to find [...] the foundations of a theory to explain behavior”. Like psychologists, this author not only noticed that people have different consumption patterns, but wanted “to find the causes and explanation of the differences”. What mostly fascinated Scitovsky was the fact that psychologists support their theories with experimental data, something that he believed also economists should do.

Agner and Loewenstein (2006) underlined that the contribution of this economist can be detected in both positive and normative theory. For what concerns positive theory, Scitovsky argued that human beings attempt to maintain an optimal level of arousal, and that great part of human behavior (like the desire for novelty) can be explained by the search for it. This process can explain, for instance, why people buy insurance and lottery tickets at the same time; in fact, freely chosen – little – amounts of uncertainty or risk (like those associated with buying lottery tickets) can help an individual move towards the optimal level of arousal, while externally imposed, perpetuated – big – amounts of uncertainty (like those against which one would insure himself) take the individual farther away from the optimum. Looking at normative theory, Scitovsky made a clear distinction between comfort and pleasure: “comfort has to do with absolute levels of arousal, whereas pleasure has to do with changes in arousal levels” (Agner and Loewenstein, 2006). According to the author, in individuals' mind it appears to be a trade-off between the pursuit of comfort and the pursuit of pleasure, with the result that people tend naturally to over-seek comfort at the expense of pleasure.

### 2.4. Old behavioral economics

The movement that in time would have been defined as “old” behavioral economics (mainly developed during the 1950's and 60's) is characterized by the presence of four different schools of thought: the Carnegie-Mellon University of Pittsburg and the University of Michigan in the United States, and the Universities of Oxford and Stirling in the United Kingdom.

Simon is considered the most outstanding representative of the “Carnegie school”, whose researchers “are known for their interest in understanding how individuals and organizations act and make decisions in the real world, and their challenges to the neoclassical theory of optimization and maximization in decision making and organizations” (Augier, 2010). This author is well known for his critique of the standard economic model of behavior, as well as of the conception of the economic man. He complained that economists “attribute to economic man a preposterously omniscient rationality” (Simon, 1947).

By identifying the assumptions of neoclassical economics and dividing them into explicit (i.e. preferences are assumed to be given a priori in the form of a utility function, and agents are assumed to choose the alternative that gives them the greater utility) and implicit (i.e. agents have complete and certain knowledge, and they are assumed to have a joint probability distribution), Simon explained the purposes of the new discipline:

“Behavioural economics is concerned with the empirical validity of these neoclassical assumptions about human behaviour and, where they prove invalid, with discovering the empirical laws that describe behaviour as correctly and accurately as possible. As a second item on its agenda, behavioural economics is concerned with drawing out the implications, for the operation of the economic system and its institutions and for the public policy, of departures of actual behaviour from the neoclassical assumptions. A third item on the agenda is to supply empirical evidence about the shape and content of the utility function (or of whatever construct will replace it in an empirically valid behavioural theory) so as to strengthen the predictions that can be made about human economic behaviour.” (Simon, 1987a)

In summary, according to Simon, behavioral economics does not provide a theoretical framework, but only tries to empirically test the neoclassical assumptions of human behavior and to modify economic theory on the basis of the results of the testing process.

One of the most remarkable contributions of this economist is the introduction of the concept of “bounded rationality”, which denotes the “whole range of limitations on human knowledge and human computation that prevent economic actors in the real world from behaving in ways that approximate the predictions of classical and neoclassical theory” (Simon, 1987a). Simon (1987b) underlined that bounded rationality theory is superior to neoclassical choice theory because it can better predict and explain the decisions that are actually taken by individuals; furthermore, they can help understand the decision-making processes.

Beside bounded rationality, “satisficing” is another central concept developed in the Carnegie school:

“[...] decision-making is a ‘satisficing’ activity: uncertainty, complexity and the costs of overcoming ignorance make it impossible for decision-makers to optimize and force them instead to set targets for satisfactory outcomes and to use rule of thumb techniques (‘heuristics’) for discovering ways of meeting these targets, once they have discovered that any of them have not been (or seem unlikely to be) met.” (Earl, 1988)

Another feature of this school of thought is the one of “aspiration levels”, which are used as criterion of selection in the process of search, creation and analysis of alternatives – instead of assuming that individuals face a fixed set of alternatives among which to choose.

Cyert and March (1963) are other two important exponents of the Carnegie school. In their most important study, the authors analyzed the reasons why agents may not be able to choose the best option available. For instance, sometimes decision-makers need to maximize several – if not excessive – goals, so that it becomes almost impossible to satisfy all the “optimality requirements” at once.

Within the same work, Cyert and March considered in a very detailed way the topic of organizational theory, combining the latest findings on firm’s behavior with previous economic discoveries. In particular, they developed an empirical – rather than normative – theory, making an extensive use of computer simulations of corporate behavior<sup>11</sup>. The central idea was that each firm should be considered as an “adaptive political coalition”, that is “a coalition between different individuals and groups of individuals in the firm, each having different goals and hence the possibility of conflict of interest” (Augier, 2010). Hence, the firm is seen as a system constantly learning – through bargaining – and experimenting to adapt to its environment. Clearly, it possesses a sort of “legacy” from the past: whenever a previous problem had been solved with success, the procedures followed in that situation were standardized, in order to be used in subsequent similar situations. Standard operating procedures, however, do not constitute an obstacle for firm’s development:

“As time passes and experience changes, so do standard operating procedures change through processes of search and learning. In other words, the firm is not an unchangeable entity – it is a system of rules, driven to change by current aspirations and targets reflecting experienced or anticipated dissatisfaction.” (Augier, 2010)

As Earl (1988) explained, Katona was to the “Michigan school” what Simon was to the Carnegie school, even though his approach to economics was more centered on psychology than Simon’s<sup>12</sup>. The focus of Michigan school is on consumer – rather than firm – behavior and macroeconomic issues. In particular, researchers are concerned about the intervening socio-psychological variables that affect consumer confidence. Their contributions are characterized by heavy reliance on questionnaire-based indexes, like the Index of Consumer Sentiment (ICS), used to improve predictions of expenditure in the United States<sup>13</sup>.

In his works, Katona (1951) strongly criticized the rationality assumption in neoclassical economics, asserting that economic behavior should be studied as it is, and then answering if it can be defined rational or not, as well as under which conditions it is more or less rational.

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<sup>11</sup> A new methodological approach, since until that time research mainly relied on questionnaire-based inquiries.

<sup>12</sup> This can be explained by the fact that, while Simon was an economist who considered the literature on private and public organizations through the eye of psychology, Katona was a psychologist that supported the idea that psychology helps economics better understand and explain its insights.

<sup>13</sup> “The success of the Michigan school in using the ICS [...] has led to the construction and use of similar types of indexes in other countries [...]” (Earl, 1988)

Agner and Loewenstein (2006) believed that the fundamental critique to neoclassical economics made by Katona is that it fails to properly take into account the importance of “intervening variables”. As a matter of fact, consumer expenditure is not only a function of income, but “motives, attitudes, and expectations of consumers and businessmen play a significant role in determining spending, saving, and investing” (Katona, 1975). According to Katona, modern psychology possesses the tools to investigate behavior, since it takes into account intervening variables, while neoclassical economics considers human beings behaving mechanistically, which means that they “show invariably the same reactions to the same developments in the economic environment” (Katona, 1951).

Among the exponents of the “Oxford school” we can name Andrews, Lamberton, Marschak and Shackle. Some of them belonged to the Oxford Economists’ Research Group (OERG), interested in empirical studies related to practical policy – involving fieldwork and the use of questionnaires and interviews –, as well as in uncertainty and informational aspects of the coordination of economic activities.

Earl (1988) noticed that not every economist would count the Oxford school as being part of behavioral economics field, since very few attempts were made by its members – notably, only by Lamberton (1965) – to integrate their contributions with those of their American colleagues:

“Indeed, Marschak’s fame came mainly from his later, Carnegie-style studies [...] *in* the United States and, particularly, from his joint work on the theory of teams [...]. Similarly, those influenced by Shackle tend to see him purely as a theoretical contributor and are often unaware of the time he spent with the OERG and his later OERG-style piece on business decision making [...]. And one can search in vain for any reference to empirical work by the Michigan school in Shackle’s [...] discussions of the connection between shifts in confidence and macroeconomic instability, despite the power it would add to his analysis.” (Earl, 1988)

Also Andrews (1964) did not take advantage of the advances of Carnegie and Michigan schools. In his studies on the theory of the firm and the competitive process, in fact, we can detect the desire of creating a model based on empirical foundations, as well as an implied rejection of the neoclassical idea that businessmen cannot be trusted – elements in common with behavioral economics. On the other side, he strongly claimed of not being a behavioral theorist, since “he saw satisficing as synonymous with ‘quiet life’ notions, whereas his fieldwork had alerted him to the highly competitive nature of many oligopolistic markets” (Earl, 1988). Unfortunately, Andrews did not figure out that his model described managers as using simple rules of thumb to face harsh selling environments and internal organizational problems, missing the opportunity of reconsidering behavioral theories.

While there can be a debate about the Oxford school as being part or not of behavioral economics, there is no doubt about the great contribution that the “Stirling school” gave to the

subject. Even though this school – among whose exponents we can list Earl, Kay, Loasby and Tylecote – did not give birth neither to cutting edge concepts nor to investigating methods, it deserves attention for its eclectic nature and integrationist tendencies. Indeed, beside the great work in linking together the ideas of the previous three schools of thought, Oxford representatives combined some branches of economics with other disciplines, like biological science, psychology, sociology, business history and philosophy of science. Furthermore:

“[...] the ‘Stirling approach’ has produced contributions to behavioural economics which share key elements with post-Keynesian macroeconomics [...], with the institutionalists [...], with the neo-Austrian literature on entrepreneurship [...], and with the subjectivist literature on public choice and bureaucracy theory [...]” (Earl, 1988)

Despite all the differences that occurred among the exponents of old behavioral economics (like the interest on separate fields of economic theory), we can still trace a common line of thought. As Sent (2004) underlined, the discipline was based on “empirical laws that described behavior”, a *modus operandi* that completely reversed the neoclassical approach, according to which economists need to find the “connection between rationality and utility or profit maximization” in order to provide “given alternatives and known consequences”.

### 3. New behavioural economics

As Kao and Velupillai (2011) stated, behavioral economics can be classified into two branches: classical and modern. While the former – which we defined old – was pioneered by Simon, the latter was developed by Edwards. These two streams are “distinguishable on the basis of their methodological, epistemological and philosophical aspects” (Kao and Velupillai, 2011). There are at least three aspects according to which classical (CBE) and modern (MBE) behavioral economics can be distinguished:

“First, MBE assumes economic agents are maximizing utility with respect to an underlying preference order [...]; CBE assumes no underlying preference order and an economic agent’s decision making behavior, at any level and against the backdrop of every kind of institutional setting, is subject to bounded rationality and exhibits satisficing behavior. Put in another way, MBE remains within the orthodox framework of optimization under constraints; CBE is best understood in terms of decision problems [...]. Second, MBE concerns the behavior of agents and institutions in or near equilibrium; CBE investigates disequilibrium or non-equilibrium phenomena. Third, MBE accepts mathematical analysis of (uncountable) infinite events or iterations, infinite horizon optimization problems and probabilities defined over  $\sigma$ -algebras and arbitrary measure spaces; CBE only exemplifies cases which contain finitely large search spaces and constrained by finite-time horizons.” (Kao and Velupillai, 2011)

For some aspects, in summary, modern behavioral economics marked a step back to the basic methods of neoclassical economics – to the extent that the authors define it “Neoclassical Theory of Behavioral Economics”.

Probably this “return to the past” is due to the emerging awareness that standard theory proved to be unable to explain many real-life anomalies in decision-making. Nevertheless, economists tried to “adjust” the existing theoretical framework to make it fit better with real data, without feeling the need of completely revolutionizing the entire subject.

Only when psychologists like Edwards, Tversky, Kahneman and Thaler started to use the existing economic models to test their psychological models, a new theory emerged, capable of overcoming the limits of expected utility theory, as well as explaining the anomalies found in empirical studies.

In this section, after considering some of the critics moved to standard theories by economists, I will exhibit the contributions of the various psychologists that gave birth to modern behavioral economics.

### 3.1. Foundations

The discoveries and considerations of Scitovsky, Katona, Simon and colleagues represented an important step in the increasing consciousness that psychology plays an important role in economics, but they did not change the fundamental direction of the subject. In fact, economists were still considering decision-making processes on the light of the existing theories.

The classic formulation of expected utility was first conceived by von Neumann and Morgenstern (1944), who wanted to render the qualitative notion of utility and preference measurable, that is “numerically definable and mutually comparable” (Kao and Velupillai, 2011). They thought that this was necessary in order to make economics a rigorous science. In the authors’ view, then, individuals can evaluate all the possibilities that may occur, and choose the outcome that will give them the highest satisfaction.

Authors like Allais and Ellsberg started to realize that expected and discounted utility models were losing their normative and descriptive power for decision-making under risk and intertemporal choice, respectively. For example, if gambles are presented to decision-makers with different probability distributions, they may not always choose the option predicted by EU theory<sup>14</sup>. The result of such considerations are the Allais paradox (1953) and the Ellsberg paradox (1961), which demonstrate the violation of the “independence of irrelevant variables” axiom.

As already underlined, to step out of the mud in which classical theories were drowning, economics had to wait the intervention of psychology. Around 1960, cognitive psychology started to depict human brain as an information-processing device, rather than a stimulus-response machine – as asserted by behaviorists. This new paradigm gave impulse to the consideration of topics like memory, problem solving and decision-making; all typical subjects of economic, rather than psychological, concern. By consequence, researchers started to consider economic models to test their theories.

Edwards (1954) can be considered the forerunner of such new wave of studies. In fact, some years before the advances in cognitive psychology, he introduced the so-called “subjective expected utility” (SEU). In an economic model under risk or uncertainty, a decision maker’s standard objective function is given by “a linear combination of the values of outcomes and probabilities attached to each of these outcomes” (Kao and Velupillai, 2011). In its very common formulation, the objective function is expressed by the sum of the value of each outcome multiplied by the probability attached to it. Both values of outcomes and probabilities can be objective or subjective, so that four possible scenarios can be pictured. While the two alternatives attached to the objective values of outcomes were considered not important or proved to be unrealistic, much more attention has been given to subjective outcomes. If their values are weighted with objective

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<sup>14</sup> The von Neumann-Morgenstern utility theorem provides four necessary and sufficient conditions (i.e. axioms) on preferences, under which the hypotheses of EU theory hold. They are: completeness; transitivity; independence; continuity.

probabilities, we get the expected utility. If, instead, they are weighted with subjective probabilities, we get the subjective expected value.

With Edwards, while the classical assumption of complete preference ordering still held, utilities and probabilities started to be conceived as subjective. In this perspective, individuals learn and adjust their prior beliefs with the occurrence of events. Interestingly:

“These properties for subjective probabilities [...], in turn, imply that individuals with different set of subjective probabilities, over the course of their experience, will end up having close subjective probabilities which coincide with each other.” (Kao and Velupillai, 2011)

The same reasoning was expressed by Hastie and Dawes (2001) as follows:

“The most important finding is that diverse people in very different situations often think about their decisions in the same way. We have a common set of cognitive skills that are reflected in similar decision habits. But we also bring with us a common set of limitations on our thinking skills that can make our choices far from optimal.” (Hastie and Dawes, 2001)

These considerations laid at the basis of a new branch of psychology that emerged in 1970's, the so-called Behavioral Decision Research (BDR). The focus of this discipline was on the identification of the common set of cognitive skills – with their related benefits and limitations – among different individuals, and on how they help to produce observable behaviors. Agner and Loewenstein (2006) confer to Kahneman and Tversky the merit of having brought BDR to the attention of economists through the formulation of their prospect theory.

### 3.2. Prospect theory

The greatest contribution to modern behavioral economics has been assigned to Kahneman and Tversky's researches, culminating in the formulation of prospect theory, which has been considered an adequate replacement of expected utility theory.

Suggesting also why the concept of “prospect” is important for this theory, Starmer (2000) explained that it describes choice as a two-phase process:

“In the first phase, prospects are “edited” using a variety of decision heuristics; in the second, choices among edited prospects are determined by a preference function that [...] can be represented by the simple decision-weighted utility form [...]” (Starmer, 2000)

Kahneman and Tversky (1974) started their studies by noticing that “people rely on a limited number of heuristic principles which reduce the complex tasks of assessing probabilities

and predicting values to simpler judgmental operations". As summarized by Agner and Loewenstein (2006), the two authors were interested in the mechanisms underlying human judgment and decision-making and, at the same time, in the conditions under which these mechanisms lead an individual into error. Kahneman and Tversky believed that understanding the heuristics that underlie human behaviors and decisions could help to "improve judgments and decisions under conditions of uncertainty".

Going deep into the subject, the two psychologists noticed that human beings apparently show contradictions in their behavior. The so-called "framing effect"<sup>15</sup> shows that subjects can be risk-averse if offered a choice in one way, but then display to be risk-seeking if the same option is offered in a different way. For example, a shopper might drive across the town for 20 minutes to buy a \$10 calculator instead of a \$15 one, but would not do the same to purchase a \$125 coat for \$5 less (see Kahneman and Tversky, 1981); a behavior that seems irrational. As Thaler (1999) underlined:

"If people were using a minimal account frame they would be just asking themselves whether they are willing to drive 20 minutes to save \$5, and will give the same answer in either version." (Thaler, 1999)

Unlike what rational economics models assert, prospect theory states that individuals' degree of pleasure depends more on their own subjective experience rather than on objective reality. Furthermore, it assigns value "to gains and losses rather than to final assets" (Kahneman and Tversky, 1979). As Angner and Loewenstein (2006) wrote:

"The theory is capable of accommodating framing effects because what counts as a gain and what counts as a loss is relative to the frame; when going from one frame to another, the theory permits the agent to change his or her choice behavior. [...] prospect theory can accommodate a range of otherwise puzzling behavior [...]." (Angner and Loewenstein, 2006)

An important concept introduced by Kahneman and Tversky is that of "loss aversion":

"Loss aversion is the disparity between the strong aversion to losses relative to a reference point and the weaker desire for gains of equivalent magnitude." (Camerer and Loewenstein, 2003)

In summary, loss aversion encapsulates the idea that the disutility attached to a loss of  $x$  is perceived worse than the utility associated to an equal-sized gain of  $x$ . This concept proved to have great conformity to what truly happens to individuals; in fact, there are hundreds of

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<sup>15</sup> With the framing effect "seemingly inconsequential changes in the formulation of choice problems caused significant shifts of preference". (Kahneman and Tversky, 1981)

experiments supporting the evidence that loss aversion is more realistic than the standard, continuous, concave utility function over wealth.

It is worth noting that inside the definition of loss aversion another relevant concept has been introduced: the “reference point”. This element is a sort of benchmark that every agent has in his/her mind; usually, it coincides with the individual's current endowment or level of welfare. Even though its description seems very intuitive and almost irrelevant, the reference point plays a prominent role in prospect theory<sup>16</sup>.

Looking at its mathematical formulation, prospect theory is represented by two components: a cumulative probability weighting function and a value function. Before considering in detail their shape and purpose, it should be useful to resume some characteristics of the EU theory utility function.

Among the hypotheses of this theory there is the idea that the utility of a risky distribution of outcomes (like monetary payoffs) is a probability-weighted average of the outcome utilities. This hypothesis reflects the “independence axiom”, according to which two gambles maintain the same preference order whenever mixed with a third gamble. Hence, the agent should not consider those events that take to the same payoff with the same probability.

Another aspect of EU theory is its highly simplifying nature; in fact, it assumes that the shape of the utility function for money can fully capture the individual's taste for risky money distributions. So, if the agent is risk-averse, the function will be concave, while if the agent is risk-seeking the function will be convex.

Literature suggests that in many situations expected utility failed in predicting agents' choices. Starmer (2000) provided a review of different studies and theories showing this “fiasco”. In some of them the independence axiom is still present<sup>17</sup>, but probabilities are weighted in different ways. In others, outcomes are first ranked and then their probabilities are weighted to reflect the ranking (i.e. probability weights are “rank-dependent”)<sup>18</sup>.

Camerer and Loewenstein (2003) argued that we can derive three conclusions from experimental research:

“One is that of the two new classes of theories that allow more general functional forms than expected utility, the new rank-dependent theories fit the data better than the new betweenness class theories. A second conclusion is that the statistical evidence against EU is so overwhelming that it is pointless to run more studies testing EU against alternative theories (as opposed to comparing theories with one-another). The third conclusion is that EU fits worst when the two gambles being compared have different sets of possible outcomes (or “support”). Technically, this

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<sup>16</sup> For a more detailed explanation, see chap. 3.

<sup>17</sup> Defined as “betweenness” property.

<sup>18</sup> “One mathematical way to do this is transform the *cumulative* probabilities of outcomes (i.e. the chance that you will win X or less) nonlinearly and weigh outcome utilities by the differences of those weighted cumulative probabilities.” (Camerer and Loewenstein, 2003)

property occurs when one gamble has a unique outcome. The fact that EU does most poorly for these comparisons implies that nonlinear weighting of low probabilities is probably a major source of EU violations. Put differently, [...] Linear probability weighting in EU works reasonably well except when outcome probabilities are very low or high. But low-probability events are important in the economy, in the form of “gambles” with positive skewness (lottery tickets, and also risky business ventures in biotech and pharmaceuticals), and catastrophic events which require large insurance industries.” (Camerer and Loewenstein, 2003)

Kahneman and Tversky’s prospect theory can better explain experimental evidence, since it takes into account psychological factors that influence agents’ decisions. This can be seen in the functional formulation of the theory.

The cumulative weighting function (see fig.1) encloses two ideas. First, the level of probability weight expresses the taste for risk; for example, if an individual hates gambling, he/she will place low weight on the chance of winning anything. Second, the curvature of the function exhibits how sensitive a subject is to differences in probabilities; for instance, if a person is more sensitive in the neighborhood of possibility and certainty (i.e. changes in probability near zero and 1) than to intermediate gradations, then their weighting function curve will overweight low probabilities and underweight high ones.

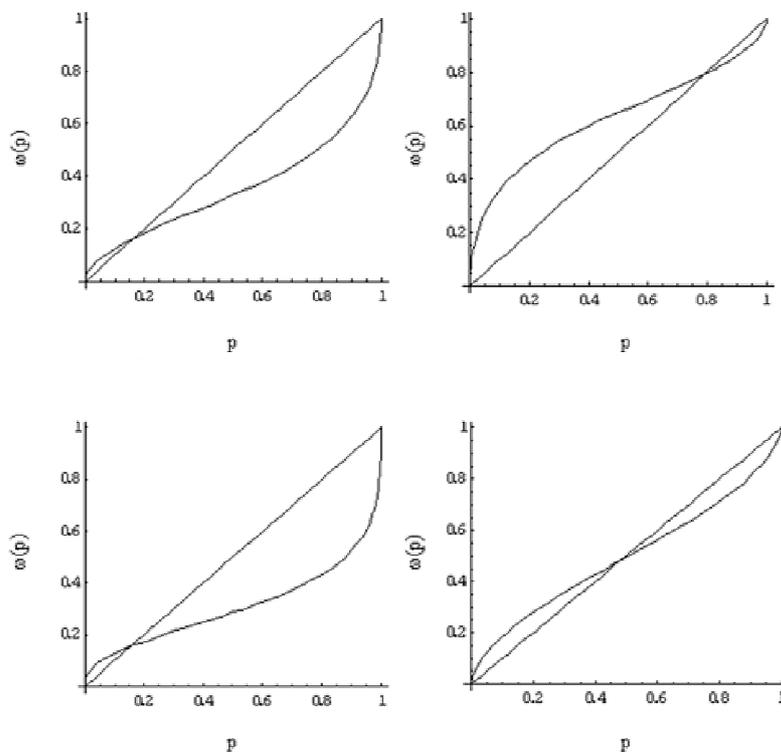


Figure 1 – Examples of cumulative weighting function<sup>19</sup>

<sup>19</sup> Source: <http://psycnet.apa.org/index.cfm?fa=buy.optionToBuy&id=2009-19590-009>

On the other side, the value function expresses the belief that utility derives from gains and losses relative to a reference point, rather than from total wealth or consumption. Looking at its graphical representation (see fig.2), the value function is “S-shaped”: concave in the domain of gains and convex in the domain of losses. Furthermore, to reflect the idea that a loss has larger impact than a gain of equal absolute value (i.e. loss aversion), and that the psychological effect of a marginal change will decrease the farther we move from the reference point (i.e. “diminishing sensitivity”<sup>20</sup>), the value function, in the neighborhood of the reference point, is steeper in the loss domain, while it increases smoother in the gain domain.

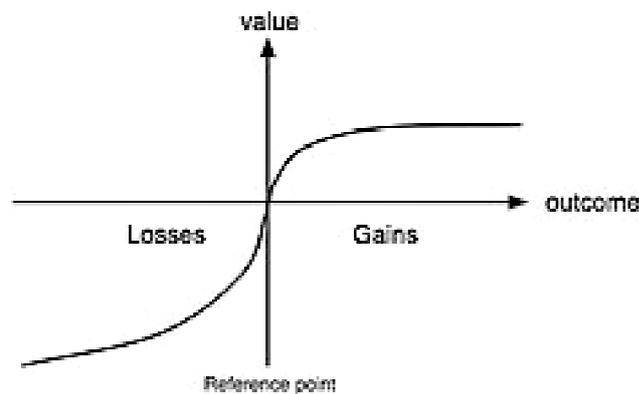


Figure 2 – Value function<sup>21</sup>

In the original article (1979), the probability weighting function was not cumulative. Indeed, we can make a distinction between prospect theory (PT), which corresponds to the first formulation by Kahneman and Tversky, and cumulative prospect theory (CPT), which derives from subsequent developments by the same authors.

In PT the overall value of a prospect is expressed by the formula:

$$V(X) = \sum_{i=1}^n \pi(p_i)v(x_i)$$

where  $x_i$  are the potential outcomes and  $p_i$  their respective probabilities, so that  $\pi$  is the probability weighting function and  $v$  the value function.

While the presence of framing effects, loss aversion and diminishing sensitivity were already incorporated in the primary structure of the value function – which does not change from the first to the second model –, the formula of the weighting function presented in PT expresses the idea that people overweight *unlikely* events, independently of their relative outcomes.

<sup>20</sup> “So, for example, relative to the status quo, the difference between a gain of \$10 and \$20 will seem larger than the difference between gains of \$110 and \$120.” (Starmer, 2000)

<sup>21</sup> Source: [http://lesswrong.com/lw/6kf/prospect\\_theory\\_a\\_framework\\_for\\_understanding/](http://lesswrong.com/lw/6kf/prospect_theory_a_framework_for_understanding/)

With time, Kahneman and Tversky (1992) understood that in reality agents tend to overweight *extreme* – even though unlikely – events, while underweight *average* events. Furthermore, the probabilities associated to gains are weighted in a different way with respect to those associated to losses. These considerations took the authors to slightly change the mathematical formulation of their theory, through the introduction of a cumulative weighting function that better describes individuals' pattern of choice. As a result, the CPT overall value of a prospect is given by the formula:

$$V(X) = \sum_{i=1}^k \pi_i^- v(x_i) + \sum_{i=k+1}^n \pi_i^+ v(x_i)$$

where the decision weights (i.e.  $\pi_i^-$  and  $\pi_i^+$ ) are defined by:

$$\pi_1^- = w^-(p_1), \quad \pi_i^- = w^-(p_1 + \dots + p_i) - w^-(p_1 + \dots + p_{i-1}) \quad 2 \leq i \leq k$$

$$\pi_n^+ = w^+(p_n), \quad \pi_i^+ = w^+(p_i + \dots + p_n) - w^+(p_{i+1} + \dots + p_n) \quad k + 1 \leq i \leq n - 1$$

As Fennema and Wakker (1997) explained:

“In the above formula, ‘cumulative probabilities’ are transformed for gains, and ‘decumulative probabilities’ for losses. [...] first consider the case of gains. A cumulative probability describes the probability for receiving an outcome or anything better than that outcome. [...] Decision weights for gains are obtained as differences between transformed values of cumulative probabilities. Similarly, for losses decision weights are obtained as differences between transformed values of consecutive decumulative probabilities, i.e. probabilities describing the receipt of an outcome or anything worse than that outcome.” (Fennema and Wakker, 1997)

The cumulative weighting function, furthermore, expresses the idea of diminishing sensitivity with respect to probability changes. In fact, near 0 and 1 it is sensitive to changes in probability, while in the middle region it is relatively insensitive to such changes. In this way, we are sure that extreme outcomes (or events) will be overweighted, while “average” outcomes will be underweighted – as explained by CPT.

Kahneman and Tversky consciously recognized the high value of their theory, since it can describe many observed behaviors toward risk – including the violation of the independence axiom – as well as an incredible amount of field data – both those already existing and those collected by the authors themselves in various experiments. Furthermore, prospect theory presents some unique properties, like the “reflection effect”:

“The fact that the concavity of the utility function in the domain of gains is mirrored by convexity in the domain of losses means behavior toward risk can be likewise mirrored across the two domains. For instance, a given individual who displays risk-aversion in a choice among particular prospects with nonnegative outcomes may display risk-seeking if all outcomes are changed to losses of the same absolute magnitude.” (Starmer, 2000)

The authors provided an example of how this effect can influence decision-makers. Two groups of subjects – namely, groups I and II – were presented the following cover story (Kahneman and Tversky, 1981):

“Imagine that the U.S. is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimate of the consequences of the programs are as follows:”

Each group had to choose between two policy options:

“Options presented to group I:

If program A is adopted, 200 people will be saved.  
If program B is adopted, there is a 1/3 probability that 600 people will be saved, and a 2/3 probability that no people will be saved.

Options presented to group II:

If program C is adopted, 400 people will die.  
If program D is adopted, there is a 1/3 probability that nobody will die, and a 2/3 probability that 600 people will die.”

The two pairs of options were stochastically equivalent; the only difference was the frame in which they were presented: in group I information was given in terms of lives saved, while in group II information was displayed in terms of lives lost.

Kahneman and Tversky found that 72% of subjects preferred option A to B, being more attracted by a sure gain of 200 out of 600 lives – without running the risk of the gamble –, while only 22% of agents preferred option C to D, rejecting the sure loss of 400 out of 600 lives – choosing, instead, to run the risk of the gamble. This phenomenon was interpreted as a reflection effect with risk-aversion for gains and risk-seeking for losses.

As already underlined, prospect theory sees decision-making as a process divided into two phases. In the first phase, agents edit prospects using some heuristics. Among the most important editing operations there is the “coding” of outcomes as gains and losses relative to a reference point. Typically, this point is considered the current endowment, but Kahneman and Tversky recognized the possibility that “the location of the reference point, and the consequent coding of outcomes as gains or losses, can be affected by the formulation of the offered prospects, and by the expectations of the decision maker”. The possibility of coding in different ways, then, can help explain results of the above example on the Asian disease.

Prospect theory numbers many other editing rules that are used to simplify prospects in order to use them in the second phase of the choice process. One of these rules is that of “combination”, which merges the probabilities associated with identical outcomes<sup>22</sup>. Another rule consists in rounding probabilities and/or outcomes. For what concerns sets of prospects, the rule of “cancellation” removes the common elements of the prospects considered<sup>23</sup>.

Starmer (2000) underlined the existence of a further rule, which he defined “dominance heuristic”, consisting in “eliminating stochastically dominated options from the choice set prior to evaluation”.

In several economic books we can detect the belief that behavioral economics was born with the development of prospect theory. Indeed, Kahneman and Tversky’s research meant for economics a sort of “Copernican revolution”, giving the first and one of the most important complete alternatives to expected utility theory. Since the publication of their most important article in 1979, the attention of many researchers – among which we can list Thaler – has been devoted to verify and give proof that this theory is actually capable of describing agents’ pattern of choice.

### 3.3. Thaler

As Loewenstein (1996) noticed, Thaler’s contribution has helped behavioral economics to be recognized and accepted among mainstream economics. Contrary to Kahneman and Tversky, he was an economist who started to be interested in psychology. Indeed, observing the way in which people took real-life decisions, Thaler identified many deviations (or, as he defined them, “anomalies”) from the standard assumptions of classical economic decision theory:

“[...] exclusive reliance on the normative theory [of consumer choice] leads economists to make systematic, predictable errors in describing or forecasting consumer choices.” (Thaler, 1980)

The author provided examples of problems for which the normative model could not predict in a proper way the choice of consumers. These anomalies included, among others, “the underweighting of opportunity costs, the failure to ignore sunk costs, the influence of considerations of regret, self-control problems” (Aigner and Loewenstein, 2006).

Following the path traced by Kahneman and Tversky, Thaler (1985) shaped a model to explain and predict consumer behavior that put together cognitive psychology and microeconomics. As Aigner and Loewenstein (2006) pointed out, the use of cognitive psychology was justified by the need for identifying in which ways people’s behavior diverges from the

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<sup>22</sup> “For example, a prospect *described* as  $(x_1, p_1; x_1, p_2; x_3, p_3; \dots)$  may be *evaluated* as the simplified prospect  $(x_1, (p_1 + p_2); x_3, p_3; \dots)$ .” (Starmer, 2000)

<sup>23</sup> “[...] a choice between prospects  $q' = (x, p; q, 1 - p)$  and  $r' = (x, p; r, 1 - p)$  may be evaluated as a choice between  $q$  and  $r$ .” (Starmer, 2000)

predictions of rational choice theory and, furthermore, to develop a theory more adequate from an empirical point of view. Confuting standard theory, according to which consumers maximize a utility function – defined on goods disposable in the economy and their respective price – subject to their budget constraint, Thaler's model is characterized by three features:

“First, the utility function [...] is replaced with the *value function* [...] from prospect theory. [...] Second, price is introduced directly into the value function using the concept of a *reference* price. [...] Third, the normative principle of *fungibility* is relaxed.” (Thaler, 1985)

This economist preferred using the value function for three reasons:

- it describes people's responsiveness to perceived changes – rather than absolute levels of wealth – with respect to a reference point, letting framing effects to influence choices
- it “captures the basic psychophysics of quantity” through the S-shape, concave for gains and convex for losses
- it gives an account of the “endowment effect”<sup>24</sup> by the fact that it is steeper in the loss domain than in the gain domain

As the author underlined, in their works Kahneman and Tversky defined the value function over unidimensional outcomes. Thaler, instead, extended the analysis to two compound outcomes – namely,  $x$  and  $y$  –, measured along the same dimension (i.e. dollars). This operation took him to investigate how to code the joint outcome, considering two options:

“The outcomes could be valued jointly as  $v(x + y)$  in which case they will be said to be *integrated*. Alternatively they may be valued separately as  $v(x) + v(y)$  in which case they are said to be *segregated*.” (Thaler, 1985)

By examining the possible combinations of outcomes (i.e. multiple gains, multiple losses, mixed gain, mixed loss), he ran an experiment to understand if agents prefer either to integrate or to segregate them. Evidence underlined that individuals tend to follow four principles: segregate gains; integrate losses; cancel (that is, integrate) losses against larger gains; segregate “silver linings” (i.e. small gains combined with large losses).

After considering how people perceive gains and losses (i.e. “static” situations), Thaler analyzed transactions (i.e. “dynamic” situations), proposing a two-stage mental accounting

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<sup>24</sup> As the author explained, “people generally will demand more to sell an item they own than they would be willing to pay to acquire the same item” (Thaler, 1980).

process. In the first phase individuals evaluate potential transactions, considering both their “acquisition utility” and “transaction utility”. While the former is the net benefit deriving from the difference between the “value equivalent”<sup>25</sup>  $p'$  of a good  $z$  and its actual price  $p$ , the latter is the value of paying  $p$  when the “reference price”<sup>26</sup> for  $z$  is  $p^*$  (this value is also defined “reference outcome”). Total utility, then, is given by the sum of acquisition and transaction utilities. The “final” value of a good  $z$  at price  $p$  with reference price  $p^*$  is given by:

$$w(z, p, p^*) = v(p', -p) + v(-p: -p^*)$$

The author underlined that reference price is determined by factors like fairness, and that transaction utility influences willingness to pay more than acquisition utility.

In the second phase of transactions, agents make their purchase decision. Thaler stated that the “purchase evaluation device”  $w(\cdot)$  refers to individual transactions, so that, according to standard optimization rules, an individual should maximize the sum  $\sum w(\cdot)$  subject to his/her budget constraint  $\sum p_i z_i \leq I$ , where  $I$  is the income. A possible solution to this maximization problem is given by:

$$\frac{w(z_i, p_i, p_i^*)}{p_i} \geq k$$

where  $k$  is a constant like the Lagrange multiplier in the classic formula. Whenever this constant is properly selected, the above inequality can be applied without problems.

As the author emphasized, his description of the second phase in transactions is consistent with real-life behavior, at least under the light of two considerations:

“First, the consumer responds to local temporal budget constraints. That is, the budget constraint that most influences behavior is the current income flow rather than the present value of lifetime wealth. [...] Second, expenditures tend to be grouped into categories. Potential expenditures are then considered within their category. [...] The tendency to group purchases by category can violate the economic principle of fungibility<sup>27</sup>.” (Thaler, 1985)

The existence of time and category distinct budget constraints suggests the idea that consumers estimate purchases when they arise, from time to time. So, the decision process could be described by the inequality:

<sup>25</sup> I.e. “[...] the amount of money which would leave the individual indifferent between receiving  $p'$  or  $z$  as a gift” (Thaler, 1985), also defined in literature as “reservation price”.

<sup>26</sup> That is, “[...] an expected or “just” price for  $z$ .” (Thaler, 1985)

<sup>27</sup> This principle “implies that any unit of money is substitutable for another and that the composition of income is irrelevant for consumption” (Abeler and Marklein, 2008).

$$\frac{w(z, p, p^*)}{p} > k_{it}$$

where  $k_{it}$  is the budget constraint for category  $i$  at time  $t$ .

Thaler stressed on the fact that the budgeting process discussed so far would be irrelevant if we were considering global optimization, which would impose all  $k_{it}$ 's to be equal. Nevertheless, evidence showed that agents do not act as if all  $k_{it}$ 's were equal:

“Unusually high category specific  $k$ 's are most likely to be observed for goods that are particularly seductive or addictive. Unusually low  $k$ 's are observed for goods viewed to be particularly desirable in the long run such as exercise or education.” (Thaler, 1985)

Finally, Thaler used his theory to analyze the effects that the new model showed to imply for economic decisions, in particular marketing. The implications he detected were used both to explain various empirical puzzles (like why some markets fail to clear) and to suggest sellers how to behave (developing, for example, a theory on gift giving).

As already underlined, beside the development of interesting models and theories, the contribution of Thaler has been very important to widespread the knowledge and use of behavioral economics and prospect theory by economists and other social scientists interested in the subject.

#### 4. Latest directions

Behavioral economics has expanded enormously since it has emerged as an independent sub-discipline. As Agner and Loewenstein (2006) underlined, in the latest contributions it is possible to detect the attempt to loose the tight between behavioral economics and behavioral decision research and, at the same time, to import more insights from other fields of psychology.

In the following section, I will focus the attention on some interesting developments: neuroeconomics; the study of affection in economic behavior; the emergence of light paternalism.

##### 4.1. Neuroeconomics

As the word suggests, neuroeconomics is a new interdisciplinary field that combines neuroscience and economics. In particular, it uses the tools developed by neuroscientists to study “the neural underpinnings of economic behavior” (Agner and Loewenstein, 2006) and explain human decision-making. The studies conducted by neuroeconomists, in fact, involve the use of brain scanners while subjects are engaged in behavioral economics tasks, like decision-making under risk and/or uncertainty, as well as problems of intertemporal choice.

Beside the use of peculiar instruments and methods, neuroeconomics tries to refine the existing models of behavioral economics, providing them with new insights. In Agner and Loewenstein’s (2006) opinion, the most relevant is that economic behavior is the result of the “interaction [...] between different specialized neural systems”. Such an intuition has been suggested by various authors. For instance, Thaler and Shefrin (1981) considered the issue of self-control, developing a theory of individual intertemporal choice in which the agent is seen like an organization:

“The individual at a point in time is assumed to be both a farsighted *planner* and a myopic *doer*. The resulting conflict is seen to be fundamentally similar to the agency conflict between the owners and managers of a firm.” (Thaler and Shefrin, 1981)

In order to mitigate the conflict between doer’s short-run and planner’s long-run preferences, the latter can use two techniques: incentives and rules. For what concerns incentives, the authors detected three ways in which they can be altered:

“First, the doer’s preferences can be modified directly. Some individuals consider saving a good in and of itself. [...] Second, inputs to a saving or dieting program can be explicitly monitored via weekly budgets or calorie counting [...]. Third, incentives can be explicitly altered: alcoholics take the drug Antabuse which makes them ill if they take a drink [...].” (Thaler and Shefrin, 1981)

Considering rules, they should be used when the costs of monitoring and persuading the doer are high. The extreme case allows for the adoption of a “strategy of precommitment”, that consists in completely eliminating doer’s freedom of choice. Alternatively, discretion can be eliminated only over specific *classes* of decisions, those “for which the conflict is particularly acute”. Otherwise, the planner can limit the *range* of doer’s discretion through some rules of thumb, like the “debt ethic” – consisting in a ban on borrowing.

Also Benhabib and Bisin (2002) considered the issue of self-control, seeing it as a tool to resolve their model on “consumption/saving decision in an environment in which agents face a conflict between present and future utility”. Like Thaler and Shefrin, these researchers underlined the existence of two different types of cognitive processes in individuals’ decision-making path. On one side, the “automatic process would induce the agent towards ‘impulsive’, ‘uncontrolled’ actions”. On the other side, the “controlled process would induce the agent to implement a set of goals, determined independently of impulses or temptations associated with the specific choice problem.” By examining the future expected reward – be it positive or negative – of his/her actions, the individual will choose the processing method to follow. In this decision, self-control – which can inhibit the temptation of exclusively following automatic processes – plays a prominent role.

The ambiguous nature of decision-makers’ behavior was detected by Bernheim and Rangel (2004), too. Analyzing the problem of addiction – to drugs, alcohol, gambling, etc. –, these authors proposed a model of intertemporal decision-making in which the individual can act either in a “cold” or in a “hot” mode. When the agent enters the hot mode, “he always consumes the substance irrespective of underlying preferences” (like the willingness to quit), choosing to feel good in the short-run, but not considering the long-run bad consequences of his/her behavior. When operating in the cold mode, instead, the individual “considers all alternatives and contemplates all consequences, including the effects of current choices on the likelihood of entering the hot mode in the future”. The choice of acting in either one mode or the other depends both on actual environmental conditions and on past decisions<sup>28</sup>.

Looking closer at its *modus operandi*, it is possible to see that neuroeconomics faces standard decision theory using either an “incremental” or a “radical” approach. For what concerns the former, its process can be divided into four steps:

“First, identify normative assumptions or models that are ubiquitously used by economists, such as Bayesian updating, expected utility and discounted utility. Second, identify anomalies – i.e., demonstrate clear violations of the assumption or model, and painstakingly rule out alternative explanations (such as subjects’ confusion or transaction costs). And third, use the anomalies as inspiration to create alternative theories that generalize existing models. A fourth step is to

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<sup>28</sup> As the authors put it: “Behavior corresponds to the solution of a dynamic programming problem with stochastic state-dependent mistakes”.

construct economic models of behavior using the behavioral assumptions from the third step, derive fresh implications, and test them.” (Agnor and Loewenstein, 2006)

The models described previously are examples of such incremental procedure.

On the contrary, the radical approach tries “to improve the predictive power and explanatory adequacy of current theory by starting from scratch” (Agnor and Loewenstein, 2006). Even though this method finds more clarifying examples in other sub-fields of behavioral economics, there is common belief among experts that it will characterize future research advances in neuroeconomics.

#### 4.2. Affection and other emotions

Even if behavioral economics usually focuses on cognition, some efforts started to be made in order to analyze the role of affection in making judgements and taking choices – a subject more frequently faced by other disciplines, like psychology and neuroscience.

Recent research has showed that some distortions of the decision-making process – causing suboptimality – can be better explained by affective reasons, rather than cognitive ones. For example, Rottenstreich and Hsee (2001) proposed an “affective rather than psychophysical deconstruction” of prospect theory’s weighting function, following two assumptions. The first is that preferences are subordinated to affective reactions to the potential outcome of a risky choice. The second assumption is that there can be a distinction between relatively affect-rich and affect-poor outcomes. Through experimental proofs, then, the two authors came to the conclusion that:

“Weighting functions will be more S-shaped for lotteries involving affect-rich than affect-poor outcomes. That is, people will be more sensitive to departures from impossibility and certainty but less sensitive to intermediate probability variations for affect-rich outcomes. [...] An affect-poor prize was preferred over an affect-rich prize under certainty, but the direction of preference reversed under low probability. [...] the assumption of probability-outcome independence, adopted by both expected-utility and prospect theory, may hold across outcomes of different monetary values, but not on different affective values.” (Rottenstreich and Hsee, 2001)

Another example of suboptimality due to affective causes has been provided by Bracha and Brown (2010) to explain the demand for insurance “in a word with a bad state and a good state”, in which markets probability perceptions are endogenous. By means of their “affective decision making” (ADM) model, these economists interpreted the evidence suggesting that agents are optimistically biased<sup>29</sup>. In this model, where decision weights – labeled as “affective” or “perceived”

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<sup>29</sup> “Optimism bias is defined as the tendency to overestimate the likelihood of favorable future outcomes and to underestimate the likelihood of unfavorable future outcomes.” (Bracha and Brown, 2010)

risk – are endogenized, two cognitive processes are detected: the “rational” and the “emotional”. While the former determines a particular action, the latter frames the agent’s perceptions of risk regarding that action, following the optimism bias. In a more formal way:

“[...] the rational process coincides with the expected utility model, where for a given risk perception (affective probability distribution), the rational process chooses an action to maximize expected utility. The emotional process forms risk perception by selecting an optimal risk perception that balances two contradictory impulses: (1) affective motivation and (2) a taste for accuracy. [...] Affective motivation is the desire to hold a favorable personal risk perception – optimism – [...]. The desire for accuracy is modeled as a mental cost incurred by the agent for holding beliefs in lieu of her base-rate probabilities given her desire for favorable risk beliefs. The base-rate probabilities are the beliefs that minimize the mental cost function of the emotional process, i.e., the risk perception that is the easiest and least costly to justify [...]” (Bracha and Brown, 2010)

Within the same individual, rational and emotional processes interact as in a simultaneous-move strategic game. The final result, defined as “consistent decision” (i.e. the observed choice), is a pure Nash equilibrium strategy.

Beside the particular interest in affection, increasing attention has been given to all emotions and their role in explaining and predicting economic behavior. Rick and Loewenstein (2007) provided a review of previous research on this topic<sup>30</sup>. As they underlined, we can distinguish between “expected” and “immediate” emotions:

“Expected emotions are those that are anticipated to occur as a result of the outcomes associated with different possible courses of action. [...] they are experienced when the outcomes of a decision materialize, but not at the moment of choice; at the moment of choice they are only cognitions about future emotions.

Immediate emotions, by contrast, are experienced at the moment of choice and fall into one of two categories. 'Integral' emotions, like expected emotions, arise from thinking about the future consequences of one's decision, but [...], unlike expected emotions, are experienced at the moment of choice. [...] 'Incidental' emotions are also experienced at the moment of choice, but arise from dispositional or situational sources objectively unrelated to the task at hand [...].” (Rick and Loewenstein, 2007)

Great part of behavioral economists’ contributions in this field can be detected in the attempt – and success – of combining all these types of emotions with the “consequentialist” nature<sup>31</sup> of standard

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<sup>30</sup> Notably, among the various contributions, many come from Loewenstein himself.

<sup>31</sup> According to this definition, “[...] decision makers choose between alternative courses of action by assessing the desirability and likelihood of their consequences and integrating this information through some type of expectation-based

economic models (see fig.3). Examples of such effort include studies on decision-making under risk, intertemporal choice and social preferences. Rick and Loewenstein illustrated that the introduction of emotions entails innovations like “relaxing the assumption that utility is strictly defined over realized outcomes” and “incorporating affective forecasting errors”.

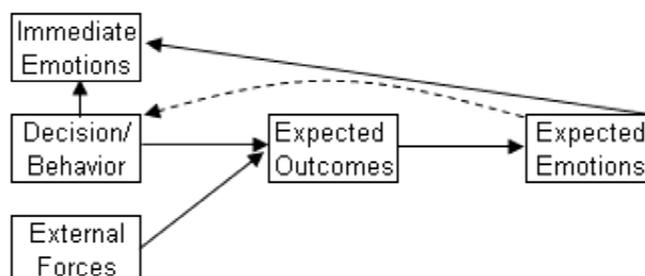


Figure 3 – Consequentialist model of decision-making

#### 4.3. Light paternalism

Since the times of Smith and his *The Wealth of Nations* (1776) – if not even before – there have always been a debate between those economists that promoted the *laissez-faire* policy and those who claimed that government has to intervene into the economic system. The former, defined as “liberalistic”, believed that market possesses all the mechanisms to assure the common good: once the government guarantees perfect competition, the “invisible hand” of the market will adjust every variable to allocate resources in the best way. As a consequence, there will be stable prices, no unemployment and maximum welfare. The latter, defined as “paternalistic”, recognized that there are some inefficiencies that make perfect competition fail<sup>32</sup>. Furthermore, whenever perfect competition can be achieved, there is no guarantee that the distribution of wealth among individuals is fair. So, public intervention is needed to better allocate resources and distribute welfare in a more equitable way.

While the exponents of liberalism were only concerned about the existence and perpetuation of Pareto efficiency in an economic system, the supporters of paternalism argued that respecting this criterion was not sufficient to provide every individual a fair level of well-being. Interestingly, these opposite points of view can be reconciled through the two theorems of welfare economics. The first theorem claims that the allocation of commodities at a competitive equilibrium is Pareto efficient. As classical economists asserted, whenever markets are perfectly competitive, they will lead to efficiency. The second theorem states that, with convex preferences, any Pareto efficient allocation can be made a competitive equilibrium. This statement expresses the idea that

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calculus” (Rick and Loewenstein, 2007). Usually, the desirability of an outcome is expressed by the concept of “utility”, which needs to be maximized.

<sup>32</sup> Among them, we can list the presence of: public goods (characterized by non-excludability and non-rivalry in consumption); positive and negative externalities; natural monopolies; differences in the level of information among agents.

there are situations in which perfect competition is satisfied, but the distribution of welfare is not the most desirable for everyone, so that government intervention is justified. In particular, the theorem detects “lump-sum transfers”<sup>33</sup> among consumers as being the ideal instrument to redistribute income and – as a consequence – welfare in a more equitable way.

According to New’s (1999) interpretation, an action can be defined paternalistic if it satisfies three conditions:

- there must be interference with the decision-making autonomy of a person by another person or the state
- the interference must have the purpose of increasing the well-being of the person receiving the action
- the interference must be implemented without the past, present or immediately subsequent consensus of the person interested by the action

Following this general definition, there can be different interpretations of paternalism. If the interference with a person’s decision-making autonomy is imposed through coercion – by the law or another individual – then we can talk about “authoritarian paternalism”. This form of paternalism is justified by the need of protecting individuals from their limited rationality, as it happens with the obligation to fasten safety belts.

There is “libertarian paternalism” when the act produces an interference on the subject’s decision-making process without coercion. An example of this type of paternalism has been provided by Sunstein and Thaler (2008): Carolyn is the director of food services for a large city school system who discovered that – without changing the menu in cafeterias – varying the order in which dishes are displayed on the lunch counter influences children’s choices. In this way, she can introduce better dietary habits with less efforts and higher success.

A third form of paternalism is called “Ulysses’ paternalism”, in which a person asks for his/her freedom of choice to be temporarily limited, with the aim of pursuing better his/her own goals and well-being. This is the case of situations in which the subject can denounce himself of being “gambling addicted”.

Finally, also donations can be considered paternalistic acts, since their goal is to improve the welfare of the beneficiary. The “food stamps” distributed by the federal government in the U.S.A. are a typical example of donation. They are vouchers that let poorer families to buy food and basic-need products.

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<sup>33</sup> “A transfer is defined lump sum if no change in a consumer’s behavior can affect the size of the transfer. For example, a consumer choosing to work less hard or reducing the consumption of a commodity must not be able to affect the size of the transfer.” (Hindriks and Myles, 2006)

For what concerns behavioral economics, in recent works it is possible to detect a higher interest on the analysis of people's decision-making process. In fact, researchers seem to be in favor of the libertarian paternalism, promoting operations that help people make better choices – in their own interest –, leaving them autonomy and freedom of choice at the same time.

Thaler and Sustein (2003) provided the following definition of paternalism:

“In our understanding, a policy counts as “paternalistic” if it is selected with the goal of influencing the choices of affected parties in a way that will make those parties better off. We intend “better off” to be measured as objectively as possible, and we clearly do not always equate revealed preferences with welfare. That is, we emphasize the possibility that in some cases individuals make inferior choices that they would change if they had complete information, unlimited cognitive abilities, and no lack of willpower.” (Thaler and Sustein, 2003)

Various authors considered issues like how to choose among paternalistic options, and how to evaluate the goodness of a policy that aims to make people better off. Among the contributors that tried to answer these questions, we can list Kahneman (1999), who proposed the use of the so-called “objective happiness” (i.e. the time-integral of monetary happiness) as welfare criterion, and O'Donoghue and Rabin (2003), who – through a model of “sin taxes” on unhealthy items<sup>34</sup> – asserted that policy-makers should find the optimal level of paternalism, keeping in mind that “some agents might be bounded rational”.

Other researchers used a more specific approach, like Loewenstein, Brennan and Volpp (2007), who considered the importance of light paternalism in improving individuals' health behavior. In particular, they analyzed the reasons why agents “engage in self-harming behaviors that contribute to poor health outcomes”. Among them, there are status quo biases<sup>35</sup> and present-biased preferences, according to which “individuals place disproportionate weight on present relative to future costs and benefits”. The presence of these phenomena can justify why simply informing patients of the bad consequences of unhealthy behaviors is not sufficient. To overcome such problem, the authors suggested to use asymmetric paternalistic techniques that “exploit the same biases that ordinarily contribute to self-harmful behavior instead to promote healthy behavior”.

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<sup>34</sup> Like cigarettes and alcoholics.

<sup>35</sup> For a more detailed explanation, see chap. 2.

## 5. Continuation or break with the past?

As the development of the discipline suggests, it can be deduced that behavioral economics represents both a new paradigm breaking with mainstream theories and a helpful tool to make advancements in neoclassical economics. Indeed, the great intuition of combining economics with psychology has an ambivalent implication.

For what concerns the support given to traditional theories, behavioral economics considers the individual as the starting point of its analysis. Like neoclassical economics, this discipline suggests that, in order to advance models on economic and social outcomes, it is necessary to start from a methodological paradigm based on individualism. Through this point of view, then, behavioral economics becomes an advanced step in the development of mainstream theorization. In particular, it improves the approach towards utility maximization, equilibrium and efficiency through a better description of the agent, based on psychological foundations.

Considering, instead, the revolutionary aspect of this field of study, the recognition that psychological phenomena have an impact on agents' choices and motivations has important consequences in the creation of models and theories. In fact, while early and postwar neoclassical economics focus on the formulation of rules – which become axioms – that the individual has to follow in order to be rational and always make the best decision possible, behavioral economics tries to give agents some general guidelines to use when making their decisions. These advices take into account psychological, emotional and cognitive biases, as well as other effects, that have an influence on behavior. In sum, mainstream theories appear to build a pretty rigid structure in which the agent needs to fit in, while behavioral economic theories attempt to shape such structure in function of subject's limits.

The innovative power of behavioral economics can be seen in empirical research<sup>36</sup>, characterized by a series of methods that draw on some typical procedures of experimentation in psychology. Once again, the difference with traditional theories is emphasized. On one side, experimental economics – typical of neoclassical research – is made of a series of procedures that need to be followed in order to guarantee “acceptable” results. On the other side, instead, the various methodologies followed by behavioral economists are less concerned about the conformity with some predetermined rules, being more attracted by the comprehension of decision-makers through a step-by-step process that describes their choice path.

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<sup>36</sup> A detailed description of empirical studies is provided in chap. 2.

## Chapter 2

### Insights from behavioral economic research

As chapter 1 suggests, behavioral economics represents one of the most important alternatives to neoclassical economics. In particular, prospect theory managed to challenge expected utility theory in a successful way.

While there is no doubt about the importance of theories and models developed by behavioral economists, still some natural questions can raise: is behavioral economics actually useful to describe real economies? Can it be applied to give effective advices to individuals, firms and public authorities?

To answer these questions, it seems appropriate to analyze, in the first place, the various developments in empirical research that have characterized behavioral economics in its process of rise and maturation. Using a narrow point of view, we can consider that behavioral economics was officially born with Kahneman and Tversky's formulation of prospect theory in 1979. Although its recent genesis – barely 33 years –, this discipline has influenced a wide range of sub-topics in many branches of mainstream economics. Indeed, authors like Kao and Velupillai (2011) distinguished different fields inside the subject, like behavioral micro, behavioral macro, behavioral finance and behavioral game theory.

Beside this great variety of sub-topics, behavioral economics is also characterized by an interdisciplinary approach towards the generation of evidence supporting its hypothesis<sup>37</sup>. The exponents of the discipline, in fact, have always used a variety of methods to generate such evidence.

In the following chapter, I will describe the different methods followed by researchers within the subject. Subsequently, I will present the various branches of modern behavioral economics, first depicting their content, and then listing the most relevant results deriving from research. In addition, I will give an account of other interesting phenomena that proved to be consistent with the assumptions of prospect theory. Finally, I will consider the issue of the relevance of behavioral economics for real economies.

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<sup>37</sup> A characteristic deriving from cognitive science, as Gardner (1985) underlined.

## 1. Methods of behavioral economics

Agner and Loewenstein (2006) underlined that behavioral economists' use of a variety of methods makes them different from experimental economists. While the latter "define themselves on the basis of their endorsement and use of experimentation as a research tool", the former define themselves "rather [on] their application of psychological insights to economics".

Experimental economists have always put a lot of effort in developing new experimental methods that were suitable for addressing economic issues. The result is a series of methodologies that have to follow precise rules, otherwise the experiment cannot be considered valid.

By contrast, behavioral economists tended to be less concerned about following a strict methodological path. Nonetheless, with the development of the discipline in time, this issue began to be more relevant also for such researchers. The result is a series of increasingly diversified and sophisticated methods that reflect the interdisciplinary nature of the subject.

The following section provides a description of the four main methodologies used by behavioral economists, whose findings will be illustrated in the subsequent paragraphs.

### 1.1. Hypothetical choices

In the earliest experiments of behavioral economics, subjects were asked to imagine hypothetical situations and decide what they would do in those situations. In some cases the hypothetical choice had to be elected among a series of alternatives given by the experimenter, in some others subjects could express their choice freely. An example of this type of methodology is provided by questionnaire-based inquiries.

When using hypothetical choices as means to collect data, the basic – and pretty strong – assumption is that agents have an approximately reasonable idea of how they would choose under the fictitious conditions proposed by the experimenter in case that they were real.

This kind of experiments derive from Thaler's papers on mental accounting<sup>38</sup>, even if in his studies the author never presented empirical data at all. In fact, Thaler used to base the evidence of his works on "thought experiments", which consisted in "hypothetical cases of economic patterns of behavior that were inconsistent with standard economic theory and which were intended to have face plausibility to the reader" (Agner and Loewenstein, 2006).

Even though his examples were not based on real data, the contribution of Thaler proved to be valid. Indeed – as it will be described forth – many following researches supported the intuitions of this economist through effective experiments.

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<sup>38</sup> For a more detailed explanation of mental accounting theory, see chap. 1.

The use of hypothetical choice studies has been criticized by experimental economists, who claimed that subjects in this kind of experiments did not have incentives to provide sincere and accurately meditated answers, and that some of the anomalous results found could be artefacts. Furthermore, some doubts can raise considering the way in which a hypothetical choice inquiry is presented to subjects. That is, if we submit to the same sample two hypothetical choice questionnaires that express the same idea but differ in the way they present it (for instance, one underlying a particular aspect and the other one not), the final answers of respondents could be completely different.

## 1.2. Experiments with real outcomes

The critiques on hypothetical choices studies pushed behavioral economists to test their results with actual outcome experiments. In particular, tests were conducted using real exchanges of goods (even simple ones, like mugs, chocolate bars, key-rings or folding binoculars) and final rewards for participants (i.e. the object used to conduct the experiment or money recompenses).

This methodology has been followed in particular to test the endowment effect, which seems to be instant (as soon as the object is given to the person, his/her valuation of it increases substantially) and persistent in time (the more the agent is in possession with the object, the more it becomes valuable to him/her). Moreover, it creates an asymmetry in valuations: those people that have been endowed with an item tend to overestimate its value, while those who were not endowed with it tend to underestimate its value.

Evidence searching by means of real outcomes tests did not completely overcome the hypothetical choice method. Indeed, behavioral economists have always considered whether and when it was more appropriate to use one approach or the other. Furthermore, very often they have been used together in the same study, as one the natural advance (or development) of the other.

By applying both hypothetical choices tests and real outcome experiments, researchers could also confront the results related to each approach. As a matter of fact, some studies found substantial differences between hypothetical and real outcomes: sometimes the imaginary price or value given to an item tended to be higher than the real one<sup>39</sup>, some others it was right the opposite.

Focusing on the experiments with actual outcomes, some researchers found that agents' behavior could drastically change as a consequence of the amount of stakes involved in the trial. In a centipede game, for example, when the monetary reward was small players were inclined to be cooperative, while when the reward was high they tended to become more self-interested – converging the game to a Nash equilibrium situation (see Parco, Rapoport and Stein, 2002).

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<sup>39</sup> “[...] as if it is easier to part with an imaginary dollar than with a real one.” (Aigner and Loewenstein, 2006)

### 1.3. Field research

More recently, behavioral economists have focused the attention on field data. This methodology resulted to be very useful in studies involving particular categories of the population, like teachers, cabdrivers, bike messengers, condominium tenants, investors of a given company and others.

The choice of making research “in the field” derived from researchers’ concerns about the external validity of laboratory experiments, be they hypothetical or real. As always happens, the laboratory context is unavoidably different from real-world decision scenarios – for the context, the information available and the content of the outcomes –, so it is not wrong to suppose that people might make different decisions in the laboratory than in the real world. Nevertheless, in some cases the environment in which the experiment took place did not influence the result (e.g. questions regarding how people behave in Internet auctions), but for others laboratory tests were not trustworthy (e.g. how much to save, how to invest money, how long or hard to work on a day).

Agner and Loewenstein (2006) divided behavioral economics field studies into different categories. The simplest ones are “observational” studies, in which “investigators attempt to draw inferences from observations of naturally occurring behavior, whether at the individual or market level”. The weakness of these inquiries is their low internal validity: even if empirical observations show correlation among the phenomena considered, causal conclusions may not be directly derived from them.

To overcome this problem, some researchers looked for natural experiments, that is “situations in which it is possible to observe the impact of quasi-exogenous change in events” (Agner and Loewenstein, 2006), or conducted real field experiments. The peculiarity of natural investigations is that participants are not randomly assigned to one “treatment” or another; rather, by comparing agents’ behavior before and after a given change, it is possible to measure the effect of this change with some degree of confidence.

The further step forward is represented by randomized field experiments, which are increasingly being used by behavioral economists nowadays. Clearly, they have both external validity, due to their resemblance to real-life decision situations, and internal validity, since it is possible to derive more general causal conclusions by randomly assigning to participants the different “roles” (e.g. distinction between test and control groups).

### 1.4. Process measures

Inspired by research in psychology, behavioral economists used also the so-called “process measures”, consisting in “methods that provide hints about the cognitive and emotional processes underlying decision making” (Agner and Loewenstein, 2006).

This approach presents some limitations. For example, as Nisbett and DeCamp Wilson (1977) noticed, people not always can explain by words why they behaved in a certain way:

“[...] when people attempt to report on their cognitive processes, that is, on the processes mediating the effects of a stimulus on a response, they do not do so on the basis of any true introspection. Instead, their reports are based on a priori, implicit causal theories, or judgements about the extent to which a particular stimulus is a plausible cause of a given response.” (Nisbett and DeCamp Wilson, 1977)

Notwithstanding, process measures have been adopted in behavioral game theory, through computerized “process trading” software to evaluate what information the players of a game use to make their decisions.

Another field in which this type of experiment has been adopted is neuroeconomics. Through brain scans, like functional magnetic resonance imaging (fMRI), researchers can investigate which parts of an agent’s brain are activated in response to a task or decision (e.g. intertemporal choice problems, decision making under risk and uncertainty, strategic behavior in games).

## 2. Empirical studies in behavioral economics

Once described the various methods followed by researchers to test their theories and models, we can examine in detail the contents of the many investigations characterizing the discipline and their results.

To give an exhaustive overview of the empirical applications, I will follow Kao and Velupillai's (2011) classification of behavioral economics in sub-topics. Furthermore, I will describe other studies that particularly prove the findings of prospect theory.

### 2.1. Behavioral microeconomics

Behavioral microeconomics, as already underlined (see chap. 1), looks at the anomalies concerning preferences and utility in decision-making, challenging the neoclassical assumption that the values of goods or outcomes can be valued directly by agents. This cannot always be possible due to the presence of framing effects and reference point dependence. Furthermore, the combination of these effects with others, like status quo, loss aversion and ambiguity aversion<sup>40</sup> can generate new phenomena, like the endowment effect.

The research in the field gave proof that these phenomena make sense with real data. For example, Hardie, Johnson and Fader (1993) used a model of brand choice to demonstrate that "consumer choice is influenced by the position of brands relative to multiattribute reference points" and that "loss aversion can account for asymmetric responses to changes in product characteristics".

Genesove and Mayer (2001) proved that loss aversion can explain sellers' behavior in the housing market:

"When house prices fall after a boom, [...] many units have a market value below what the current owner paid for them. Owners who are averse to losses will have an incentive to attenuate that loss by deciding upon a reservation price that exceeds the level they would set in the absence of a loss, and so set a higher asking price, spend a longer time on the market and receive a higher transaction price upon sale." (Genesove and Mayer, 2001)

Camerer, Babcock, Loewenstein and Thaler (1997) confuted the classical model of intertemporal substitution between work and leisure, according to which agents work more when wages are high and consume more leisure when wages are low, through a daily income targeting

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<sup>40</sup> "[...] ambiguity aversion (also known as uncertainty aversion) describes an attitude of preference for known risks over unknown risks. People would rather choose an option with fewer unknown elements than with many unknown elements. [...] There are a number of choices involving uncertainty and normally they can be classified in two categories: risky and ambiguous events. Risky events have a certain probability for a given outcome. Ambiguous events have a much greater degree of uncertainty. This includes the uncertainty of outcome and also the probability of an event occurring or the payoff associated with such events." (Wikipedia, 2011)

model. They took evidence from New York City cab drivers' tendency to work more hours in bad days, when the wage per hour is low, and to quit early in good days, when the wage per hour is higher. The authors explained this negative wage elasticity through loss aversion and "narrow bracketing"<sup>41</sup> both combined with the one-day horizon of cab drivers, which precludes the ability to intertemporally substitute days of high wage with days of low wage – an aptitude that could make wage elasticities positive.

Part of behavioral microeconomics is devoted to the analysis of the heuristics that help decision makers to find the short cuts for relevant information. Once a given criteria is achieved – be it endogenous or exogenous –, the agent is supposed to stop searching. This implies that it does not matter whether or not the pursue taking to the final decision has followed a rational path to the best option possible. For instance, there is a class of processes that appears to influence people's perception of probabilities. Among them we can name the "representativeness heuristic", according to which:

"[...] the subjective probability of an event, or a sample, is determined by the degree to which it: (i) is similar in essential characteristics to its parent population; and (ii) reflects the salient features of the process by which it is generated." (Kahneman and Tversky, 1972)

Kahneman and Tversky (1973) – who first recognized this type of heuristic – provided a number of empirical examples "demonstrating predictable and systematic errors in the evaluation of uncertain events". In particular, they showed that agents "assign probabilities to events so that the more representative events are assigned higher probabilities, and equally representative events are assigned equal probabilities".

Another phenomena that has an impact on subjective probabilities is the so-called "availability heuristic", which expresses the idea that the easier an event (or an attribute) comes to mind – through mechanisms like retrieval, construction or association –, the higher is the probability that it will happen (or it will appear to be so) in reality:

"For example, one may assess the divorce rate in a given community by recalling divorces among one's acquaintances; one may evaluate the probability that a politician will lose an election by considering various ways in which he may lose support; and one may estimate the probability that a violent person will "see" beasts of prey in a Rorschach card by assessing the strength of association between violence and beasts of prey." (Kahneman and Tversky, 1973)

Kahneman and Tversky (1973) – once again, the first who detected such heuristic – ran a series of experimental studies, consisting in mathematical and logical questions whose answers had

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<sup>41</sup> "[...] a decisionmaker who faces multiple decisions tends to choose an option in each case without full regard to the other decision and circumstances that she faces." (Rabin and Weizsäcker, 2009)

probabilistic nature. They found that there was a significant difference between the median judgments (i.e. the values provided by their samples) and the correct values for each question. Such result was a clear demonstration that the availability heuristic affects individuals' perception of the probabilities associated to given outcomes.

There are other heuristics that, instead of affecting the probabilities attached to outcomes, have an impact on individuals' final preferences. Among them, we can list the "status quo bias", which is the propensity of agents to maintain their actual condition or situation, described by Samuelson and Zeckhauser (1988). These authors identified three main categories that can explain status quo bias:

"The effect may be seen as the consequence of (1) rational decision making in the presence of transition costs and/or uncertainty; (2) cognitive misperceptions; and (3) psychological commitment stemming from misperceived sunk costs, regret avoidance, or a drive for consistency." Samuelson and Zeckhauser (1988)

In addition, Samuelson and Zeckhauser listed a series of applications in which the phenomenon can be detected, like periodic or recurring decisions (insurance payments, contributions to savings accounts, fund-raising activities), theory and practice of search (in models of technological innovation and consumer's consumption decisions under uncertainty), soft selling (trial purchase without obligation, free baby picture offer, order takers' deposit from customers, pricing of multiple telephone and cable television service options, S&H green stamp and frequent flyer programs), sticky prices (for wages), exit barriers, market competition (brand loyalty, pioneering brands advantage), public policy (lack of performance evaluations, negotiated agreements, compensations for bearing negative externalities), scientific advancements (changes in methodologies and/or theories).

There may be also cases in which status quo is not affecting agents' decisions, but rather a propensity for "default choices", whichever they may be. For example, Johnson, Hershey, Meszaros, and Kunreuther (1993) observed this behavior in the field of insurance purchasing. The states of Pennsylvania and New Jersey offered cheaper automobile insurance that limited the right of the insured person to sue for damages from accidents. Both states adopted similar forms of limited insurance, but with different default options. Insurance companies made fill in a form to their customers, asking whether they wanted the cheaper limited-rights insurance or the unlimited-rights insurance. While one state chose the limited-rights insurance as the default (i.e. the person would get that if he/she did not respond), the other chose the unlimited-rights one. In the end, the percentage of people choosing the limited-rights insurance was higher in the state in which that was the default.

With a two-stage experiment – involving 45 students of the Massachusetts Institute of Technology –, Ariely, Bracha and L'Huilier (2010) tested if looking at other people's pricing

decisions can be considered a type of heuristic; indeed, they found that this is the case. Such a result can give some hints on how values and prices are set in actual markets:

“If the valuations of others affect an individual’s valuation this can lead to rigidities (of price or quantities), and seemingly create a common value even in the absence of one, as in the case of fashion trends. This adds an aspect to firm-consumer interactions and gives an additional explanation as for why firms hire experts or public-opinion shapers. Beyond the role of information, firms may hire experts or public-opinion shapers to *generate* consumers’ value and, in turn, economic rents.” (Ariely, Bracha and L’Huillier, 2010)

Different authors analyzed the so-called “affect heuristic”, recognizing that affect plays an important role in human judgement and decision making. As Slovic, Finucane, Peters and MacGregor (2002) specified:

“[...] “affect” means the specific quality of “goodness” or “badness” (i) experienced as a feeling state (with or without consciousness) and (ii) demarcating a positive or negative quality of a stimulus. Affective responses occur rapidly and automatically – note how quickly you sense the feelings associated with the stimulus word “treasure” or the word “hate”. [...] that reliance on such feelings can be characterized as “the affect heuristic”.” (Slovic, Finucane, Peters and MacGregor, 2002)

Among the contributions that support the relevance of this phenomenon we can mention the various studies by Zajonc (1968 and 1980) on “mere exposure effect”, which is “the observation that repeated, unreinforced exposure is sufficient to enhance attitude toward a stimulus” (Bornstein and D’Agostino, 1992).

Another phenomenon that can be considered as a heuristic is the “home country bias”, studied by Grinblatt and Keloharju (2000). The authors analyzed the share-ownership records and all trades of 97 publicly-traded Finnish companies over a period of about two years, noticing that:

“[...] investors are more likely to hold, buy, and sell the stocks of Finnish firms that are located close to the investor, that communicate in the investor’s native tongue, and that have chief executives of the same cultural background.” (Grinblatt and Keloharju, 2000)

This behavior has been explained by investors’ ambiguity aversion, which pushes them to “overinvest in the country they are most familiar with – their own” (Camerer and Loewenstein, 2003).

Ambiguity aversion has also been detected by Asch, Patton and Hershey (1990), whose study underlined that uncertainty-averse individuals value information even if it does not change the decision they are going to make after becoming better-informed. This tendency is due to

agents' idea that their non-additive decision will be closer to being additive, making them "feeling better" about what they elect. Some concrete situations in which researchers detected this effect are people's demand for information about medicine or personal finance, "where new information usually does not change choices, but relieves anxiety people have from knowing there is something they could know but do not" (Camerer and Loewenstein, 2003).

## 2.2. Behavioral macroeconomics

Psychological and social tools are also used to explain some macroeconomic phenomena, like money illusion. Shafir, Diamond and Tversky (1997) presented a series of survey questions to undergraduate students at Princeton University, people in Newark International Airport and New Jersey shopping malls to evaluate their reactions to variations in inflation and prices. They concluded that people think about economic transactions both in nominal and in real terms, even if money illusion, which comes from the interaction between these two representations, "results in a bias toward a nominal evaluation".

Also Fehr and Tyran's (2001 and 2004) experiments, involving pricing games – with strategic complementarity and a unique equilibrium – among human and computerized opponents, gave evidence of the distinction between nominal and real term representations. Furthermore, they noticed that the so-called "nominal inertia" is substantial and long lasting after a negative shock, while it is rather small after a positive shock.

Among the sub-fields of behavioral macroeconomics, research on labor market gave interesting results. For example, in a survey on Swedish manufacturing firms, Agell and Lundborg (1995) explained involuntary unemployment through a gift-exchange model that considers fairness (i.e. treat and/or being treated in a fair way) as a key element to explain companies as well as workers' behavior.

Kuroda and Yamamoto (2007) compared 19<sup>th</sup> and 20<sup>th</sup> centuries time-series data on the inflation rate and the rate of nominal wage change in Japan, the United States and the United Kingdom, finding that nominal wages tend to become downwardly rigid in time, even if the extent of the phenomenon changes from country to country. The authors explained that this result is due to workers and employees' loss aversion, endowment and framing effect.

A classical notion that behavioral macroeconomists challenged is the one of "discounted utility"<sup>42</sup>. Once proved that its shape was not exponential, more complex models were provided to explain the phenomenon of time discounting in intertemporal choice problems. Many authors proposed hyperbolic discounted utility models:

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<sup>42</sup> For a general discussion, see Jamison and Jamison (2010)

“Hyperbolic time discounting implies that people will make relatively far-sighted decisions when planning in advance – when all costs and benefits will occur in the future – but will make relatively short-sighted decisions when some costs or benefits are immediate. The systematic changes in decisions produced by hyperbolic time discounting create a time-inconsistency in intertemporal choice not present in the exponential model. An agent who discounts utilities exponentially would, if faced with the same choice and the same information, make the same decision prospectively as he would when the time for a decision actually arrives. In contrast, somebody with time-inconsistent hyperbolic discounting will wish prospectively that in the future he will take far-sighted actions; but when the future arrives he will behave against his earlier wishes, pursuing immediate gratification rather than long-run well-being.” (Camerer and Loewenstein, 2003)

Strotz (1955) is one of the first researchers who proposed this type of model to describe planning problems for economic agents. Many ordinary-life decisions (like savings, educational investments, labor supply, health and diet, crime and drug use) present costs and benefits that occur at different points in time. Believing that an agent will always stick to the plan – of consumption, saving, investment, etc. – he/she made at a given time is unreal. Rather, the agent will recognize that he/she is not “obeying” to the plan and will change behavior with respect to future further possible variations. Strotz found that a hyperbolic discounted utility can best express this attitude.

Other authors, instead, proposed models with quasi-hyperbolic discounted utility to incorporate issues like self control and satisfaction:

“[...] quasi-hyperbolic time discounting is basically standard exponential time discounting plus an immediacy effect; a person discounts delays in gratification equally at all moments except the current one – caring differently about well-being now versus later. This functional form provides one simple and powerful model of the taste for immediate gratification.” (Camerer and Loewenstein, 2003)

Laibson (1997) used quasi-hyperbolic utility in a model – which he defined “golden eggs model” – of lifetime consumption-savings decisions. He noticed how partially illiquid assets can help consumers hold back their own future consumption. In fact, people would tend to over-consume if they could withdraw money right away from their assets – as it is with simple savings and checking accounts. Even if less liquid assets lack flexibility and yield low returns, they may be used as a tricky aid to prevent over-consumption by those persons that can be “tempted” of doing it.

Hyperbolic and quasi-hyperbolic time discounting models continued to be analyzed by several behavioral economists. Among the most recent works, we can name those of Della Vigna and Malmendier (2004), Laibson, Repetto and Tobacman (2007), Goldin (2007), Huang and Hsu (2008).

For what concerns life-cycle theory, standard models state that, to decide how much to consume and save, people should estimate their permanent income – based on their predictions on future income –, and consume a constant fraction of that total amount each year. Real data prove that the majority of workers earn larger and larger incomes throughout their lives, which implies that people should spend more than what they earn when they are young – with the chance of borrowing –, and earn more than what they spend when they are older. But indeed:

“[...] spending on consumption tends to be close to a fixed fraction of current income, and does not vary across the life cycle [...]. Consumption also drops steeply after retirement, which it should not if people anticipate retirement and save enough for it.” (Camerer, 2000)

Considering the empirical analysis of Shea (1995), he found that unionized teachers – whose contract is negotiated year by year – spend more when future wages are expected to increase, but do not cut back their present consumption when future wages are expected to decrease – as it should be by means of the classical model.

This behavior can be explained using Bowman, Minehart and Rabin’s (1997) stylized two-period consumption-savings model, in which the agent’s utility from consumption shows reference dependence – on past consumption –, loss aversion and reflection effect. The authors concluded that:

“[...] there is a fundamental asymmetry in the response of consumption to anticipated changes in income. When there is sufficient income uncertainty, a person resists consuming below his reference point in the first period even when his expected average per-period income is below his reference point, whereas upward revisions are more likely to immediately affect consumption.” (Bowman, Minehart and Rabin, 1997)

### 2.3. Behavioral finance

This field of behavioral economics challenges the hypothesis of existence of an efficient market and tries to explain some typical financial phenomena through the analysis of investors’ behavior.

Considering asset pricing, Epstein and Wang (1994) confuted the models proposed by standard theory. Simply substituting the Euler equation with a pair of Euler inequalities – that represent investors’ ambiguity aversion –, the equilibrium found can better explain the high volatility of assets prices.

Camerer (2000) detected two fundamental anomalies in finance: the equity premium and the disposition effect. For what concerns the former:

“Stocks – or equities – tend to have more variable annual price changes (or “returns”) than bonds do. As a result, the average return to stocks is higher as a way of compensating investors for the additional risk they bear.” (Camerer, 2000)

What financial economists tried to explain is why the equity premium is so high<sup>43</sup>. Mehra and Prescott (1985) investigated which degree of risk aversion is implied by this premium (i.e. how large it is), and found that, under the classical assumptions of economic theory, investors must be extremely risk averse to ask such a high premium<sup>44</sup>.

Benartzi and Thaler (1997) suggested a theory – based on prospect theory – according to which investors are averse to losses (or the chance of negative returns), rather than to variability of returns. In fact, annual stock returns are negative more frequently than annual bond returns, so loss-averse investors will demand a large equity premium to counterbalance the higher chance of losing money in a year. Furthermore, the authors underlined that investors base the amount of premium they ask on a relatively short time horizon (i.e. one year), over which stocks are more likely to lose money than bonds. If, instead, they considered a long time horizon, the result could be different, since “the higher average return to stocks means that the cumulative return to stocks over a longer horizon is increasingly likely to be positive as the horizon lengthens” (Camerer, 2000).

Barberis, Huang and Santos (1999) explained the equity premium inserting some elements of prospect theory into a standard general equilibrium model of asset pricing. The investor in this model “derives utility not only from consumption levels but also from changes in the value of his financial wealth from year to year”. He is characterized by loss aversion, being more sensitive to reductions in wealth than to increases; furthermore:

“ [...] the utility he receives from gains and losses in wealth depends on his prior investment outcomes: prior gains cushion subsequent losses – the so-called “house-money” effect – while prior losses intensify the pain of subsequent shortfalls.” (Barberis, Huang and Santos, 1999)

The result of the model is that the investor’s “risk-aversion changes over time as a function of his investment performance”, which generates time-varying risk premia. Moreover, due to the agent’s loss aversion, “the high volatility of returns generates large equity premia”.

Moving to the disposition effect, Shefrin and Statman (1985) described it as the phenomenon according to which investors tend to retain stocks that have lost value – relative to their purchasing price – for a long time, while they are impatient to sell those stocks that have

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<sup>43</sup> As Camerer (2000) notices, in the current century stocks returns are about 8% higher than bond returns.

<sup>44</sup> In Camerer’s (2000) words: “For example, a person with enough risk-aversion to explain the equity premium would be indifferent between a coin flip paying either \$50,000 or \$100,000 and a sure amount of \$51,209.”

increased their value. This happens “because people dislike incurring losses much more than they like incurring gains and are willing to gamble in the domain of losses” (Camerer, 2000).

Weber and Camerer (1998) found the disposition effect in some experiments involving subjects buying and selling shares in a series of risky assets – whose prices fluctuated in each period. These authors specified that the disposition effect “can be explained by the two features of prospect theory: the idea that people value gains and losses relative to a reference point (the initial purchase price of shares), and the tendency to seek risk when faced with possible losses, and avoid risk when a certain gain is possible”.

Another important contribution for the analysis of the disposition effect is the one of Odean (1998), whose field study involved 10,000 customer accounts from a brokerage firm. The author noticed that previous research, while supporting the hypothesis that investors sell winner stocks sooner than loser ones, does not specify the reasons why they act in this way. Beside the explanation given by prospect theory, Odean detected an alternative behavioral theory argument, according to which agents may believe – rationally as well as irrationally – in a short-term mean reversion of future returns. He also argued that it is possible that investors do not make a clear distinction between these two explanations:

“For example, an investor who will not sell a stock for a loss might convince himself that the stock is likely to bounce back rather than admit his unwillingness to accept a loss.” (Odean, 1998)

Whichever the reason, Odean found that empirical data support the existence of the disposition effect, that is, agents “realize their profitable stocks investments at a much higher rate than their unprofitable ones”. More interestingly, looking at trends month by month, the difference between winning and losing stocks disappears in December. In this month, in fact, “investors have their last chance to incur a tax advantage from selling losers (and selling winners generates a taxable capital gain) so their reluctance to incur losses is temporarily overwhelmed by their last chance to save on taxes” (Camerer, 2000)<sup>45</sup>.

More recent research has been devoted to the study of the psychological status affecting agents’ decisions in stock markets. For instance, Brunnermeier (2001) listed a series of feelings that proved to have an impact on market trends: greed affects bubbles<sup>46</sup>, fear influences crashes<sup>47</sup>, and herd behavior<sup>48</sup> explains investors’ rush to get in or out of a market.

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<sup>45</sup> Very typical in the financial market, this result is due to the so-called “calendar effect”.

<sup>46</sup> When investors buy stocks of a given market or company in a massive and uncontrolled way, following the enthusiasm of an increase in the yields, a stock market bubble can arise. As a result, the price of stocks is much higher than their actual value. The bubble bursts when agents – realizing that the market in which they invested is not as profitable as expected – try to sell back their stocks but nobody is willing to buy them, given their low value.

<sup>47</sup> “Stock market crash is a sharp and unexpected decline of stock market prices for a very short period of time, usually accompanied with the decline of many other assets’ prices. As a result, the most of the investors and speculators in the market realize significant capital losses. [...] a stock market crash is usually a self reinforcing process that is totally uncontrollable.” (stockmarketcrashes.net, 2012)

## 2.4. Behavioral game theory

Behavioral game theory investigates strategic interactions in their deviations – due to some behavioral assumptions – from the orthodox game theoretic predictions. More than the other sub-disciplines, behavioral game theory proposes models that can be easily tested in laboratory experiments by gathering a sufficient number of subjects. As Gintis (2005) suggested, the topic can be divided into “five interdependent and partially overlapping stages”. The first is represented by the paradoxes proposed by Allais (1953) and Ellsberg (1961), who detected some choice problems that show inconsistency between actual observed choices and the predictions of expected utility theory. Other authors like Segal (1987) and Machina (1987) explained these paradoxes inserting nonlinear weights in their expected utility models.

The second stage is depicted by the research of Vernon Smith (1991), who is recognized as the main creator of the discipline of experimental economics. In particular, he focused the attention on market games, studying the behavior of buyers and sellers in evaluating a fictitious commodity following the rules of real world market institutions (e.g. double auction, English and Dutch auctions). Quite surprisingly, Smith found that prices and quantities traded in these markets converge on the values that would be predicted by the economic theory of perfect competition, despite the violation of some typical assumptions of it (like large numbers and perfect information).

The third stage is symbolized by Tversky and Kahneman's (1979) prospect theory, which boosted the research toward new decision-making models and theories. Among them, we can list the hyperbolic discounting model developed by Ainslie and Haslam (1992) or Ahlbrecht and Weber (1995), and the regret theory formulated by Sugden (1993).

The fourth stage includes the research on decision-making under conditions of strategic interaction, characterized by non-self-interested behavior of agents, which is considered “anomalous and based on irrational behavior and faulty reasoning on the part of subjects” (Gintis, 2005). Among the contributions to this research, we can name the ultimatum games of Güth, Schmittberger and Schwarze (1982). In their experiments:

“[...] a Proposer has an amount of money, typically about \$10, from which he must propose a division between himself and a Responder. (The players are anonymous and will never see each other again.) If the Responder accepts the offered split, they both get paid and the game ends. If she rejects the offer they get nothing and the game ends. In studies in more than 20 countries, the vast majority of Proposers offer between a third and a half of the total, and Responders reject offers of less than a fifth of the total about half the time.” (Camerer and Loewenstein, 2003)

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<sup>48</sup> Herd behavior describes the actions of individuals in a group when they have no planned direction, but simply follow what the others do.

The authors justified the behavior of responders who did not accept the offer as a punishment towards an unfairly behaving proposer.

Other experiments that can be listen in the fourth stage are the trust game research by Berg, Dickhaut and McCabe (1995) and the studies on common pool resource and public goods of Hayashi, Ostrom, Walker and Yamagishi (1999).

Finally, the fifth stage carries on the research of the fourth stage, but through a different point of view. The result is a series of models that follow rational decision theory, in which agents, instead of having an anomalous behavior due to faulty reasoning, follow “other-regarding preferences” (Gintis, 2005). For example, Fehr, Gächter and Kirchsteiger (1997) argued that reciprocal motivations have important implications for the enforcement of contracts, while Levine (1998) showed that theorizing selfish players in market games gives good results as well as hypothesizing altruistic players.

Bolton and Ockenfels (2000) created a simple model according to which a variety of laboratory games can be explained through equity (like ultimatum, two-period alternating offer and dictator games), reciprocity (like prisoner’s dilemma and gift exchange name) or competitive behavior (like Bertrand and Cournot markets, and guessing game).

In their experiments, Charness and Rabin (2002) showed that subjects, motivated by reciprocity, are more concerned with increasing social welfare than with reducing differences in payoffs.

The most recent research in behavioral game theory is represented by the work of Janvin (2010-2011) on the so-called “social dilemmas”, which are those problems that can only be solved if individuals work together (like broad issues about climate change, sustainable future and pollution, or local issues as marriage and partnerships). The author found a link between an individual’s experience in a social dilemma and his social preference<sup>49</sup>, focusing on the level of cooperation and trust among players in the dilemma itself.

## 2.5. Future research

Beside the developments within each sub-discipline mentioned so far, other topics have been analyzed by behavioral economists. In particular, interesting considerations can be detected in issues like racetrack betting, gambling and insurance.

For what concerns betting, a curious fact that happens during horse races is that parimutuels record more bets on horses that have a relatively small chance of winning, defined as

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<sup>49</sup> “Social preference is the degree to which a player is concerned about his own well-being and the well-being of others.” (Janvin, 2010-2011)

longshots. Indeed, people dislike betting on favorite horses, since the return for a dollar bet is very low if the horse wins<sup>50</sup>.

There can be various explanations for this phenomenon, defined as “favorite-longshots bias”, like the simple fact that gamblers may erroneously believe that a horse that lost many races is due to win soon. Jullien and Salanié (2000) studied a sample of horse bets run in England for ten years – with a total of 34,443 races –, assuming that bettors value bets on horses using either expected utility theory – according to which the only way to explain the favorite-longshots bias is to assume that people have convex utility functions for money outcomes –, rank-dependent utility theory or cumulative prospect theory. The authors found that the latter has higher explanatory power. In particular, the estimate of the probability weighting function for gain probabilities is linear, while the weighting function for loss probabilities extremely overweights low probabilities of loss:

“These estimates imply a surprising new explanation for the favorite-longshots bias: bettors like longshots because they have convex utility and weight their high chances of losing and small chances of winning roughly linearly. But they hate favorites because they like to gamble ( $u(x)$  is convex), but are disproportionately afraid of the small chance of losing when they bet on a heavy favorite.” (Camerer, 2000)

Another phenomenon in racetracks, detected by McGlothlin (1956) and Ali (1977), is the tendency of bettors to shift their bets toward longshots later in the racing day. Most bettors, in fact, by the end of the day have lost more money than what they gained; so they prefer longshots, since even a small bet on them can generate a large profit to cover previous losses.

This “end-of-the-day effect” emphasizes once more the great explicative power of prospect theory. Indeed, while expected utility theory cannot justify the shift in risk preferences throughout the day, since in agents’ utility the last race of the day is considered equal to the first one, cumulative prospect theory can shed a light on this shift by assuming that people open a mental account at the beginning of the day – with a given reference point, for example a zero daily profit –, close it at the end, and hate closing an account in the red (i.e. below their initial reference point).

Moving to the issue of gambling and insurance, their simultaneous presence in people’s life – which seems to be contradictory and irrational – cannot be explained by means of expected utility theory. Through their prospect theory, Kahneman and Tversky (1979) interpreted this “co-existence”, finding that agents tend to overweight the small probabilities of winning a lottery as well as the small probability that incidents covered by insurance may occur. In other words, people happen to be disproportionately concerned about small gains and small losses, since they are sensitive to change decreases as changes become larger.

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<sup>50</sup> As Camerer (2000) explained: “Since the track keeps about 15% of the money bet for the expenses and profit, bettors who bet on such a heavy favorite share only 85% of the money with 70% of the people, a payoff of only about \$2.40 for a \$2 bet.”

Harbaugh and Kornienko (2000) found that a similar effect can be detected in a model of “local status maximization” for social reasons:

“Since individuals are most likely to compare their status with others of comparable wealth, they are most concerned with small changes around their current wealth, and are therefore risk loving in losses and risk averse in gains.” (Harbaugh and Kornienko, 2000)

This means that every agent tends to compare himself to a social group of reference and then act in different ways:

“[...] individuals whose reference group is wealthier than they are will tend to buy lottery tickets, while individuals whose reference group is poorer than they are will tend to buy insurance.” (Harbaugh and Kornienko, 2000)

Cochran (2001) linked the research of Harbaugh and Kornienko to a practical application about gambling. The author considered some scratch cards promoted by the state government (see fig.4).

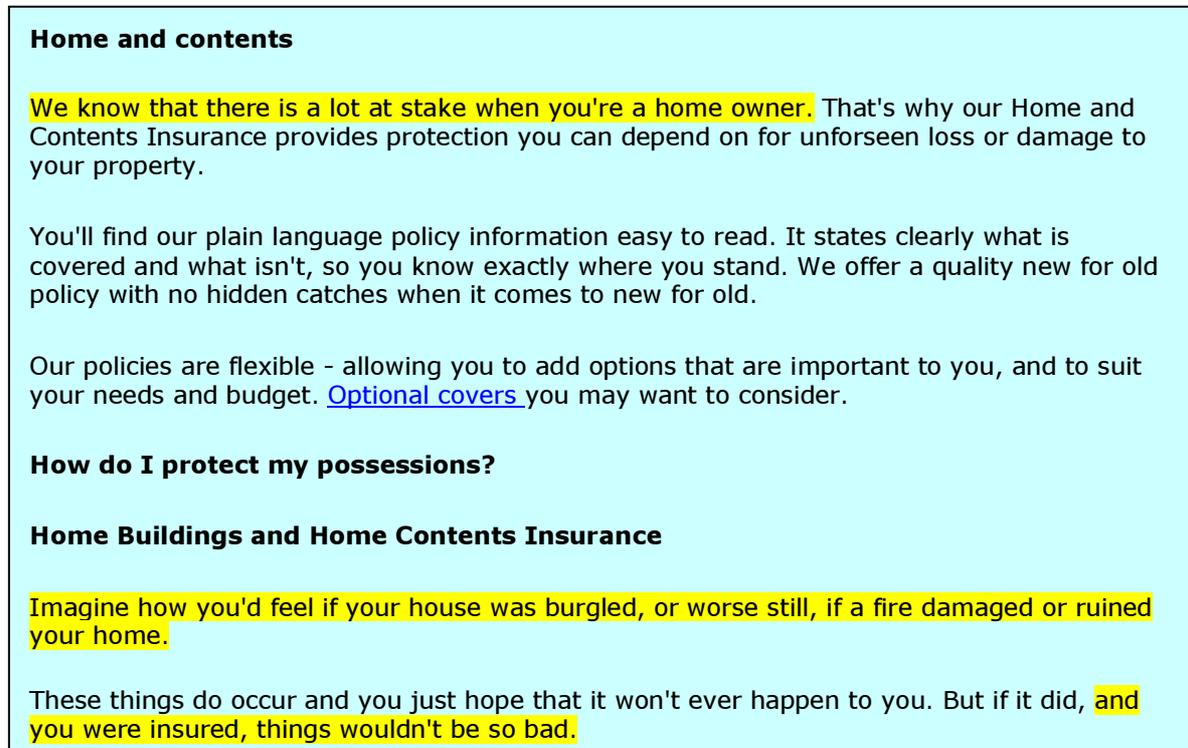


Figure 4 – Examples of scratch cards

Even if the chances of winning are remote, still thousands of people invest their money in instant scratches. This conduct can be justified by means of “positive framing”, so that framing the offer in low probability situations makes agents more disposed to gamble. Furthermore, the motto promoted by the cards – “Win for life” – can be a powerful motivator, since it suggests the idea of ensuring a status quo higher than most people’s normal one<sup>51</sup>.

<sup>51</sup> “Free money for life would surely raise both the financial and social status of a person within their “community”.” (Cochran, 2001)

Cochran also analyzed an application on insurance, noticing that insurance companies rely on people's aversion to loss. He examined an excerpt (see fig.5) in the web site of AMP promoting their insurance products. The author highlighted that "[...] the copy [...] has been written to accentuate the feeling of loss that would be experienced if a person were to lose their home".



**Home and contents**

We know that there is a lot at stake when you're a home owner. That's why our Home and Contents Insurance provides protection you can depend on for unforeseen loss or damage to your property.

You'll find our plain language policy information easy to read. It states clearly what is covered and what isn't, so you know exactly where you stand. We offer a quality new for old policy with no hidden catches when it comes to new for old.

Our policies are flexible - allowing you to add options that are important to you, and to suit your needs and budget. [Optional covers](#) you may want to consider.

**How do I protect my possessions?**

**Home Buildings and Home Contents Insurance**

Imagine how you'd feel if your house was burgled, or worse still, if a fire damaged or ruined your home.

These things do occur and you just hope that it won't ever happen to you. But if it did, and you were insured, things wouldn't be so bad.

Figure 5 – AMP exhibit

As prospect theory predicts, when a person is making a decision about a potential loss opposed to a gain, he/she tends to be very risk averse. If insurance companies design advertisements and offers that amplify this sense of loss, the probability of a sale will surely increase.

### 3. Relevance for real economies

The revolution introduced by behavioral economics involves both positive and normative economics. While the former concerns the description and explanation of economic phenomena, focusing on facts and their cause-effect relationship to develop and test economic theories, the latter makes value judgments about the fairness of theoretical and real economies, with the aim of providing hints to improve individual and social welfare.

In the following paragraph, I will underline the important advances at the positive and normative level made by the discipline.

#### 3.1. Advances in positive economics

As already underlined, behavioral economics can be considered as being opposed to neoclassical economics and its theories, in the first place for their different conception of the individual. Believing that economic agents are always perfectly rational, patient and computationally skilled like robots is unrealistic. People cannot know what makes them happy and which choices maximize their happiness in an objective way.

Traditional economists already understood that agents are not perfect utility-maximizers, but they did not provide evidence of consistent biases to explain the deviations from standard assumptions; rather, they asserted that these irregularities were due to “random events”. Behavioral economists, instead, are conscious that people postpone bad circumstances, while are impatient and try to anticipate good situations. When decisions are harder, agents may not be good decision makers, or even abstain from making a decision at all. Furthermore, they avoid what they feel like a loss, care about fairness – not only economic gain –, and are subject to psychological biases that distort the information they have to interpret.

By means of empirical observation, behavioral economists showed that subjects are bounded in many dimension. One of the most important limits is represented by bounded rationality, according to which the individual is not able to process information in a complete way. The agent uses heuristics and rules of thumb when he/she has to make a decision, with the risk of being overconfident about him/herself and misrepresenting the probability of outcomes – be they positive or negative. Moreover, the individual can be influenced by irrelevant information and other biases that express his/her loss-averse aptitude. All these behaviors prevent the subject to maximize his/her expected utility.

Another limit is represented by incomplete self-control (also defined as bounded willpower), which drives agents to make decisions that are in conflict with their long-term interest. One of the expressions of this behavior is time inconsistency (also called dynamic inconsistency), that describes the tendency of decision makers to change their preferences over time in such a way

that what is preferred at one point in time is inconsistent with what is preferred at another point in time. Addictive behavior, undersaving and procrastination are some of the effects of time inconsistency due to self-control problems. Contrary to the claims of neoclassical theory, it has been proved that restricting the set of choices available can be beneficial for agents with limited self-control issues<sup>52</sup>.

A third boundary is the lack of self-interest, according to which individuals make their own choices and act caring – or, at least, as if they cared – about other individuals' well-being. So, personal preferences have a social dimension. Furthermore, agents are worried about reciprocity: they want to be treated fairly and treat the others fairly as long as they feel to be treated that way. The consequence is that people are at the same time nicer and meaner – whenever they feel to be treated unfairly – than what predicted by neoclassical theory.

The “discovery” of individuals' boundaries helped researchers explain many anomalies in the economic behavior of agents, like the disposition and endowment effects, or the greed, fear and herd behavior in stock markets. Taking into account people's limits and the related effects, behavioral economists have developed various models that describe a new “homo oeconomicus”, who can make mistakes and change his/her mind at any moment. In particular, prospect theory and mental accounting proved to be useful tools to describe how people make choices in situations of uncertainty.

Once the concept of economic agent had changed, also the approach towards economic institutions – which, by definition, are made by a multitude of individuals – needed to be updated. This revolution has involved all types of macro-variables, from the private (i.e. households and firms) to the public ones (i.e. government and other public authorities).

The basic revolution brought by behavioral economics is characterized by the introduction of psychological insights into the framework of economic analysis. Generally speaking, psychology mainly concerns single persons. As a consequence, almost all the developments regarding the descriptive power of behavioral economics are focused, first of all, on the characteristics of the single agent. Only after regarding the behavior of the individual, models can provide a description of larger groups of people.

Considering households, for instance, some researchers have investigated how parents make choices on the educational level of children. Mullainathan (2005) particularly focused the attention on developing countries families, for which present-biased preferences seem to be more evident. Indeed, if an Indian father wants his son to go to school but, at the same time, he has not enough money to pay for his education and maintain the entire family, he will be forced to give up on the long-run perspective of guaranteeing a wealthier future to his son in favor of the short-run basic necessities of the entire household.

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<sup>52</sup> An example of such finding was provided by Laibson (1997).

As already seen, behavioral economics formulated numerous theories that consider market anomalies on the light of psychological insights. Among them, we can recall the studies on price stickiness and inefficient wages in labor market, and those on the equity premium puzzle, disposition and calendar effects in finance.

Furthermore, behavioral economists have considered public choice issues. With respect to this topic, their approach seems to be divided into two steps:

- first, they analyze either typical topics considered by mainstream public economics (like public goods and saving plans), or particular cases that can be representative of a given problem for the whole society (like addiction);
- second, they build models to describe such issues and, most importantly, create the bases to develop normative policies that help policy-makers to cope with those problems

Empirically understanding people's limits and how they make decisions about what to consume, how much to save, how hard to work, which educational level to have, and more, is important for at least two reasons. First, the analysis of agents' actual behavior helps general economic theory to be more descriptive of reality and, therefore, more useful. Second, through the comprehension of behavioral biases, economists can build normative rules to help people raise their objective happiness.

### 3.2. Advances in normative economics

The majority of studies described so far have a positive (i.e. descriptive) nature, but this fact should not induce to think that behavioral economics has not the ability to make judgments about real economies and give advices to improve them. In particular, there are two branches of the discipline that are interested in such topics: behavioral public economics and behavioral law and economics.

For what concerns the former, beside the unavoidable descriptive side that characterizes every branch of economics, we can detect the strong presence of normative considerations, in particular about welfare. In this sense, the contribution of Bernheim and Rangel (2005) is remarkable<sup>53</sup>. The authors started their analysis confuting the neoclassical conception that agents have revealed preferences, that is, individuals' preferences can be inferred looking at what they choose. Standard theories consider that people can rank their preferences in a well defined way, following four assumptions: agents know their preference domain, have coherent and lifetime fixed preferences, and make no mistakes when choosing one option instead of another. Bernheim and

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<sup>53</sup> Saez (2007) commented: "The analysis of Bernheim and Rangel is [...] the first comprehensive and systematic effort to review the difficulties that arise in measuring welfare in nonstandard models."

Rangel explained that by relaxing these assumptions it should be possible to capture the real behavior of decision-makers.

Clearly, if individuals are no more considered impeccable when expressing their preferences, also social issues can be affected. So, the intervention of public authorities is needed to guarantee a better level of welfare for citizens. The authors detected three fields in which behavioral economics had already provided some hints for policy-makers: the provision of public goods, the healthcare system – in particular, considering the issue of addiction – and the social security system – especially for private savings.

Although knowing that behavioral public economics is a field relatively younger than other sub-disciplines of behavioral economics, Bernheim and Rangel suggested its great potential for creating better models, solving difficult questions in welfare economics, and giving practical advices to public authorities about their policies.

Moving to behavioral law and economics, Jolls (2007) underlined that, in addition to the analysis of the endowment effect – already discussed by “traditional” law and economics –, this branch of behavioral economics considers the effects of bounded rationality, willpower and self-interest in assessing legal rules and welfare maximization.

The author identified two approaches that characterize the normative attempts of such discipline. One methodology is to use a “strategy of insulation”, which consists in creating rules and institutions that protect legal outcomes from the various bounds characterizing human behavior. Examples of this type of approach are discovery rules in litigations, the “business judgment” rule in corporate law, contract renegotiation rules, and the consumer protection law. The other policy is defined as “debiasing through law”, and attempts to create rules that help people either to reduce or to completely overcome their biased behaviors. Jolls distinguished between two types of rules that can “debias” agents: procedural rules (i.e. those governing during an adjudicative process) and substantive rules (i.e. those regulating actions outside of the adjudicative process). Even though debiasing through law cannot be applied to every context, Jolls recognized its potential for future developments, since it expresses the attempt of “avoiding the step of paternalistically removing choice from people’s hands”, typical of the first normative approach.

Examining the literature on behavioral economics, it seems evident that groundwork at the positive level provided much more contributions than research at the normative level. This could be explained by the fact that the discipline is still relatively young, so before assessing rules to improve individual and social welfare, it needs to verify that its theories effectively have descriptive properties. Nevertheless, given that many studies have witnessed the power of behavioral economics in understanding and explaining economic phenomena, we expect that in the next future normative issues will be of greater concern among researchers.

## Chapter 3

### Reference point adaptation: when frames change

One of the most remarkable aspects that distinguish behavioral from neoclassical economics is its different approach toward the figure of the decision-maker. The result of such difference is mirrored in the formulation of prospect theory as opposed to expected utility theory. Both these models have the aim of describing the decision process “activated” by individuals under risk or uncertainty.

Expected utility theory hypothesizes that agents, being rational actors, evaluate each possible (or disposable) outcome on the basis of the utility attached to it, independently of the context in which such outcome is embedded. In other words, “two prospects with the same expected utility will be given the same preference by rational decision makers” (Cochran, 2001).

Prospect theory, on the contrary, postulates that subjects, being affected by biases and other effects, evaluate the outcome of each possible choice with respect to the context in which it is presented. So, it is possible that prospects having the same expected utility will be given different preferences.

Behavioral economists define the possible contexts in which an outcome is presented as “frames”. Deriving this intuition from psychology, researchers understood that, while the *content* of alternative payoffs is still important – as suggested by neoclassical economics –, also the *context* (or *frame*) in which it is presented has an impact. For instance, many investigations have witnessed that “the outcome of decision-making under conditions of gains and losses is not symmetrical” (Cochran, 2001).

Prospect theory is in possession of an element that can help describe how a modification in the frame of decision-making can affect final outcomes: the reference point. By analyzing how it is formed and how it varies according to given alterations in the context of decision, it is possible to describe in a better way the choice of economic agents.

In the following chapter, after explaining why the reference point has an important role in Kahneman and Tversky's (1979) prospect theory, I will present some models and applications having a focus on this feature. In particular, I will make a distinction between those inquiries considering the initial assessment of the reference point (i.e. static environments), and those that analyze its evolution in time (i.e. dynamic environments). With reference to this second type of investigations, I will explain the meaning of “reference point adaptation” and introduce the concept of “hedonic adaptation”, describing an interesting study considering the effect of this phenomenon in the domain of security trading. Finally, I will make a brief consideration about the normative implications of using frames, reference points and hedonic adaptation.

## 1. Studies on the reference point

“Prospect theory is characterized by: (1) *reference dependence*—the value function  $v$  is defined over differences from a reference point  $r$ , instead of over the overall wealth; (2) *loss aversion*—the value function  $v(x)$  has a kink at the reference point and is steeper for losses ( $x < 0$ ) than for gains ( $x > 0$ ); (3) *diminishing sensitivity*—the value function  $v$  is concave over gains and convex over losses, reflecting diminishing sensitivity to outcomes further from the reference point; and (4) *probability weighting*—the decisionmaker transforms the probabilities with a probability-weighting function  $\pi(p)$  that overweights small probabilities and underweights large probabilities.” (Della Vigna, 2009)

As we can see from the description by Della Vigna, the reference point is one of the most important features of prospect theory. And it is so for at least two reasons. First, it is the starting point from which individuals set up their value function, distinguishing between the domain of losses and the domain of gains<sup>54</sup>. Since in prospect theory outcomes are measured against current wealth, the reference point describes in a direct way the agent’s present level of utility.

Second, by definition, it can change from time to time, according to either an “internal” switch (e.g. new preferences, tastes, social status, aspiration levels, cultural background) or an “external” one (e.g. a more profitable job, a lottery win, a losing investment). This second characteristic is strictly connected to the idea that different frames have an impact on subjects’ valuation.

Due to its very important role in behavioral economics, the reference point has been analyzed by various authors in different ways. One of the classifications that can be proposed is to distinguish between “static” and “dynamic” decision environments (or frames).

When the reference point is examined in a static decision environment, the focus is on its nature and conformation, trying to understand what agents consider as being their initial reference point, or which mechanisms influence its formation.

On the other side, when the reference point is analyzed in a dynamic decision environment, the focal point is on its development in time, considering the factors that can have an impact on its change. With reference to this second domain, the phenomenon according to which people update their reference point is defined “adaptation”.

Interestingly, it seems that Kahneman and Tversky (1979), in their formulation of prospect theory, have analyzed the reference point only in static decision-making situations. More recent research, instead, while still making remarkable considerations on reference-dependence in stationary conditions, started to pay more attention on dynamic environments, trying to describe and explain the path leading to a shift in the reference point.

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<sup>54</sup> In particular, to reflect loss aversion, the value function has a kink at the reference point and it is steeper for losses than for gains.

The following section provides an overview of the main studies about the reference point, both in static and dynamic decision-making contexts.

### 1.1. Analysis in the static domain

Research considering static frames predominantly looks at what agents consider as being their initial reference point. For example, with respect to stock trading, Spranca, Minsk and Baron (1991) proved that the price at which a stock was initially purchased is a typical starting reference point. More recently, other authors like Kőszegi and Rabin ([2004] 2006) or Yogo ([2005] 2008) asserted that the reference point is a person's expectation about future outcomes, rather than the original purchase price.

Other researchers investigated the effects of reference-dependence – connecting it with other phenomena typical of prospect theory assumptions – in the evaluation of individuals' utility. Among them, we can list: in the labor market, Camerer, Babcock, Loewenstein and Thaler (1997), who developed a model for NYC cab drivers which considers as reference point a given daily income target; Barberis, Huang and Santos (1999), who explained the equity-premium puzzle observed in finance as being a consequence of reference-dependence; Genesove and Mayer (2001), who detected the difference in sellers' and buyers' reference points in the housing market; again with regard to financial markets, Barberis and Xiong (2009) underlined the presence of reference points as a means to give an account for the disposition effect.

In their most important work on prospect theory, Kahneman and Tversky (1979) provided evidence that framing effects have an impact on the assessment of the reference point. Dividing their sample into two groups, they presented the subjects the following problems:

“[Problem 1] In addition to whatever you own, you have been given 1,000. You are now asked to choose between

A: (1,000, .50), and B: (500).

[Problem 2] In addition to whatever you own, you have been given 2,000. You are now asked to choose between

C: (–1,000, .50), and D: (–500).”

Even though the allocations in options A and C were identical (i.e. giving the same utility), as well as those in options B and D, only 16% of the respondents to problem 1 chose A, while 69% of the subjects valuating problem 2 chose C. Clearly, a different representation of outcomes had an influence on the determination of agents' reference points, making them either less or more risk-averse.

The concept of reference point is strictly connected to that of endowment effect. Their combination helped Kahneman, Knetsch and Thaler (1990) explain why buying and selling prices for a good are very often different. In their experiments, half of the subjects were endowed with coffee mugs and half not. Those who possessed the mugs asked a price about 2-3 times larger than the price that those without mugs were willing to pay to get them. This result challenges the Coase theorem, according to which “the allocation of resources to individuals that can bargain and transact without extra costs should be independent of initial property rights”. Nevertheless, the individual who is given the property right to a good will be more likely to maintain it, due to the impact of endowment on his marginal rate of substitution between one good and another.

A similar experiment was conducted by Knetsch (1992), who endowed some subjects with a mug and the rest with a pen. The two groups had the chance to exchange their good with the other one at a minimal transaction cost, by giving it to the experimenter. The result was that only few individuals (22%) accepted to trade. Again, this is a sign that the endowment effect makes people “excessively” prefer the good they were given, independently of its nature.

Many other trials were conducted to test how the endowment effect determines individuals' reference point, like Reb and Connolly's (2007) experiment with chocolate bars, Lens and Pandelaere's (2008) research with clickers, or Bauer and Schmidt's (2008) investigation with Christmas presents. All these studies demonstrated that *current* ownership status affects object valuation – creating a difference between WTP (willingness to pay) and WTA (willingness to accept) – and that this effect occurs instantaneously on possession of an object.

A further step forward is represented by the research of Strahilevitz and Loewenstein (1998), who found that object valuation is affected also by the history of *past* ownership:

“For objects in one's possession, [...] valuation increases with duration of ownership. For objects not in one's possession, previous ownership experience increases valuation, and the increase appears to be related to the duration of ownership before loss. In addition, the perceived attractiveness of objects, although not instantly affected by endowment, is found to increase with duration of ownership.” (Strahilevitz and Loewenstein, 1998)

A slightly different set of results is represented by the studies of List (2003 and 2004), who investigated if there are some factors that can influence or eliminate the endowment effect. Analyzing agents' behavior in sports card and pin markets, he found that market experience plays a prominent role in eliminating the effect:

“[...] an endowment effect is evident for inexperienced consumers, but not for experienced consumers: inexperienced traders (those who trade fewer than 7 times in a typical month) executed a trade at a rate of 28 percent (9 of 32), whereas 11 of 21 (52.3 percent) experienced consumers chose to trade.” (List, 2003)

The author also observed that the endowment effect varies with respect to the type of market in which the good is traded. Running a specific experiment that tries to simulate real-market situations (as Kahneman and colleagues did) is different than simply observing the behavior of subjects in a naturally occurring market. Finally, the type of good traded can have an impact on the endowment effect, too. In fact, individuals have different behaviors with respect to everyday consumable goods (such as mugs or candy bars) and “unusual” goods (like unique pieces of memorabilia, such as sports cards or pins), for which expert dealers clearly “have had substantial previous opportunities to interact in a market setting, rendering the marginal impact of another trade less important” (List, 2004).

Beside present and past ownership, reference point formation can be affected also by other factors<sup>55</sup>, like social comparison – in particular “the possessions and attainments of other people” (Camerer and Loewenstein, 2003) – and individual’s self-esteem. Locke, Saari, Shaw and Latham (1981) assumed that the initial reference point of an agent consists in a target or preliminary goal, which can be affected by self-esteem. In particular, people with high self-esteem are more likely to set challenging targets (i.e. challenging initial reference points) than those with low self-esteem, who tend to choose attainable initial reference points.

Another factor that has an impact on the generation of the reference point is the individual’s attitude toward risk. As Huber and Puto (1985) found in their inquiry, the majority of people acted as predicted by prospect theory, being risk-averse for gains and risk-seeking for losses. However, there was a part of respondents who showed the opposite pattern, being risk-averse for losses and risk-seeking for gains. Generalizing their results, then, the authors claimed that inherent attitudes toward risk can lead agents to shape their reference point in conformity with such disposition: those who are generally risk-averse will tend to set a less “challenging” reference point than those who are generally risk-seeking.

Considering the particular field of consumer choice behavior, the initial reference point can be also set in function of preliminary information in the form of published prices. Indeed, Puto (1986) underlined that relatively high published prices will generate correspondingly high initial reference points, while relatively low published prices will generate correspondingly low initial reference points.

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<sup>55</sup> The following examples are all taken from Rowe and Puto’s (1987) study on consumer preferences.

## 1.2. Analysis in the dynamic domain

When Kahneman and Tversky formulated prospect theory, while suggesting the great importance of the reference point, they did not specify *how* it changes over time. This aspect can be summarized by one single word: “adaptation”. As Arkes, Hirshleifer, Jiang and Lim (2008) suggested, by “adaptation of the reference point” we mean “a shift in the reference point in the direction of a realized outcome”. To show the relevance of this topic, especially in risk-taking decisions, the authors made a simple example:

“[...] consider a prospect-theory investor who purchases a stock at \$30 per share, observes it drop to \$20, and expects that the stock price will either go up or down by \$5 with equal probability. If her reference point remains at the purchase price \$30, she will hold on to the stock because people are risk-seeking in the loss domain. In contrast, if her reference point has adapted to the new price \$20, she will sell the stock at \$20 since, owing to loss-aversion, a zero-expected-value gamble is not attractive. On the upside, if the stock were to rise from \$30 to \$40, the extent of upward migration of the reference point would also affect the propensity to sell the stock.” (Arkes, Hirshleifer, Jiang and Lim, 2008)

Stock markets represent a good instrument to investigate reference point adaptation. For instance, Chen and Rao (2002) showed that investors tend to move their reference point – although incompletely – from the initial purchase price to a value between that price and the current one.

Gneezy (2002), basing his consideration on prospect theory assumption that agents are risk averse in the domain of gains, asserted that they should sell a stock only when its current price is greater than the reference point. By analyzing subjects’ decisions to sell when prices followed a random walk, the researcher inferred their reference point adaptation. As a result, he found that investors tend to set the reference point on the basis of the historical peak of the stock value.

Other behavioral economists focused on the factors that influence a change in the reference point with respect to cross-sectional data. For instance, Kume and Suzuki (2010) examined “whether a generational difference exists between old and young individuals in terms of risk-taking behavior”. Through a laboratory experiment with monetary incentives, they found that behavioral differences primarily derive from the probability weighting functions. While both are inverse S-shaped, the weighting function of the elderly is like a step function, while the one of younger is more like a linear function. This means that:

“[...] old individuals tend to be less sensitive to changes in probability and overweigh the low probability of a good outcome occurring more significantly in a larger range of probability domains. [...] old individuals update their reference points every time after a gain and so only consider the

stakes of lotteries, not their entire wealth. On the other hand, young individuals appear to retain the initial reference point throughout repeated rounds, and evaluate risky lotteries by total wealth.” (Kume and Suzuki, 2010)

So, while the elderly group tends to fully adapt to a gain (i.e. prior gains are segregated from subsequent mental accounts), the young group seems to not adapt at all. According to these results, Kume and Suzuki concluded that “the old group’s behavior departs from the traditional EUT<sup>56</sup> than does that of the young”.

Literature on adaptation suggests that agents can adapt either fully or partially, as well as not adapt at all. Looking at figures 6a and 6b, consider the case in which an individual occurs into a gain<sup>57</sup>. If he does not adapt to the change, his position with respect to the value function will be in the domain of gains. This means that, in case of a subsequent decision to be made, the agent will be more risk averse – due to the concavity of the value function in that domain.

If, instead, the individual fully adapts his reference point to the change, in future decisions he will be less risk averse (or more risk seeking), since “re-centering” the origin of the value function on the current state of affairs causes a gain to be more satisfactory than it would have been.

Finally, if the agent partially adapts to the change, the new reference point will be set on a certain level between the old point and the current gain. In this case, part of the gain – represented by the difference between  $x$  and  $t$  – will be included in future switches, making the agent less risk seeking than in the case of full adaptation, even if not as risk averse as in no adaptation at all.

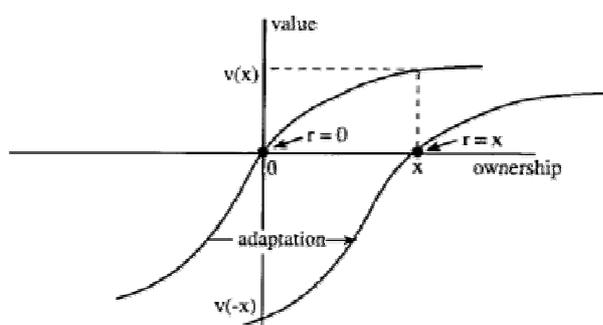


Figure 6a – No adaptation and full adaptation

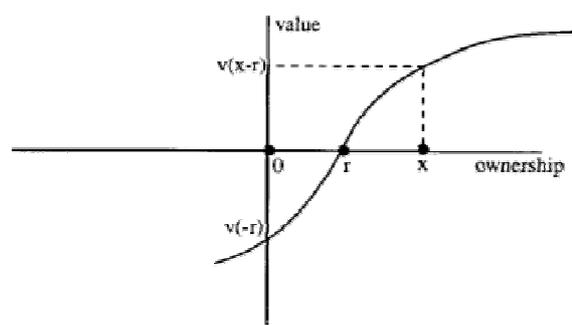


Figure 6b – Partial adaptation

The issue of partial and full adaptation is linked to the concept of mental accounting, introduced by Thaler (1985). Mental accounting describes the ways in which individuals and households keep track of where their money is going, in order to evaluate the performance of their investments,

<sup>56</sup> I.e. Expected Utility Theory.

<sup>57</sup> Notice that, in these pictures, “ownership” (on the x-axis) represents what in chapter 1 we labeled – in more general terms – “outcome”, as we were considering the possession of something (like an object or a given amount of money) to be the independent variable to which the agent attaches a certain value.

control their spending and plan future investment decisions. Arkes and his colleagues (2008) explained that:

“If investors fully adapt to the changes in stock prices by closing out their old mental accounts with all of the realized gains/losses, they will evaluate future prospects relative to the current stock price. This implies that prior gains or losses are segregated from the subsequent mental account. However, if investors do not fully adapt to the price change, a part of the prior gain or loss will be included in the mental account containing the future prospect.” (Arkes, Hirshleifer, Jiang and Lim, 2008)

Considering the various processes of adaptation, Frederick and Loewenstein (1999) distinguished between two types of approaches: “shifting adaptation levels” and “desensitization”. While the former is characterized by those “adaptive processes that diminish subjective intensity by altering the stimulus level that is experienced as neutral”, the latter delineates the “adaptive processes that diminish the subjective intensity of the stimulus”. In other words, both methods aim at diminishing the subjective intensity of an occurrence, but, while shifting adaptation levels tends to maintain – if not increase – the sensitivity to differences in stimuli, desensitization leads to diminish such sensitivity.

To make clear this distinction, the authors considered the example of a person that has been incarcerated, whose utility – represented by the prospect theory value function – is given “by the difference between the prisoner’s current state and the state to which he has adapted”. At the beginning of his detention, the prisoner is settled in a seven-foot cell. At this time, he is quietly indifferent between staying in a seven-foot or a nine-foot cell (see fig.7a), since he has not already adapted to his condition of imprisoned man ( $V_0(7\text{-ft.cell}) < 0$ ). However, after he has adapted to the incarceration ( $V_t(7\text{-ft.cell}) = 0$ ), the prisoner can either shift his adaptation levels (see fig.7b), so that a change from the small cell to the larger would make him significantly happier ( $[V_t(9\text{-ft.cell}) - V_t(7\text{-ft.cell})] > [V_0(9\text{-ft.cell}) - V_0(7\text{-ft.cell})]$ ), or desensitize himself (see fig.7c), so that such change would not influence in a relevant way his mood ( $[V_t(9\text{-ft.cell}) - V_t(7\text{-ft.cell})] < [V_0(9\text{-ft.cell}) - V_0(7\text{-ft.cell})]$ ).

As figure 7c suggests, there can be also the case in which, instead of adapting, an agent becomes more sensitive to a stimulus. Precisely, the process defined as “sensitization” corresponds to those situations in which the “intensity of a constant stimulus *increases over time*” (Frederick and Loewenstein, 1999). Among the examples of such mechanism, Frederick and Loewenstein named the “increasing irritation produced by exposure to a disliked roommate”.

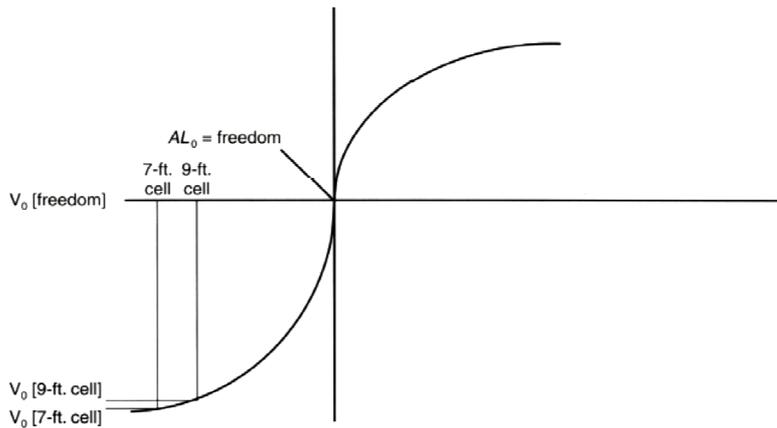


Figure 7a – Prisoner's value function before adapting to incarceration

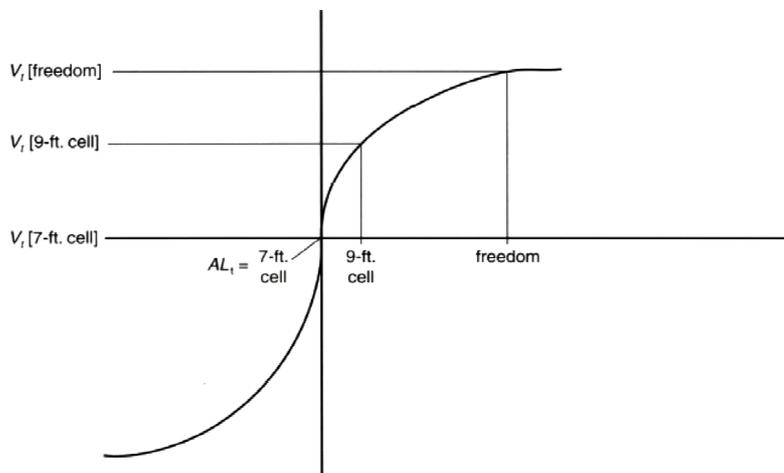


Figure 7b – Prisoner's value function after adapting to incarceration (through shifting adaptation levels)

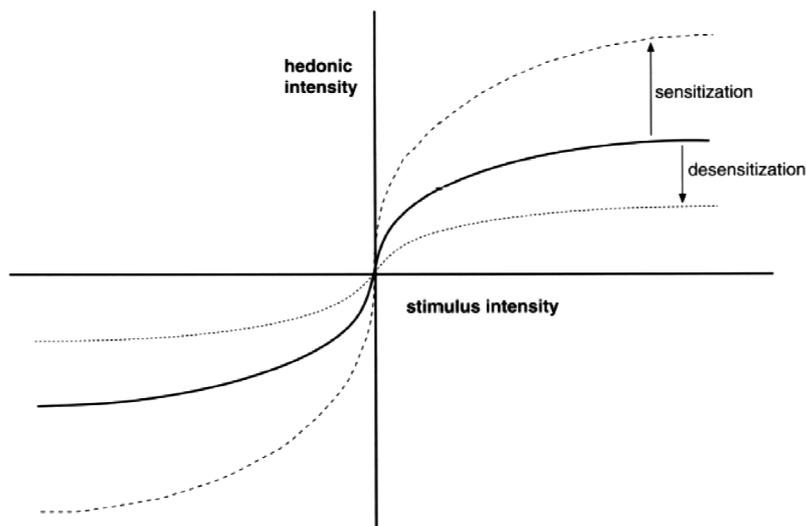


Figure 7c – Prisoner's value function after adapting to incarceration (through sensitization or desensitization)

Hence, while there are some situations to which agents hedonically adapt – even the tougher ones, like living in prison –, there are others that, in spite of repeated exposure, do not generate the same process<sup>58</sup>. Following this reasoning, Frederick and Loewenstein listed a series of factors that moderate adaptation. For instance, an inadequate social support – from friends and family members – makes it harder to recover from bad news (like mutilation or conjugal mourning). Other factors that can slow down hedonic adaptation are: the uncertainty of an outcome (like the doubt of being able to conceive a child); reminding situations or people (for example, parents who have lost an infant are more sensitive when looking at other babies); the impossibility of assigning responsibility of a bad event (like breast cancer) to something or someone. Furthermore, the creation of counterfactuals (i.e. “mental representations of things that were not actually experienced”) can influence the evaluation of an occurrence, increasing or decreasing the reference point of an individual and, consequently, reducing or improving his/her well-being.

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<sup>58</sup> For instance, for some types of food (like coffee and strong spices) the pleasure of eating them increases through repeated “exposure”, i.e. consumption.

## 2. The case of hedonic adaptation

Part of more recent research regarding dynamic frames is devoted to the phenomenon called “hedonic adaptation”. In the next session I will describe it, considering the reasons why agents adapt hedonically and providing some models that showed an attempt to include hedonic adaptation in behavioral economic theorizations. Furthermore, I will give an account of an interesting study on such phenomenon in the context of security trading.

### 2.1. Describing the phenomenon

“When an external situation changes, people may first feel strongly about the change, but with the passage of time, their feelings fade away. For example, when a person first moves from a small apartment to a large one (or from a large apartment to a small one), she will be happy (or unhappy), but with the passage of time, her happiness (or unhappiness) tapers off. This process is called *hedonic adaptation* [...]” (Hsee, Hastie and Chen, 2008)

As suggested by the example of Hsee, Hastie and Chen (2008), hedonic adaptation (also known as “hedonic treadmill”) is the tendency of agents to return to an approximately stable level of happiness, notwithstanding highly positive or negative events they can experience in life. In other words, it is “the tendency for people to become psychologically accustomed to changes in their material situation” (Strahilevitz and Loewenstein, 1998).

In literature, this phenomenon has been justified by multiple factors. Helson (1964) explained it by means of basic “psychological habituation”: the more a person is exposed to a stimulus, the less sensitive he/she becomes to it<sup>59</sup>. A second reason is the “dilution of attention”:

“When a junior faculty member gets tenured, she will first be overwhelmed with joy, but before long, many other things, such as new administrative duties and annoying students, will grab her attention, and tenure is just one of a myriad of events that affect her life.” (Hsee, Hastie and Chen, 2008)

Another reason for hedonic adaptation is “ordinization”:

“[...] people fail to learn from experience that the impact of emotional events is not as strong as they anticipated. This would be the case if people made the same mistake in retrospect, recalling that their reactions were stronger than they were.” (Wilson, Meyers, and Gilbert, 2003)

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<sup>59</sup> See forth the adaptation-level model proposed by Helson (1947).

Some authors underlined that, depending on the event, adaptation can have different rates. In their studies, Kurtz, Wilson and Gilbert (2007) found that a prize coming from an uncertain condition – a mysterious source – created a more prolonged positive mood than an equivalent prize from a certain condition – a known source.

Among the first researchers that proposed a quantitative model of hedonic adaptation, we can name Helson (1947), who expressed the notion that past stimuli have an impact on the subjective experience of a present stimulus. According to this psychologist, the adaptation level  $AL$  (i.e. the level of a stimulus that requires no response by the individual, being affectively neutral) is given by the average of past stimulus levels:

$$AL_t = \frac{1}{t} \sum_{T=0}^t X_T$$

where  $X$  is the stimulus level and  $t$  represents time. An agent's hedonic state  $u$  at time  $t$  is expressed by a function of the difference between the current stimulus level and  $AL$ :

$$u_t = f(X_t - AL_t)$$

where  $f(0) = 0$  and  $f \geq 0$ <sup>60</sup>. As deductible from this formulation, the difference between the current stimulus level and the adaptation level gradually diminishes over time, since  $AL$  tends to converge to the value of  $X$  as  $t$  increases. So, also  $u$  gradually decreases in time. Through these simple equations, Helson's "adaptation-level theory" is able to describe the pattern of adaptation: "persistent bad things gradually become less aversive, and persistent good things gradually become progressively less pleasurable" (Frederick and Loewenstein, 1999).

Parducci (1965) criticized the model of Helson, finding that judgments are influenced by various determinants, not only the mean stimulus level. The author elaborated the "range-frequency theory", based on two principles:

"The range principle postulates that subjects judge each stimulus relative to its position between the endpoints of the stimulus range. The frequency principle postulates that each stimulus is judged according to its percentile rank." (Haubensak and Petzold, 2002)

If "stimuli from different parts of the range are presented with unequal frequencies" (Haubensak and Petzold, 2002), these principles can be in conflict. So, the final judgment will be the result of a compromise between them.

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<sup>60</sup> Clearly, Helson used the prospect theory value function to describe decision-makers' pattern of choice.

As many authors have underlined, neither Helson's nor Parducci's model succeeded in taking into account the diminishing impact of events as time passes by:

“For example, although both theories imply that the judged quality of a dinner will be influenced by the quality of past dinners, they make no explicit distinction between the effects of a fancy dinner experienced last week and one enjoyed last year.” (Frederick and Loewenstein 1999)

To overcome this fault, researchers like Ryder and Heal (1973) started to use a different formulation for the adaptation level:

$$AL_t = \alpha X_{t-1} + (1 - \alpha)AL_{t-1}$$

with  $t \geq 0$ . The parameter  $\alpha$  – which varies between 0 and 1 – indicates the speed of adaptation:

“If  $\alpha = 1$ , then the adaptation level is equal to the last period's stimulus level, so that the individual's hedonic state will depend solely on the difference in stimulus level between the last period and the current period. If  $\alpha = 0$ , then the adaptation level will not be influenced by past stimulus levels at all.” (Frederick and Loewenstein 1999)

The above equation can be also written as:

$$AL_t - AL_{t-1} = \alpha(X_{t-1} - AL_{t-1})$$

underlying that the adaptation level changes from time to time in proportion to the difference between the stimulus level and the adaptation level of the last period.

Applying the last formula recursively, it is possible to represent the adaptation level as a weighted average of past stimuli, with those more recent having higher weight. Nevertheless, many researchers criticized such vision, since it does not consider that there are some experiences having a great influence on adaptation independently of their position in time, as well as some other stimuli that, although very recent, cannot affect the reference point.

Another critic to the above formulations is that the hedonic state of an agent can be affected by the “inherent” pleasure or pain of an experience, independently of the comparison with previous similar occurrences. To reflect this characteristic, then, it is possible to change  $u$  as follows:

$$u_t = c + f(X_t - AL_t)$$

where  $c$  is a constant expressing the inherent goodness or badness of a stimulus.

The majority of studies consider the issue of hedonic adaptation as referred to past life events. Nevertheless, in literature we can also find some attempts to relate adaptation to future stimuli, anticipating them. Such process is defined “feedforward”. One of the researches that detected the phenomenon is Van Praag (1977), who verified that agents consider an income to be “sufficient” basing their judgment not only on its actual value, but also on their future expectations about it.

As already highlighted, hedonic adaptation can be detected in a lot of situations, be they positive or negative. For example, Brickman, Coates and Janoff-Bulman (1978) identified it in the behavior of lottery winners and accident victims, Beale, Lambert, Lisper, Ohlsen and Palm (1985) in cosmetic surgery patients, Wilson, Wheatley, Meyers, Gilbert and Axson (2000) in professional status alterations, while Lucas, Clark, Georgellis and Diener (2003) in the change of marital status – from unmarried to married, and from married to widowed or divorced. Oswald and Powdthavee (2008) focused on bad life events causing disability, finding that the rates of hedonic adaptation of the subjects analyzed were approximately between 30% and 50%, depending on the severity of the disability.

The majority of theory and empirical research suggests that hedonic adaptation is faster and more “complete” for positive than negative experiences, a pattern defined as “negativity bias”. A simple but very effective explanation of this phenomenon is the one provided by Baumeister, Bratslavsky, Finkenauer and Vohs (2001): “bad is stronger than good”.

Numerous investigations witness that negative stimuli have stronger cognitive effects than positive stimuli. Pratto and John (1991), for example, conducted some studies using the emotional Stroop procedure<sup>61</sup> and found that negative words interfere with color naming – attracting more attention – more than positive words, and that negative words tend to be recalled twice than positive ones.

Previous as well as subsequent research underlined that people are more likely to monitor, remember and be influenced by negative than positive feedback. Furthermore, negative information is weighted more heavily in first impressions, nonverbal messages, interpersonal interactions and evaluative categorization. Eventually, different studies proved that everyday negative events affect subjects in a more powerful way, with a longer lasting effect than positive events. For example, Sheldon, Ryan and Reis (1996) reported that students showed a “carryover” effect after a bad day:

“Participants had somewhat worse days when they had felt more sick or sad the day before, whereas participants did not have better days when they had felt more positive affect or vitality the

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<sup>61</sup> In psychology, the Stroop effect is a demonstration of the reaction time of a task. When the name of a color (e.g., “blue,” “green,” or “red”) is printed in a color not denoted by the name (e.g., the word “red” printed in blue ink instead of red ink), naming the color of the word takes longer and is more prone to errors than when the color of the ink matches the name of the color. (Wikipedia, 2012)

day before.” (Sheldon, Ryan and Reis, 1996)

Evidence highlighting the predominance of negative over positive experiences is consistent with the S-shape value function of prospect theory.

More recently, Wilson and Gilbert (2008) developed the AREA model, which describes agents’ “affective adaptation” (i.e. “the psychological process that causes an affective response to weaken after one or more exposures to a stimulus”<sup>62</sup>) through a 4-steps process of attention, reaction, explanation and adaptation (see fig.8):

“People attend to self-relevant unexplained events; react emotionally to these events; attempt to explain or understand these events; and, if they succeed, adapt to the events as much as they attend less to them and have weaker affective reactions. Through these processes [...] professional awards and romantic breakups that are initially surprising and attention-grabbing come to seem perfectly understandable and thereby trigger less intense affective reactions than they did initially.” (Wilson and Gilbert, 2008)

The AREA model has various useful practical properties. For instance, through the process of explanation it is possible to “speed recovery” from negative as well as positive events. Furthermore, the model can: clarify the different effect of emotions and moods; make predictions about which types of emotional events urge people to adapt faster; shed a light on the influence that cultural roots have on emotional experiences.

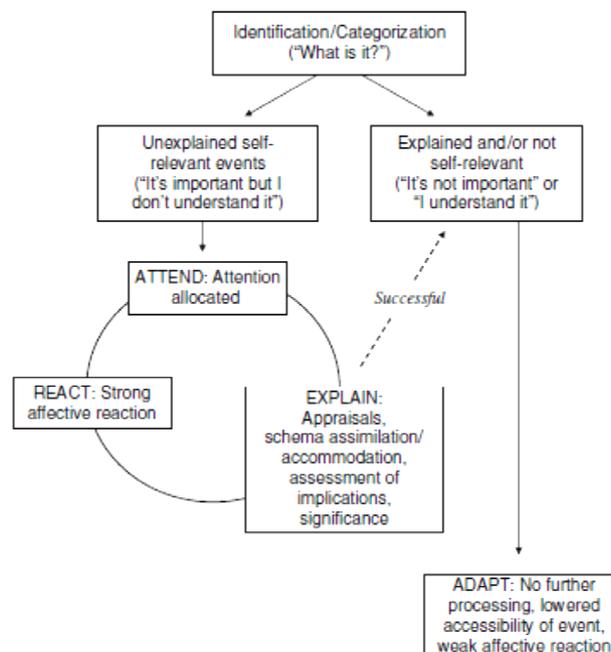


Figure 8 – AREA model of affective adaptation

<sup>62</sup> This definition suggests that psychological habituation, detected by Helson (1964), is a key feature in determining affective adaptation.

The “fading effect” of emotions has been considered also by Lyubomirsky (2011), who – together with her colleague Sheldon – developed the Hedonic Adaptation to Positive and Negative Experiences (HAPNE) model, in which initial gains in well-being associated with a positive life change or drops in well-being associated with a negative life change erode over time via two different paths:

“The first path specifies that the stream of positive or negative emotions resulting from the life change (e.g., joy or sadness) may lessen over time, reverting people’s happiness levels back to their baseline. The second, more counter-intuitive path specifies that the stream of positive or negative events resulting from the change may shift people’s expectations about the positivity (or negativity) of their lives, such that the individual now takes for granted circumstances that used to produce happiness or is inured to circumstances that used to produce unhappiness.”  
(Lyubomirsky, 2011)

Both in case the emotional state of an agent levels back to its baseline status – adapting through a “bottom-up” trajectory – and in case it is updated to the new situation – getting accustomed through a “top-down” route –, there are some differences in the reaction to positive and negative occurrences. Indeed, hedonic adaptation happens to be rapid and complete for positive events, while it is slow and incomplete for negative ones. As a consequence, in order to achieve increasing and sustainable levels of well-being, agents should adopt strategies that prevent, delay or block their positive adaptation path. Conversely, they should speed up adaptation, through the process of coping, in order to restore the level of well-being previous to a particular negative occurrence.

As figures 9a and 9b show, by using the HAPNE model in their strategies, people can modify the adaptation processes in order to “facilitate coping with stressors” (i.e. adaptation-accelerating) and “make the most of triumphs” (i.e. adaptation-forestalling). In particular, Lyubomirsky detected three critical variables that impact agent’s rate of adaptation: attention, variety and surprise.

Considering the variable of attention, the author underlined how the events that grab attention are those most difficult to adapt to. So, if the aim is to prevent hedonic adaptation, the individual should keep his/her mind on the positive happening; if, on the contrary, the aim is to accelerate hedonic adaptation, the agent should stop ruminating on the negative episode.

For what concerns the second variable, Lyubomirsky pointed out that “hedonic adaptation occurs in response to constant stimuli”. As a consequence, to increase and sustain happiness – slowing down adaptation –, agents should carry out dynamic and varied activities, while, to speed up adaptation to negative events, they should “find ways to reduce variety and promote repetition”.

Finally, with regard to surprise, whenever a circumstance happens without being expected, the novelty it introduces causes an increase or decrease in well-being, depending on its “content”. Then, in order to foster adaptation to negative events, the subject should “seek to tone down surprises and attempt to inject repetition”, if not “boredom”; on the other side, to forestall positive adaptation, he/she should sustain novelty and surprise, choosing “activities that have the potential to yield relatively more frequent novel moments”.

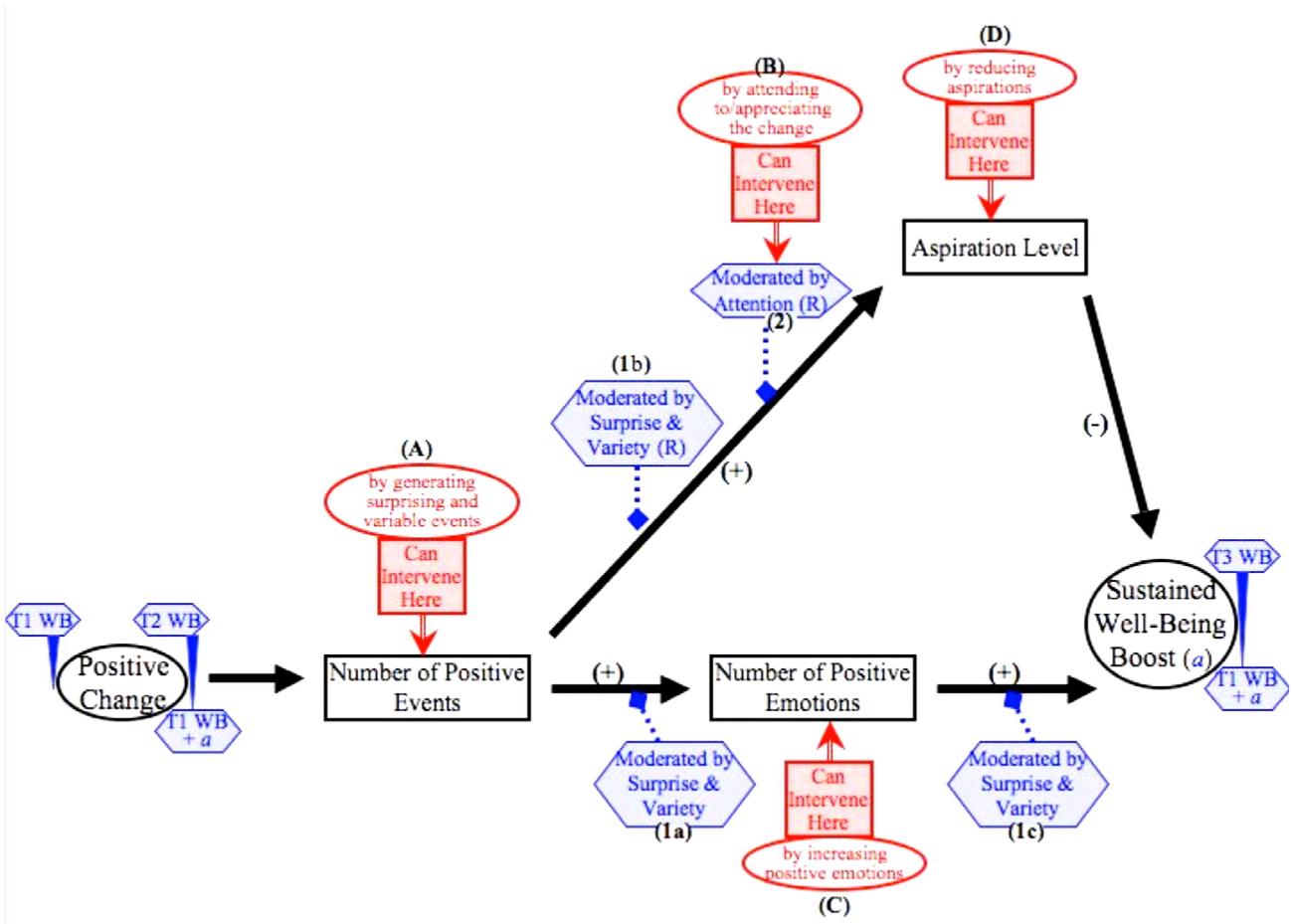


Figure 9a – HAPNE model in the positive domain

In a nutshell, the aim of the HAPNE model is to increase agent’s well-being or, in other words, their happiness. Hsee, Hastie and Chen (2008) called “hedonomics” that part of behavioral decision theory interested in maximizing happiness with limited wealth. Its conceptualization derives from some interesting considerations:

“[...] hedonomics would not be necessary if happiness depended only on the absolute level of desired external outcomes. Nor would it be necessary if people could accurately predict which option brings them the greatest happiness and could base their choices on their predictions. But neither of these conditions is true. [...] happiness depends not simply on the absolute level of desired outcomes, but also on how these outcomes are presented and evaluated [...]. In addition,

decision makers exhibit systematic biases in predictions and choices leading to failures to maximize happiness [...]” (Hsee, Hastie and Chen, 2008)

As already seen, the level of well-being related to a situation is connected to the direction of the

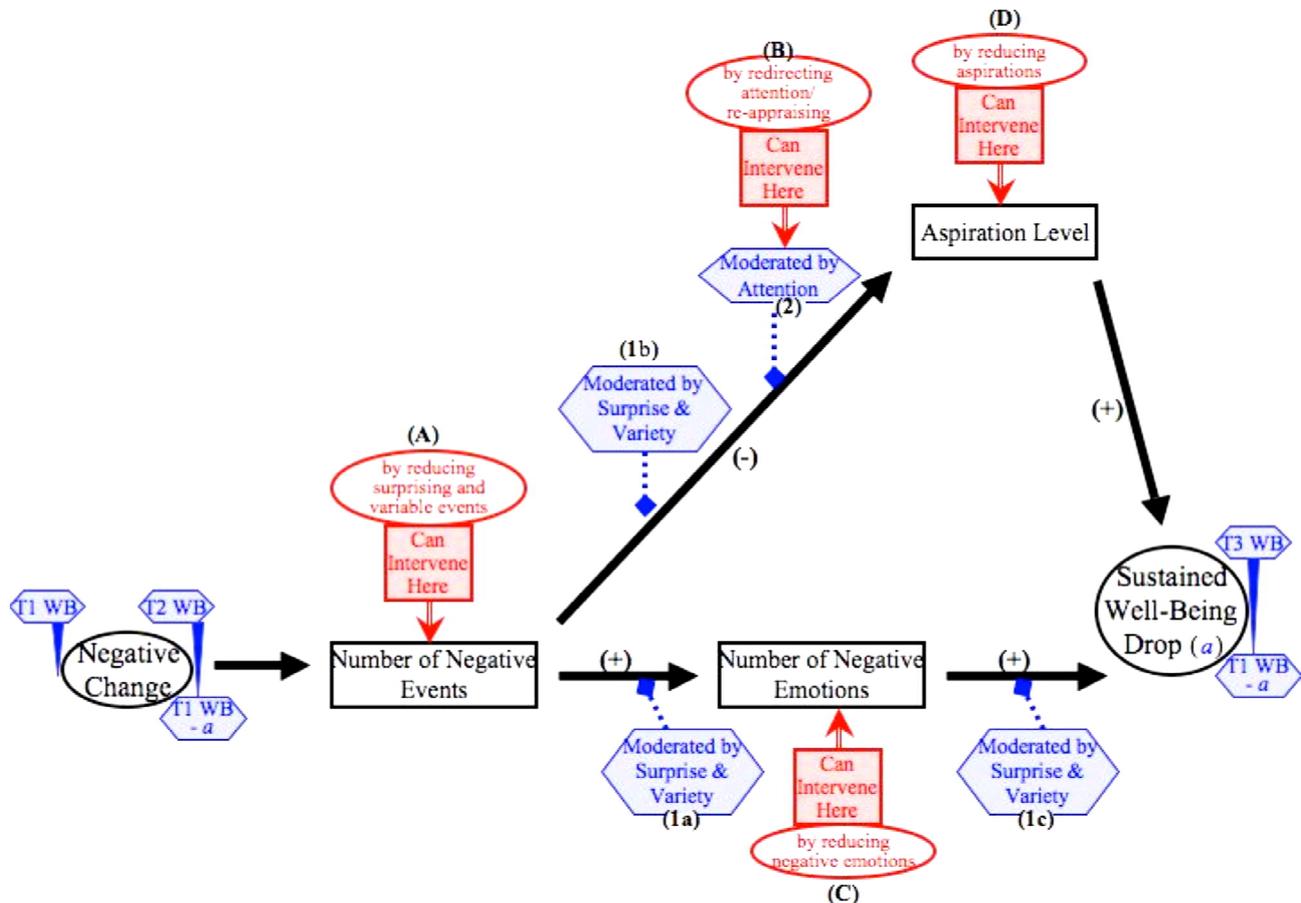


Figure 9b – HAPNE model in the negative domain

change it brings (i.e. “the experience is positive if the change is in the desired direction and is negative if the change is in the opposite direction”), its rate of change (or velocity) and the “composition” of such velocity (that is, acceleration and/or deceleration). Furthermore, elements like an individual’s representation of range and frequency of an hedonically relevant outcome, as well as his/her consideration of which outcomes represent the “norm” and which the “exception”, are all variables that have an impact on happiness levels.

The concern about raising and maintaining the well-being of people derives from the awareness that they often make their decisions using defined strategies, which prove to be experientially sub-optimal. Among them, we can list: impulsivity; prediction, simulation and affective forecasting; rules and heuristics.

An interesting aspect of hedonomics is that it expands the neoclassical notion of utility:

“In the neoclassical view, utility is simply a number that codifies an expressed preference (“decision utility”). But people may also have memories of which goods or activities they enjoyed

most ("remembered utility"), immediate momentary sensations of pleasure and pain ("instant utility"), and guesses about what future utilities will be like ("forecasted utility")." (Camerer and Loewenstein, 2003)

Whenever a difference between decision utility and one of the other types of utility is detected, there is room for the intervention of policy, education, or social guidance.

In the development of this section, the relationship between reference point and hedonic adaptation has been explained. Since the concept of adaptation makes constantly reference to psychological insights, many of the studies cited so far focus on a broad range of topics, from incurable diseases to marital status. Nevertheless, hedonic adaptation causes relevant effects also for economic issues.

Some examples have already been provided, even if not analyzed under the light of this phenomenon. For instance, the four principles that agents follow (i.e. segregate gains, integrate losses, integrate losses against larger gains, segregate "silver linings") described by Thaler (1985)<sup>63</sup> can be considered as hedonic-editing rules, that is, guidelines that help people cope with bad situations and maintain the impact of good ones. Another example can be Strahilevitz and Loewenstein's (1998) inquiry about the effect of ownership history on object valuation, which takes into account that hedonic adaptation is also a function of the passing of time. Again, the study of Kume and Suzuki (2010) on the effect of ageing in reference point changes gives a hint on cross-generational hedonic adaptation.

Other investigations start from a particular argument not strictly related to economics and then make some considerations about the implications of their findings for economic agents. For instance, in their analysis of bad life events that cause disability – for which they detected partial hedonic adaptation –, Oswald and Powdthavee (2008) discussed also the potential implications for economists and judges.

Among the researchers most interested in the effects of hedonic processes in economics, we can list Arkes and his coworkers, whose contribution is described in the next sub-section. Their study is one of the most important contributions in the analysis of hedonic adaptation and its effects for investors.

## 2.2. An interesting study on hedonic adaptation

Arkes, Hirshleifer, Jiang and Lim (2008) analyzed reference point adaptation following gains and losses in the domain of security trading, finding that subjects act as hedonic maximizers. To infer such behavior, they designed questionnaire based inquiries and experiments with monetary

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<sup>63</sup> See chap. 1.

incentives having the aim of detecting if the magnitudes of reference point adaptation following increases and decreases of stock prices were different.

Questionnaire experiments consisted of five groups of questions, each group characterized by two complementary problems, one depicting a scenario of gain and the other a scenario of loss. In the basic questions (i.e. the first group), subjects were asked to imagine a situation in which, two months before the present time, they bought a stock at a given price. After a period of time (i.e. one month), the value of the stock increased (in case of gain) or decreased (in case of loss). Then, agents had to express which value the stock needed to have at the present time in order to generate the same utility as the previous change in its value.

The subsequent three couples of questions represented a variant version of the basic inquiry: one hypothesized that the agents sold and then repurchased the stock; one depicted a scenario in which subjects bought a portfolio of assets, instead of a single stock; another, combining the previous two, presented the sale and repurchase event in case of portfolio-holding.

The content of the last two groups of questions were arranged following a different methodology: the variation of stock price was determined by a coin flip, which was not predictable by any means. The difference between the two groups consisted in the absence or presence of the sale and repurchase intervention.

Arkes and colleagues analyzed the results obtained dividing the five groups of questions into two categories, according to the methodology followed. On one side, they compared the basic problem with the sale and repurchase event problem and the portfolio-holding problem. Running a series of tests, the researchers detected that: adaptation was greater following gains than following losses in each hypothetical situation; an intervention of sale and repurchase of the stock had a greater impact on average adaptation – increasing it in case of gain and decreasing it in case of loss – than the other two scenarios; there was no significant difference in adaptation between the case of portfolio-holding and the case of possession of a single stock.

On the other side, Arkes and his workmates compared the two coin flip problems. In this case, they found that, while in both situations reference point adaptation was greater for gains than for losses, there was no significant difference between the scenario in which the stock was sold and then repurchased, and the scenario without such intervention.

Once completed the analysis of all questionnaire-based inquiries, the researchers concluded that – independently from the methodology followed – agents always updated their reference point following gains as well as losses. The fact that adaptation to gains was greater than adaptation to losses was justified by Arkes and colleagues through the concept of mental accounting, as described by Thaler (1985). In particular, they underlined that “people may be tempted to be “creative” in adjusting their accounting principles in order to feel good about themselves or about their pecuniary outcomes”. This intuition took the authors to make two

hedonic considerations that help explain how investors adapt their reference point with respect to a change in price:

“First, [...] the value function<sup>64</sup> is concave in the domain of gains; diminishing returns render subsequent gains less valuable than initial ones. Thus a hedonic maximizer might adapt to gains in order to re-set the origin of the [...] function close to the new level of wealth. On the other hand, the convexity of the value function in the region of losses might cause a value maximizer to resist reference point migration downward following a loss. If the reference point adapts to the first loss, a subsequent loss will be more painful than if the original reference point were to be maintained. [...] second [...], closing an account re-sets the reference point and segregates the prior consequences from future ones. Due to the differential immediate hedonic consequences, investors will have more incentive to close a prior account after a gain than after a loss.” (Arkes, Hirshleifer, Jiang and Lim, 2008)

Hence, as hedonic maximizers, people will tend to adapt in a faster and more complete way their reference point in case of gain than in case of loss.

Arkes, Hirshleifer, Jiang and Lim underlined a potential critique to the above analysis: answering to hypothetical questions may lead to different results than in case of experiencing real outcomes. For this reason, they ran similar tests using experiments with monetary incentives. The purposes of the investigations, then, were to detect if there still was asymmetric reference point adaptation after gains and losses, and whether selling and repurchase events had an impact on such adaptation.

Following the Becker, DeGroot and Marschak (1964) procedure (BDM), the researchers designed a series of experiments in which subjects had to reveal their minimum selling price when evaluating some risky gambles. From these valuations, Arkes and coworkers could infer the reference point adaptation after a gain or a loss.

Once again, the analysis of data obtained from participants suggested that adaptation following gains was greater than adaptation following losses, and that the selling-repurchasing activity accelerated adaptation. The hypotheses of mental accounting and hedonic maximization, hence, were still confirmed.

In summary, the authors came to the conclusion that, independently from the experiment conducted, agents tended to adapt their reference point upward in case of gains in stock value and downward after losses in such value, with greater adaptation in the former situation than in the latter. Furthermore, this result was robust to whether investors sold and repurchase the stock or kept holding it, as well as whether they hold a single stock or a portfolio.

To justify such findings, the researchers used the concepts of mental accounting and hedonic maximization:

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<sup>64</sup> Clearly, they were referring to prospect theory value function.

“[...] the asymmetric adaptation can be [...] explained by the tendency to segregate intertemporal gains and integrate intertemporal losses. Specifically, after experiencing gains, segregating part of the prior gains from the subsequent mental account increases hedonic utility by placing the remaining prior gains in the steeper region of the gain domain and also using it to cushion the future possible losses. In contrast, after experiencing losses, investors are inclined to keep it integrated so that it is evaluated in the flatter region in the loss domain in order to minimize hedonic disutility.” (Arkes, Hirshleifer, Jiang and Lim, 2008)

Throughout this study, Arkes and his fellows made reference to previous research in inherent topics, both to justify some choices in their own contribution and to shed a light on the findings of other behavioral economists through their analysis. The next sub-section provides a description of those works cited in the paper of Arkes and coworkers. Furthermore, it gives a hint on subsequent research developments by the same as well as other authors.

### 2.3. Previous and subsequent related research

As underlined, Arkes, Hirshleifer, Jiang and Lim (2008) used some of the results of precedent literature having a connection with their investigation. For what concerns the assessment of the initial reference point, they cited the work by Spranca, Minsk and Baron (1991), who claimed that the price at which the stock is initially bought plays a prominent role. Given that they did not provide any further information about the value of the stock before the initial purchase, Arkes et al. followed the idea expressed by Spranca and colleagues, developing their calculations considering as subjects' starting reference point the price at which they purchased the stock.

Considering the issue of adaptation, Arkes and coworkers examined some papers analyzing this phenomenon, finding that their model and results were consistent with such studies. For instance, according to the investigation of Gneezy (2002), the selling behavior of investors can be better understood if the past price peak is assumed as their reference point. Such result was explained by Arkes et al. through asymmetric adaptation:

“Since investors tend to move reference points upward after gains more than downward after losses, after experiencing gains or losses, reference points tend to be closer to the higher of the two prices – the past period price and the current period price. When a reference point moves more quickly upward to a higher price compared to downward toward a lower price, after a number of periods it will eventually approach the past price peak.” (Arkes, Hirshleifer, Jiang and Lim, 2008)

The investigation that Arkes and fellows developed, enabled them to shed a light on Thaler and Johnson's (1990) “house money effect”, that is, the tendency of investors to become more risk

seeking after prior gains. According to these authors, when facing a gamble after a prior gain, an individual segregates gains and integrates losses, in order to render the gamble more attractive. They defined such process as “quasi-hedonic editing rule”. The framework of partial reference point adaptation proposed by Arkes et al. made sense with the findings of Thaler and Johnson, providing also an alternative to their quasi-hedonic editing rule:

“[...] under the quasi-hedonic editing rule, one uses two different reference points to evaluate a gamble: the current wealth is the reference point to evaluate the gain prospect of the gamble; the initial wealth is the reference point to evaluate the loss prospect. [...] When one partially adapts to prior gains, the prior gain is segregated into two parts: one part goes to the old mental account; the other part goes to the current mental account. The remaining gain in the current mental account can serve as a cushion for the future possible loss, which reduces the incremental disutility of the loss prospect. Therefore, the gamble becomes more attractive conditional on a prior gain.” (Arkes, Hirshleifer, Jiang and Lim, 2008)

Arkes and colleagues have been able to explain another finding by Thaler and Johnson (1990): framing a question as a static (i.e. “one-stage game”) or a dynamic (i.e. “two-stage game”) choice problem changes the way agents perceive payoffs, modifying also their risk preferences. As the authors explained:

“In a one-stage game, there is no prior outcome and thus reference points do not update. However, in a two-stage game, the presence of prior outcomes forces reference points to adapt toward the outcome payoffs. In the case with a prior gain, reference points move upward, which segregates the prior gains intertemporally and increases the attractiveness of the gamble. In contrast, when there is a prior loss, reference points move downward, which segregates the prior losses intertemporally and decreases the attractiveness of the gamble. Taken together, due to adaptation toward prior outcomes, people exhibit increased risk preferences in the two-stage gamble with a prior gain but decreased risk preferences in the two-stage gamble with a prior loss.” (Arkes, Hirshleifer, Jiang and Lim, 2008)

If, on one side, the study by Arkes, Hirshleifer, Jiang and Lim (2008) proved to be valid with respect to previous findings, on the other side it prompted subsequent research using similar methodologies. For example, consider the contribution of Lee, Kräussl, Lucas and Paas (2009), who asked themselves why investors eventually capitulate to their losing investment. Their analysis, then, was focused on the loss domain of the value function. Combining reference point adaptation with prospect theory and the expected utility model, they investigated “the antecedents of reference point adaptation and the role that it plays in the decision to capitulate a losing investment”. Through a dynamic experiment, they concluded that:

“[...] a large prior loss and a longer time spent in a losing position predict greater reference point adaptation. [...] negative expectations lead to a stronger tendency to capitulate. Moreover, the effect of negative expectations is stronger when investors have adapted less to the prior loss. Thus, in the presence of negative expectations, investors who adapted more to prior losses are less likely to capitulate to their losing investment, compared with those who have adapted little.” (Lee, Kräussl, Lucas and Paas, 2010)

The researchers underlined that this study, based on Shefrin and Statman’s (1985) disposition effect, was in line with the results found by Arkes and colleagues, adding to their static single-decision experiments a more complete dynamic investigation, capable of approximating real-life investment decision-making in a better way.

Another contribution that made reference to the work of Arkes et al. is that of Grant, Xie and Soman (2010), who ran some experiments proving that investors update reference prices asymmetrically. Similarly to what already discovered, these authors found that the adaptation to an increased value of the stock was greater than the adaptation to an equally-sized decrease in stock value. Unlike Arkes and coworkers, however, Grant et al. did not consider the “hedonic consequences of adaptation by measuring how much higher (or lower) a stock must rise (or fall) to achieve a comparable level of happiness (or sadness)”. Rather, they preferred focusing on the comprehension of the reasons why asymmetric updating happens:

“[...] we provide evidence that asymmetric updating occurs because positive asset price movements foster a selling mentality, eliciting greater attention to positive prices, and leading investors to reset their reference price. Negative asset price movements create a holding mentality, whereby investors cling to the goal of breaking even, reinforcing their original reference price. As further support to this view, we find evidence of selective processing attention such that investors pay greater attention when a stock follows a positive path versus a negative path.” (Grant, Xie and Soman, 2010)

A few years later from the publication of their important study, Arkes, Hirshleifer, Jiang and Lim (2010) ran a similar inquiry, asking themselves if there are cross-cultural differences in the adaptation of the reference point between Asian (i.e. Chinese and Korean) individuals and North American subjects. As in their first research, the authors used both questionnaire-based and monetary-incentive experiments. Once again, the results found did not change with respect to the type of inquiry tool used.

From their analysis, Arkes et al. came to three main conclusions. First, both Asian and American respondents showed to be hedonic maximizers, updating asymmetrically their reference point with respect to gains and losses.

Second, without a sale and repurchase intervention, “adaptation to prior outcomes was greater among Asians than among Americans”. Such result has been explained by the fact that Asian people are less loss-averse. Furthermore, they have a “holistic” view of the world:

“East-Asians view the world as complex and highly changeable with interrelated components where individuals are less able to impact the course of an event. In contrast, Americans view the world consisting of discrete, independent, and stable objects where each individual is in control of their own behavior and the consequence of such behavior. Such viewpoints lead to Asians’ more malleable and Americans’ more stable preferences and personalities.” (Arkes, Hirshleifer, Jiang and Lim, 2010)

Third, the sale and repurchase episode “facilitated adaptation in the US significantly more than that in the two Asian countries”. The authors underlined that the finding for American respondents was consistent with that of their previous study:

“[...] by having the subject sell the stock and realize the paper gain/loss, the new price at which their gain or loss occurs becomes more salient. This encourages adaptation from the original price toward that new price at which the sale and new purchase occurs.” (Arkes, Hirshleifer, Jiang and Lim, 2010)

To explain the different behavior of Asians, once again Arkes and colleagues made reference to the holistic point of view typical of the oriental culture, which makes people notice the connection among all the events. Hence, unlike Americans – who are used to see every occurrence as an independent entity –, Asians will tend to keep their old mental account, instead of opening a new one, after an intervention of sale and repurchase. Furthermore, the authors found trace that Asians, depending on how a scenario is framed and presented, are characterized by “a strong contrarian view in prediction”, believing that actual circumstances will eventually change:

“[...] in our experimental setting the sale intervention makes that outcome more salient and thus more strongly triggers the contrarian prediction of Asians. If the first price change is positive, Asian participants will have a somewhat greater expectation of an adverse outcome. Therefore, they will be unwilling to adapt their reference point upward substantially; by adapting sluggishly, they add a cushion to their mental account against the greater possibility of a future loss. In the case with a prior loss, Asians will expect a greater likelihood of a future gain. By adapting less aggressively to the prior loss, Asians will anticipate this future gain and use part of it to offset part of the prior loss.” (Arkes, Hirshleifer, Jiang and Lim, 2010)

Comparing the two works by Arkes, Hirshleifer, Jiang and Lim (2008 and 2010), some questions could raise: what if the findings of their first study is only one of the possible outcomes

that researchers can obtain? Is it possible to detect a behavior similar to that of East-Asians in subjects that do not share their culture?

In order to verify the reliability of the results found by Arkes and coworkers in their first inquiry, I ran an experiment that presented to the subjects some of the problems proposed by these researchers (see chap. 4).

### 3. Frames, reference point and hedonic adaptation: a look on normative implications

The presence of frames in the context of decision-making processes implies that agents can perceive similar outcomes in very different ways, according to how they set their own reference point. Given the non-axiomatic nature of prospect theory – as opposed to expected utility theory –, the analysis of decision-makers' behavior requires a series of investigations that involve changes in the frame of reference. In particular, the reference point is one of the elements that received great attention by behavioral economists, since it gives a hint on the effect of different frames.

When the frame is considered in a static environment, the focus is on those elements that take to the assessment of a given – initial – reference point. When, instead, the frame is examined in a dynamic environment, the focus is on its development in time.

With reference to dynamic decision-making contexts, the study of the reference point focuses on the process of adaptation. In particular, various experiments have witnessed that agents act as hedonic maximizers.

The examination of the reference point is important not only for positive (i.e. descriptive) purposes, in the attempt of understanding the real behavior of economic actors, but also for normative reasons, like the aim of improving the welfare of individuals through more effective social policies. Consider the emergence of light paternalism in recent developments of behavioral economic theorization<sup>65</sup>. According to such line of thought, the purpose of policy-makers should be to promote operations that help people make better choices – in their own interest –, leaving them autonomy and freedom of choice at the same time.

In this context, then, frames can be the key element to intervene in decision-making processes without the need of stronger coercive means (like laws, as advanced by authoritarian paternalism). In particular, once detected the initial reference point of individuals in a given ambit of interest (e.g. issues on public goods, healthcare, or social security), policy-makers could change it through a series of operations stimulating the adaptation toward the direction desired. In doing so, they should take into account the fact that agents act as hedonic maximizers, even though with different degrees. The divergences in hedonic adaptation processes can be justified by various factors, like cultural backgrounds, as Arkes, Hirshleifer, Jiang and Lim (2010) detected in their cross-cultural inquiry.

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<sup>65</sup> See chap. 1.

## Chapter 4

### Testing for hedonic processes in the domain of security trading

As chapter 3 highlights, frames play a key role in prospect theory's attempt to describe and predict individuals' decision-making process in conditions of risk or uncertainty. To see how – and when – agents change their final choices, researchers need to vary the frame in which such choices are taken. The immediate effect of a change in frames is reflected in a variation of the reference point, which represents one of the most characterizing features of prospect theory.

Several authors considered the issue of reference point adaptation, since it is strictly connected to the idea that different frames have an impact on subjects' valuation. Particular interest has been recently given to hedonic adaptation, defined as the tendency of agents to return to an approximately stable level of happiness, notwithstanding highly positive or negative events they can experience in life.

Arkes, Hirshleifer, Jiang and Lim (2008) are some of the researchers most interested in the effects of hedonic processes in economics. Their most important investigation focused on reference point adaptation following gains and losses in the domain of security trading (for a detailed explanation, see chap. 3). The results found suggested that agents act as hedonic maximizers, adapting their reference point in an asymmetric way with respect to a gain or a loss. Such asymmetry was justified by means of mental accounting theory: given the S-shape of the value function, which reflects loss-aversion, agents tend to segregate intertemporal gains and integrate intertemporal losses.

Given the relevance of this study for its innovative approach – indeed, no similar studies can be detected in previous literature – and the subsequent developments it prompted, I chose to verify the reliability of the results found by Arkes and coworkers conducting an experiment that presented to the subjects some of the problems proposed by these researchers.

The following chapter will describe such experiment, from the characteristics of the inquiry and of the sample, to the final considerations it suggested.

## 1. Describing the experiment

The model of reference for the development of my own inquiry is the study by Arkes, Hirshleifer, Jiang and Lim (2008) on reference point adaptation in the domain of security trading. In conformity with the purpose of these researchers, I wanted to detect if the magnitudes of reference point adaptation following increases and decreases of stock prices were different, testing if mental accounting and hedonic maximization were confirmed. Whenever my results were not compatible with those of Arkes et al., I tried to detect whether such differences were due to methodological reasons or other factors (e.g. psychological, emotional, cognitive, etc.).

### 1.1. The questionnaires

The investigation was conducted over a period of 38 days (from March 20<sup>th</sup> to April 26<sup>th</sup> 2012) and consisted of two questionnaires – namely, A and B – each presented to a given group of subjects. The structure of the questionnaires was divided into two parts. The first contained some questions about demographic aspects of the respondents, like gender, age, educational level and net disposable income. The second part was made of open-ended questions describing hypothetical situations regarding the stock market. Subjects had to imagine that they bought one or more stocks, whose value increased (or decreased) after a period of time; then, they had to express at what price the stock needed to be traded at the present time in order to make them as happy (or as sad) as the previous rise (or fall) of price made them.

With respect to their content, the problems presented to subjects were divided into 4 groups, each group being formed by couples of questions, which, starting from the same initial conditions, depicted either a scenario of gain or a scenario of loss. Hence, the total problems were 8. The complementary questions have been equally divided between questionnaires A and B, so that those subjects answering to a “gaining” problem were different from those answering to its “losing” counterpart.

Table 1 shows how the 4 groups of questions have been distributed between the questionnaires. The number assigned to each group corresponds to the number of its related questions as presented to the respondents. Appendix A reports the entire questionnaires.

Group	Name	Questionnaire A	Questionnaire B
1	Basic	Gain	Loss
2	Sale and repurchase	Loss	Gain
3	Portfolio	Gain	Loss
4	Coin flip	Loss	Gain

Table 1 – Division of problems between questionnaire A and questionnaire B

## 1.2. Computational methods

Before considering the sample and the various answers obtained, it should be useful to explain the calculations I made in my analysis. As already highlighted, each problem asked respondents at what price the stock needed to be traded at the present time in order to make them as happy (or as sad) as the previous rise (or fall) of price made them. In other words, subjects had to express which value of the stock would generate – in their opinion – the same utility (or disutility) as a former modification in the price of such stock.

Marking as  $P_1$  the purchase price of the stock and  $R_0$  the initial reference point of respondents, the difference between these two values should be the same as the difference between the new value declared by agents  $P^*$  and their new reference point  $R^*$ . Then, under the assumption that the shape of the value function does not change, the following equation is obtained<sup>66</sup>:

$$P^* - R^* = P_1 - R_0 \xrightarrow{\text{yields}} R^* - R_0 = P^* - P_1$$

As the transformation suggests, in this way it is possible to calculate the reference point adaptation. This formula has been used to find the magnitude of adaptation in questions 1, 2 and 3, while for question 4 a slightly different procedure – which will be explained later in the chapter – was followed.

The further step in my calculations consisted in comparing among them the data of each problem, in order to detect if reference point adaptation showed significant differences either between the case of gain and the correspondent case of loss (i.e. intra-group analysis), or between one scenario and another (i.e. inter-group analysis). Hence, I conducted a series of analyses of variance (i.e. ANOVA tests), confronting two problems per time.

The ANOVA test had the aim to verify the null hypothesis that the difference between the mean answer to one problem and the mean answer to another problem was equal to zero (or, in other words, if the two means were equal), against the alternative hypothesis that this difference was not equal to zero (that is, if the means were not equal):

$$\left\{ \begin{array}{l} H_0: \mu_0 - \mu_1 = 0 \\ H_1: \mu_0 - \mu_1 \neq 0 \end{array} \right. \longrightarrow \left\{ \begin{array}{l} H_0: \mu_0 = \mu_1 \\ H_1: \mu_0 \neq \mu_1 \end{array} \right.$$

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<sup>66</sup> Since I compared my results with the findings of Arkes et al. (2008), this procedure is the same as the one used by the authors.

### 1.3. The sample

Before analyzing the results, I will give an account of the characteristics of the sample. The questionnaires have been presented to a total of 63 subjects. Precisely (see fig.10), 32 persons (12 males and 20 females) answered to questionnaire A, while 31 persons (12 males and 19 females) answered to questionnaire B.

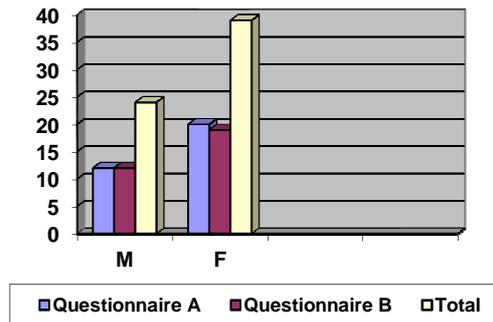


Figure 10 – Gender distribution

45 respondents have an age included between 19 and 24 years old, 14 between 25 and 30 years old, 3 are older than 30, and only one has less than 18 years old (see fig.11). The majority of them is Italian (50 out of 63 persons), while one subject is Mexican, and the rest belong to a European country: 5 are Spanish, 5 French, one is Portuguese, and one Swiss.

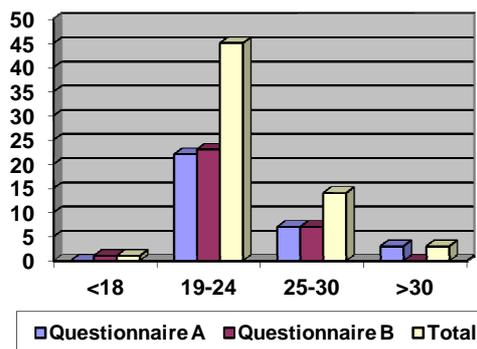


Figure 11 – Age distribution

Looking at the educational level, 2 persons have only attended the primary school, while 31 subjects possess a high school qualification, 24 a bachelor degree, 5 a master degree, and only one obtained a PhD.

Considering their current occupation, almost 70% of respondents are students (44 out of 63), 11 are employed, 4 are self-employed, 3 have no occupation (i.e. unemployed), and one is retired.

More than 90% of subjects (57 out of 63) belong to a 3-to-5-persons family unit, while 4 live alone, one lives with another person (i.e. the individual belongs to a 2-persons family unit), and one has a family with more than 5 members.

Finally, considering the disposable net income per year, it has been divided into 5 ranges (see fig.12): 28 subjects belong to the zero-to-10,000€ range, 10 persons earn an income included between 10,000 and 20,000€, 16 subjects between 21,000 and 50,000€, 8 from 51,000 to 100,000€, and only one more than 100,000€.

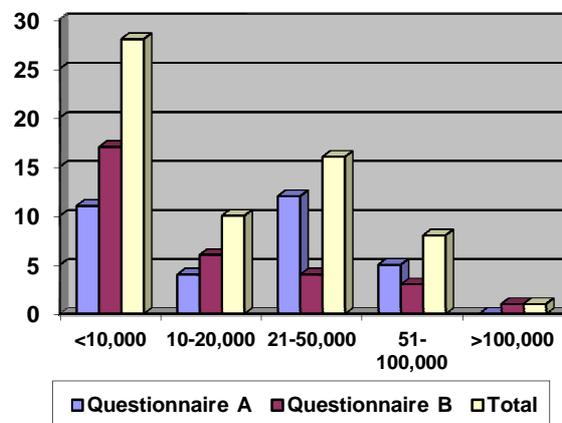


Figure 12 – Distribution of disposable net income per year

## 2. Analysis of data

Once provided a description of the survey, the computational methods and the demographic characteristics of the sample, it is possible to look at data, comparing my findings with those of Arkes, Hirshleifer, Jiang and Lim (2008). In order to expose each computation and result in a clear way, I divided the examination into four steps. The first consisted in testing if the adaptation to gains was greater and significantly different than the adaptation to losses, through an intra-group analysis.

The second and third steps involved in an inter-group analysis, testing the effect of the different scenarios presented in the problems with respect to a gain or a loss.

Finally, the fourth stage consisted in analyzing problem 4. I considered such question separately from the others since its content has been arranged following a different methodology (see forth for an explanation).

### 2.1. The intra-group analysis

Considering if the adaptation to gains was greater and significantly different than the adaptation for losses, first of all I ran the ANOVA test in problems 1, 2 and 3 separately. For all groups I rejected the null hypothesis that the average of gains and the average of losses were equal ( $F(1,61) = 499.88$  in problem 1,  $F(1,61) = 105.83$  in problem 2,  $F(1,61) = 376.40$  in problem 3, all with  $p < 0.0001$ ). This result implied that the difference between the two means was significant. So, I could assert that the adaptation for gains was significantly different than the adaptation for losses. Furthermore, the implied adaptation for gains was greater than the implied adaptation for losses for each problem, as showed in table 2.

In a second phase of the intra-group analysis, I ran the ANOVA test considering the gain/loss answers of the three problems all together. Once again the difference between the two means was significant ( $F(1,187) = 1374.5$ ,  $p < 0.0001$ ), with the adaptation for gains greater than the adaptation for losses.

Both these findings were congruent with those of Arkes and colleagues.

Implied adaptation	Gain	Loss	Mean	Standard deviation
Problem 1	\$5.04	\$3.17	\$4.119841	\$1.32229
Problem 2	\$5.2	\$3.04	\$4.102857	\$1.527351
Problem 3	\$4.98	\$2.19	\$3.607143	\$1.972828

Table 2 – Reference point adaptation for gains and losses in each question

## 2.2. The inter-group analysis in the gain domain

As previously underlined, the second stage of my analysis consisted in testing the effect of the different scenarios presented in each problem with respect to an increase in the stock value (i.e. a gain). In order to give an exhaustive explanation of each result, I compared two problems per time.

In every type of problem, I found that the reference point has always been updated upwards. This was a consequence of a process called “Bayesian updating”: when agents are informed that the stock value had increased the period before, they tend to be more confident on the fact that it will trade higher in the subsequent period. Furthermore, such finding mirrored the mental accounting hypothesis of Thaler (1985), according to which individuals tend to segregate gains. Indeed, given the concavity of the value function in the gain domain, to obtain more pleasure from subsequent gains agents prefer re-setting their reference point at the new price of the stock or, at least, at a closer value.

Comparing problem 1 (basic question) with problem 2 (sale and repurchase intervention question), the average answer for the former (\$41.04) was smaller than the average answer for the latter (\$41.20). Extending the idea of gains segregation expressed by mental accounting theory, subjects are expected to reset their new reference point to the new price and away from the initial purchase price when they sell the stock and later repurchase it at the same price. Hence, my result seemed to mirror the one found by Arkes and coworkers (2008) – which confirmed the hypothesis of mental accounting theory –, suggesting that individuals tend to segregate the first gain from the second in a more relevant way when they face an intervention of sale and repurchase. However, while the difference between the two average answers in the researchers’ paper was significant ( $\$41.84 - \$40.24 = \$1.60$ ), my data gave a very low result ( $\$41.20 - \$41.04 = \$0.16$ ), so that it was necessary to conduct an ANOVA test.

In summary, I wanted to test if the reference point adaptation to a simple change in the stock value was significantly different from the adaptation to a change with selling and repurchasing intervention. Unfortunately, the test accepted the null hypothesis that the means of these two groups of data were equal ( $F(1,61) = 0.04, p = 0.85$ ). Hence, even though mental accounting had an impact on reference point adaptation in each scenario considered separately, I could not conclude that there were significant differences between the case with selling and repurchasing and the case without such intervention.

This result could have derived from the nature of the inquiry itself. Facing a questionnaire that asks people to imagine a possible scenario and answer what they would do in that situation, clearly is not the same as making them experience that particular circumstance in real life and collect their reactions. Furthermore, in order to guarantee impartial results, the selling and repurchasing operation has not been particularly underlined to the subjects (nevertheless, in each

problem I used the same language that Arkes and colleagues used), otherwise they could have felt a sort of need for answering in a “proper” way, rather than giving their simple opinion.

Another interesting comparison was the one between problem 1 (basic question) and problem 3 (portfolio question). Here, the focus was on whether investors behaved differently when they hold a portfolio of stocks instead of a single stock. Indeed, in the real world investors possess portfolios rather than single stocks, so that their reference point could be updated differently following the fluctuations of the entire set, rather than those of one asset. Notwithstanding this reasoning, which seems rationally plausible, in their analysis Arkes et al. found that for agents there was no significant difference between these two contexts.

My sample appeared to give the same result. Indeed, simply looking at the average answers (\$41.04 for problem 1 and \$40.98 for problem 3), it seemed that there were no difference for agents between single stocks and portfolios ( $\$41.04 - \$40.98 = \$0.06$ ). To confirm this intuition, I ran the ANOVA test. As expected, the analysis supported the idea that there was no significant difference in reference point adaptation between the two scenarios. In fact, I accepted the null hypothesis that the means of the two groups of data were equal ( $F(1,62) = 0.005, p = 0.95$ ).

Even if it validated previous research findings, the result I obtained could have been a consequence of the fact that the answers to both problems derived from the same sample (i.e. those people who answered to questionnaire A). As a matter of fact, the percentage of subjects that gave the same final stock value to both situations was almost 69% (precisely, 68.75%), while the correlation between the two groups of answers was 79%.

In order to give a complete analysis, I also compared problem 2 (sale and repurchase intervention question) with problem 3 (portfolio question). So, I wanted to check if there was any significant difference in reference point adaptation between the situation of selling and repurchasing intervention and the scenario of portfolio holding. Arkes and colleagues found that the mean adaptation following the sale and repurchase intervention significantly exceeded the mean adaptation of the portfolio group.

Confronting the average answers in my data (\$41.20 for problem 2 and \$40.98 for problem 3), there was a relevant difference between them (\$1.20). However, the ANOVA test accepted the null hypothesis that the means of these two groups of data were equal ( $F(1,61) = 0.06, p = 0.81$ ), so I could assert that there was no significant difference between an intervention of sale and repurchase and holding a portfolio of stocks. There was no much surprise in this result, since I should have expected to obtain a similar result to the one found in the comparison between problems 1 and 2, given the high correlation between the answers to the basic question (problem 1) and the portfolio question (problem 3).

### 2.3. The inter-group analysis in the loss domain

Once concluded the study of the gain domain, I considered the loss domain under the same type of perspective. Here, the Bayesian updating process was again present, even if with “opposite sign”. In fact, in every problem the reference point was updated downwards, since when agents are informed that the stock value had decreased the period before, they tend to be more confident on the fact that it will trade lower in the subsequent period. Also Thaler’s (1985) mental accounting hypothesis, according to which individuals tend to integrate losses, was confirmed. Given the convexity of the value function in the loss domain, to mitigate the sorrow of future losses subjects choose to maintain their reference point at the old stock price or, at least, at a similar level.

In the comparison between problem 1 (basic question) and problem 2 (sale and repurchase intervention question), the average answer for the former (\$20.83) was smaller than the average answer for the latter (\$20.96). These data could suggest that mental accounting has a greater impact on subjects when they sell and repurchase the stock, becoming more inclined to close their prior mental account, resetting the reference point to the new purchase price and away from the initial one. Nonetheless, the difference between the average answers of my sample was almost irrelevant (\$0.13), suggesting that mental accounting did not have a bigger effect in reference point adaptation in presence of a selling and repurchasing intervention. To confirm this intuition, I ran the ANOVA test.

As expected, the null hypothesis that the means of the two groups were equal had to be accepted ( $F(1,61) = 0.02$ ,  $p = 0.9$ ), so the reference point adaptation in the sale and repurchase situation was not significantly different from the adaptation in absence of this intervention. Once again, I could assert that mental accounting, while having an impact on reference point adaptation in each scenario considered separately, did not generate relevant differences in the comparison between the case with selling and repurchasing and the case without such intervention.

As explained in the previous analysis for the gain domain, the reasons for this difference with respect to Arkes and colleagues’ result could have been the nature of the inquiry itself and the will of not influencing subjects’ answers.

Comparing problem 1 (basic question) with problem 3 (portfolio question), the average answer of the latter (\$21.81) was greater than that of the former (\$20.83), suggesting that holding a portfolio makes agents update their reference point in a different way with respect to holding one single stock. However, the ANOVA test was not significant ( $F(1,60) = 1$ ,  $p = 0.32$ ), so I concluded that for subjects there was no difference between single stocks and portfolios when adapting their reference point.

Again, even if it validated previous research findings, this result could derive from the fact that the answers to both problems came from the same sample (i.e. those people who answered to questionnaire B). Indeed, the percentage of subjects that gave the same final stock value to both

situations was almost 67% (precisely, 66.66%), while the correlation between the two groups of answers was 42%.

Finally, I compared problem 2 (sale and repurchase intervention question) with problem 3 (portfolio question). The difference between the two average answers (\$20.96 for problem 2 and \$21.81 for problem 3) was not so relevant (\$0.85), suggesting that there is no distinction between adaptation in the selling and repurchasing scenario and the portfolio holding situation.

As a matter of fact, the ANOVA test was not statistically significant, accepting the null hypothesis that the means of the two groups were equal ( $F(1,61) = 0.76$ ,  $p = 0.39$ ). Like in the gain domain, this result was not surprising, since the answers to the basic question (problem 1) and the portfolio question (problem 3) were correlated, so I should have expected to obtain the same result as in the comparison between problem 1 and 2.

#### 2.4. The separate case of problem 4

The third and last step of my analysis consisted in examining problem 4. I considered this question separately from the others since it used a slightly different methodology to describe the gaining or losing event. Indeed, I hypothesized that the value of the stock was determined by a coin flip<sup>67</sup>, so that respondents have been induced to consider that stock prices were not predictable by any means. The aim of such maneuver was to minimize the chance that any difference in the expectation about future price alterations was responsible for the results found in previous problems.

In problem 4, after having witnessed an increase (or drop) in the value of their stock due to a coin flip, subjects were asked to indicate the minimum selling price that would have made them indifferent between selling their stock at \$X, through a private transaction, and wait until the second coin flip to sell it. As already highlighted, in this analysis I used a different computational methodology. In fact, using a procedure that resembled the one followed in expected utility theory, I compared the utility deriving from the stock sale in a private transaction with the expected utility of the gamble, hypothesizing that the chances of gaining (i.e. a head) and losing (i.e. a tail) had equal probability. In my computations, however, I used the value function instead of the utility function – given that the frame of reference was prospect theory.

Considering the version of problem 4 in which, after the first coin flip, the stock value became \$56 (that is, the gain situation), the reference point at time 1 (i.e. before the second coin flip) was found by solving the following equation:

$$V(X - R_1) = 0.5V(60 - R_1) + 0.5V(52 - R_1)$$

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<sup>67</sup> See problem 4 in appendix A.

where  $X$  was the dollar amount subjects indicated and  $R_1$  their implicit reference point.

For what concerns the value function  $V(x)$ , I used the cumulative version of it, as proposed by Kahneman and Tversky (1992):

$$V(x) = \begin{cases} x^\alpha & x > 0 \\ -2.25(-x)^\alpha & x < 0 \end{cases}$$

In order to compare my results with those of Arkes and colleagues (2008), I chose  $\alpha = 0.2^{68}$ .

To find the implicit reference point  $R_1$  in the above equation, I needed to distinguish among different cases, depending on the possible value assigned to  $R_1$ . Given all previous results in my analysis, I found plausible that the value of  $R_1$  had to be included in a range between the minimum and the maximum price of the stock in case of gambling, with a particular attention to  $X = 56.03$ , i.e. the average answer of my sample. Hence, the two possible equations expressing the implicit reference point were:

$$\begin{aligned} \text{a) } (56.03 - R_1)^{0.2} &= 0.5[(60 - R_1)^{0.2} - 2.25(R_1 - 52)^{0.2}] && \text{if } 52 < R_1 < 56.03 \\ \text{b) } -2.25(R_1 - 56.03)^{0.2} &= 0.5[(60 - R_1)^{0.2} - 2.25(R_1 - 52)^{0.2}] && \text{if } 56.03 < R_1 < 60 \end{aligned}$$

Hopefully, only one of them had a real – and plausible – solution for  $R_1$ . Indeed, the solutions to these equations were:

- a) no solution
- b)  $R_1 = 56.0368 \approx 56.04$

Excluding case a), since it gave no real solution for  $R_1$ , the unique possible solution for the implicit reference point was  $R_1 = 56.04$ .

Once detected the reference point, I calculated the magnitude of its adaptation by taking the absolute deviation of  $R_1$  from  $P_0$ :

$$\$56.04 - \$50 = \$6.04$$

With some obvious modifications, I followed the same reasoning to find the implicit reference point at time 1 in the other version of problem 4, where, after the first coin flip, the stock value became \$44 (that is, the loss situation). So,  $R_1$  was found by solving the equation:

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<sup>68</sup> The authors justified the choice of this value for  $\alpha$  to “increase the range of minimum selling price that makes [the above] equation [...] solvable” (Arkes, Hirshleifer, Jiang and Lim, 2008).

$$V(X - R_1) = 0.5V(48 - R_1) + 0.5V(40 - R_1)$$

Once again, to determine  $R_1$  in the above equation, I need to distinguish among different cases. Using the same argument as above, I found plausible that the value of  $R_1$  had to be included in a range between the minimum and the maximum price of the stock in case of gambling, with a particular attention to the average answer of my sample, i.e.  $X = 45.13$ . Therefore, the two possible equations expressing the implicit reference point were:

$$\begin{aligned} \text{c) } (45.13 - R_1)^{0.2} &= 0.5[(48 - R_1)^{0.2} - 2.25(R_1 - 40)^{0.2}] && \text{if } 40 < R_1 < 45.13 \\ \text{d) } -2.25(R_1 - 45.13)^{0.2} &= 0.5[(48 - R_1)^{0.2} - 2.25(R_1 - 40)^{0.2}] && \text{if } 45.13 < R_1 < 48 \end{aligned}$$

With a little bit of fortune, only one of these equations had a real – and plausible – solution for  $R_1$ . Indeed, the solutions were:

- c) no solution
- d)  $R_1 = 45.143 \approx 45.14$

Ruling out case c), since it gave no real solution for  $R_1$ , the unique possible solution for the implicit reference point was  $R_1 = 56.04$ .

After having detected the reference point, I calculated the magnitude of its adaptation by taking the absolute deviation of  $R_1$  from the original reference point, i.e. the purchase price ( $P_0 = 50$ ):

$$\$50 - \$45.14 = \$4.86$$

As the calculations showed, I found that reference point adaptation following a gain (\$6.04) was greater than the one following a loss (\$4.86), like in all previous analyses. Such result suggested that, although a change in the methodology followed, still adaptation to gains was different and greater than adaptation to losses.

To confirm this finding, I ran the ANOVA test comparing the two sets of data. Having rejected the null hypothesis ( $F(1,61) = 301.93$ ,  $p < 0.0001$ ), I could corroborate that there was a significant difference between reference point adaptation to gains and reference point adaptation to losses, with the former being far greater than the latter.

The result found was congruent with that of Arkes and colleagues.

### 3. Final discussion

Once all the calculations and tests have been concluded, it is necessary to comment the results in a more detailed way. In this section, I resume the findings of my experiments, providing further considerations to those already given. In addition, I make a few suggestions on future possible investigations that can sustain the validity of this research.

#### 3.1. Commenting the results

Through the analysis of my sample, it was possible to derive some immediate conclusions. First, in problems 1, 2 and 3, reference point adaptation for gains was significantly different and greater than adaptation for losses, both in case that each scenario was examined separately, and in case it was considered in conjunction with the others.

Second, when comparing problems 1 and 2, the hypothesis that mental accounting had a greater impact in case of selling and repurchasing interventions – so that subjects were expected to reset their new reference point to the new price and away from the initial purchase price when they sold the stock and later repurchased it at the same price – was confirmed neither in the gain domain, nor in the loss domain.

Third, in the comparison between problems 1 and 3, investors did not behave differently when they hold a portfolio of stocks instead of one single stock. Indeed, there was no significant difference in reference point adaptation between the two scenarios, both in the domain of gains and in the domain of losses.

Fourth, considering problems 2 and 3, neither in the gain domain, nor in the loss domain it was possible to detect a significant difference between the case of sale and repurchase intervention and the case of portfolio-holding.

Finally, with respect to problem 4, a change in the methodology followed did not imply relevant changes in the result. Once again, hence, adaptation for gains was more complete than adaptation for losses.

The greater and more complete adaptation to gains than losses was a signal that individuals thought as hedonic maximizers. To obtain more pleasure from subsequent gains – due to the concavity of the value function in the gain domain –, agents prefer re-setting their reference point at the new price of the stock or, at least, at a closer value. Conversely, to mitigate the sorrow of future losses – due to the convexity of the value function in the loss domain –, subjects choose to maintain their reference point at the old stock price or, at least, at a similar level. Such conclusion, which is in line with the findings of Arkes, Hirshleifer, Jiang and Lim (2008), confirmed that people segregate gains and integrate losses, as expressed by Thaler's (1985) mental accounting theory.

While accepting the postulation of Thaler in each problem considered separately, when it came to the comparison between two problems per time this theory did not succeed in predicting subjects' behavior. In particular, Arkes and coworkers detected a significant difference between reference point adaptation in case of stock sale and repurchase and in case of absence of such intervention. On the contrary, I did not detect any relevant change from one situation to the other.

As already underlined, some of the results that did not converge with those of Arkes and colleagues could be justified by the nature of the survey. Recalling the critique of experimental economists (see chap. 2), hypothetical choice questionnaires can give very different results even within the same sample, since a slightly different presentation of a problem can modify respondents' point of view. Since the primary aim of my inquiry was to verify if the findings of Arkes et al. (2008) could be replicated using a brand new sample, I chose to strictly follow the path of these researchers, knowing that if I had presented the questions in a different way, I could have obtained a different set of answers. Furthermore, in order to guarantee impartial results, the selling and repurchasing operation has not been particularly underlined to the subjects, otherwise they could have felt a sort of need for answering in a "proper" way, rather than giving their simple opinion.

A particular case was represented by the comparison between problem 1 and problem 3. Indeed, the results I obtained, both in case of gain and in case of loss, could have been a consequence of the fact that the answers to the two problems derived from the same sample (see table 2 above). Indeed, the percentage of subjects answering to the gaining event (i.e. respondents to questionnaire A) who gave the same final stock value to both situations was almost 69%, with a correlation between the two groups of answers of 79%. With regard to the losing event (i.e. respondents to questionnaire B), the percentage of subjects providing the same final stock value to both situations was almost 67%, while the correlation between the two groups of answers was 42%.

It seemed reasonable, then, to think that if questions 1 and 3 were faced by the same sample, but each depicting opposite changes in the stock value (that is, one with a gain and the other with a loss, instead of both with a gain or a loss), the results could have been slightly different, at least for the fact that I should not have needed to consider the correlation between the two groups of answers. However, since the research by Arkes and colleagues (2008) – in which the respondents to each problem were not the same – provided the same result as my own inquiry, I felt comfortable in accepting the final outcome: when adapting their reference point, subjects did not detect any difference between holding a single stock rather than a portfolio of assets.

Generalizing the findings, my experiment highlighted that agents tend to adapt their reference point after a change in the stock value. When the value increases, the reference point is shifted upwards, while when the value decreases, the reference point is adjusted downwards.

Such result can be explained by means of the Bayesian updating process and Thaler's (1985) mental accounting theory. In particular, the former states that when agents are informed that the stock value had increased (or decreased) the period before, they tend to be more confident on the fact that it will trade higher (or lower) in the subsequent period. According to the latter, individuals are inclined to segregate gains and integrate losses. Indeed, given the concavity of the value function in the gain domain, to obtain more pleasure from subsequent gains agents prefer re-setting their reference point at the new price of the stock or, at least, at a closer value. Conversely, given the convexity of the value function in the loss domain, to mitigate the sorrow of future losses subjects choose to maintain their reference point at the old stock price or, at least, at a similar level.

The idea of gains segregation and losses integration incorporates the concept of "hedonic maximization". Indeed, agents tend to close their prior mental account when facing a gain and maintain open such account when incurring a loss because they are hedonic maximizers. As the theory on hedonic adaptation suggested, individuals are inclined to return to an approximately stable level of happiness, notwithstanding the positive or negative events they experience. Following the reasoning expressed by Lyubomirsky (2011) and her HAPNE model (see chap. 3), in order to be as happier (or more satisfied) as possible, subjects activate a series of strategies to adapt faster to losses and enjoy gains more long-lastingly. Among these strategies, we can count the mental accounting principles of gains segregation and losses integration.

### 3.2. Future research

My investigation suggests some further analyses that can be developed taking these results as the starting point. For instance, it should be interesting to run similar experiments with monetary incentives. The reason to use such methodology is related to the concerns of experimental economists, who often claim that agents' decisions may be different when real payoffs are involved (see chap. 2). This objection seems to make sense, since real-life investment decisions involve monetary payoffs, not only making suppositions about one's reaction to gains or losses, as prospected in hypothetical questions. Then, by comparing the results of questionnaire inquiries and money-incentive experiments, it is possible to detect if there are some differences in the magnitudes of reference point adaptation, as well as whether agents still act as hedonic maximizers or not.

My study analyzed how reference point is updated by different subjects with respect to a gain or a loss. A catching further research could be to see if there are internal or external factors that have an impact on hedonic adaptation across individuals. In other words, taking into account that elements like cultural background, personality, positive or negative attitudes, particular moods, etc. contribute to form and shape personal judgments, a series of experiments could consist in

testing which of these factors can help explain differences in reference point adaptation among given groups of subjects.

A related stream of experiments could involve a within-individuals inspection, considering if, with the passing of time, some determinants can affect the magnitude of hedonic adaptation in single agents (or specific categories of subjects). This analysis consists in shifting from a static experimental environment – in which subjects experience given stock variations at the present time and need to express their judgments immediately – to a dynamic one, with the possibility of testing stock valuations in a certain lapse of time.

Finally, to develop in a more precise way such type of inquiries, a step forward in research could be to focus either on the domain of gains or on the domain of losses. Indeed, there can be particular events or factors having an impact either only on one side of the prospect theory value function or on both, but in different ways. Some typical questions concerning this kind of surveys could be: how the size of a gain (or loss) affects the extent of reference point adaptation? How the time spent in a winning (or losing) position influences the magnitude of such adaptation?

## Conclusions

In the development of my thesis, I analyzed behavioral economics. The reasons of this choice are multiple. First, such discipline represents one of the first applications of psychology into the field of economics. Under this point of view, it is possible to assert that behavioral economics can render more powerful the neoclassical models by providing them with psychological foundations.

Second, besides being a supportive tool, behavioral economics also represented a “Copernican revolution” with respect to mainstream theories. In particular, Kahneman and Tversky’s prospect theory – and the subsequent developments by Thaler (1985) and other economists – proposed a new way of describing decision-making processes under risk and uncertainty.

A third reason is provided by the fact that, although its recent genesis, behavioral economics has been able to capture the attention of many researchers due to its highly descriptive and explicative power. Indeed, models like that of prospect theory or mental accounting theory found great support in empirical research, since they proved to make sense with real data. Furthermore, this discipline can give an account for phenomena that neoclassical models would have not been able to explain.

The interdisciplinary approach towards the generation of evidence supporting its hypothesis is another reasons why I chose to study behavioral economics. The greater concern about the comprehension of agents through a step-by-step process describing their choice path, rather than strictly following a series of procedures in order to guarantee “acceptable” results, renders the discipline more flexible with respect to the tools used to gather new data to be analyzed. Such characteristic, nonetheless, does not imply that there are no rules to be followed when conducting an experiment, but only that it is possible to choose among various methodologies, all capable of providing meaningful results.

Combining all the above aspects, I ran my own experiment. Given the constant reference that behavioral economics makes to neoclassical models and theories, I focused the attention on a particular element that marks the clear difference between the two disciplines: frames. While expected utility theory states that individuals evaluate outcomes only on the basis of the utility attached to them, prospect theory postulates that also the context (i.e. the frame) in which such outcomes are presented is relevant.

The key element that gives a hint on how frames affect decision-makers’ choices is the reference point. Depending on whether we consider a single initial frame or various changing frames, we can distinguish between static and dynamic analyses of the reference point. While static investigations have the aim of detecting which is the initial reference point of individuals and how they formed it, dynamic inquiries focus on the evolution in time of such element.

Among the various studies in the dynamic domain, some interesting results have been introduced using the concept of hedonic adaptation, defined as the tendency of agents to return to an approximately stable level of happiness, notwithstanding highly positive or negative events they can experience. An interesting work that considered such phenomenon, inspiring subsequent research by other behavioral economists, is the one by Arkes, Hirshleifer, Jiang and Lim (2008).

With the aim of verifying the findings of such researchers, I developed my own experiment, based on two questionnaires that investigated reference point adaptation to gains and losses in the domain of security trading. As predicted by Arkes and colleagues (2008), I found that agents tend to adapt their reference point after a change in the stock value. When the value increases, the reference point is shifted upwards, while when the value decreases, the reference point is adjusted downwards.

I explained this result by means of the Bayesian updating process and Thaler's (1985) mental accounting theory. In particular, the former states that when agents are informed that the stock value had increased (or decreased) the period before, they tend to be more confident on the fact that it will trade higher (or lower) in the subsequent period. According to the latter, individuals are inclined to segregate gains and integrate losses. Indeed, given the concavity of the value function in the gain domain, to obtain more pleasure from subsequent gains agents prefer re-setting their reference point at the new price of the stock or, at least, at a closer value. Conversely, given the convexity of the value function in the loss domain, to mitigate the sorrow of future losses subjects choose to maintain their reference point at the old stock price or, at least, at a similar level.

The principles of gains segregation and losses integration incorporate the concept of hedonic maximization. Indeed, agents tend to close their prior mental account when facing a gain and maintain open such account when incurring a loss because they are hedonic maximizers. As already highlighted, hedonic adaptation means that individuals are inclined to return to an approximately stable level of happiness, in spite of the positive or negative events they experience. In order to be as happier (or more satisfied) as possible, then, subjects activate a series of strategies to adapt faster to losses and enjoy gains more long-lastingly. Among these strategies, we can count the mental accounting principles of gains segregation and losses integration.

While the majority of the results I found were congruent with those of Arkes and colleagues (2008), confirming that people act as hedonic maximizers, a few of them needed to be analyzed with more attention, in order to understand their discrepancies with respect to the study of the authors. For instance, while Arkes and coworkers (2008) detected a significant difference between reference point adaptation in case of stock sale and repurchase and in case of absence of such intervention, I did not detect any relevant change from one situation to the other.

Such incongruence in results could be justified by the nature of the survey itself. Indeed, hypothetical choice questionnaires can give very different results even within the same sample,

since a slightly different presentation of a problem can modify respondents' point of view. Since the primary aim of my inquiry was to verify if the findings of Arkes et al. (2008) could be replicated using a brand new sample, I chose to strictly follow the path of these researchers, knowing that if I had presented the questions in a different way, I could have obtained a different set of answers. Furthermore, in order to guarantee impartial results, the selling and repurchasing operation has not been particularly underlined to the subjects, otherwise they could have felt a sort of need for answering in a "proper" way, rather than giving their simple opinion.

My investigation suggests some further analyses that can be developed taking these results as the starting point. For example, it should be interesting to run similar experiments with monetary incentives. Other studies could look for internal or external factors (like cultural background, personality, positive or negative attitudes, particular moods, etc.) that have an impact on hedonic adaptation across individuals. A related stream of experiments could involve a within-individuals inspection, considering if, with the passing of time, some determinants can affect the magnitude of hedonic adaptation in single agents (or specific categories of subjects). Finally, to develop in a more precise way such type of inquiries, a step forward in research could be to focus either on the domain of gains or on the domain of losses. Indeed, there can be particular events or factors having an impact either only on one side of the prospect theory value function or on both, but in different ways.

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## List of websites

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<http://www.wikipedia.org/>

<http://psycnet.apa.org/index.cfm?fa=buy.optionToBuy&id=2009-19590-009>

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<http://stockmarketcrashes.net/>

<http://alexcochran.com.au/wp-content/uploads/2008/04/propect-theory-customer-choice.pdf>

# Appendix A

## Questionnaire A

The questionnaire is divided into two parts: the first asks some general demographic information about you (like gender, age, educational level, etc.); the second contains open-ended questions.

Please answer the questions:

- putting an “x” beside the correct option in the first part of the questionnaire
- writing your answers in the chart at the bottom of the second part of the questionnaire (remember that there are no correct or wrong answers in this section)

### Part 1

Gender:        Male  
                  Female

Age:    Less than 18 years old  
          19-24 years old  
          25-30 years old  
          More than 30 years old

Nationality:

City of residence:

Educational level:    None  
                              Primary school  
                              Professional school  
                              High school  
                              Bachelor degree  
                              Master degree  
                              PhD

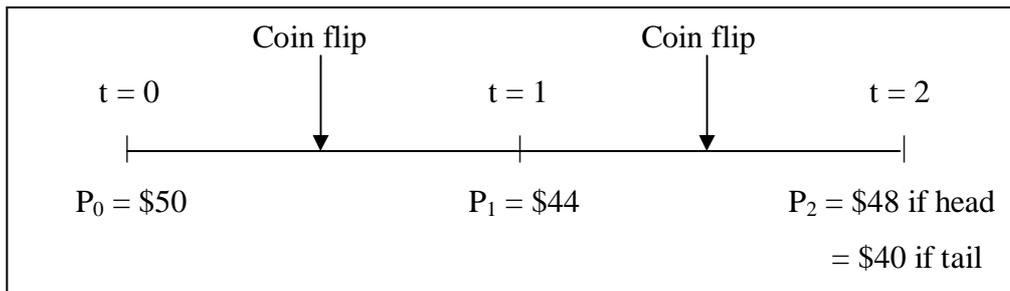
Occupation:    Unemployed  
                      Student  
                      Employed  
                      Self-employed  
                      Retired



Problem 4

At  $t=0$ , you bought a share of stock A for \$50 per share. At  $t=1$ , the experimenter flipped the coin: : if it was a head, you would “win” and the stock price would be \$56; if it was a tail, you would “lose” and your stock price would be \$44.

Unfortunately, the coin flip gave a tail. Now your stock is worth \$44. You have a chance to sell your shares now through a private transaction to another investor or wait until the second coin flip and sell your share at  $P_2$ . So, you have two options:



Option A: sell your share to another investor through a private transaction for  $\$X$ .

Option B: wait until the second period to sell your share at the second period stock price  $P_2$ .

The experimenter will flip the coin again, and the stock price will be \$48 if it is a “head” or \$40 if it is a “tail”.

Which stock price  $\$X$  in Option A will make you exactly indifferent between the two options?

Please indicate your minimum selling price  $\$X$ .

Problem	Answer
1	
2	
3	
4	

## Questionnaire B

The questionnaire is divided into two parts: the first asks some general demographic information about you (like gender, age, educational level, etc.); the second contains open-ended questions.

Please answer the questions:

- putting an “x” beside the correct option in the first part of the questionnaire
- writing your answers in the chart at the bottom of the second part of the questionnaire (remember that there are no correct or wrong answers in this section)

### Part 1

Gender:      Male  
                 Female

Age:    Less than 18 years old  
         19-24 years old  
         25-30 years old  
         More than 30 years old

Nationality:

City of residence:

Educational level:    None  
                         Primary school  
                         Professional school  
                         High school  
                         Bachelor degree  
                         Master degree  
                         PhD

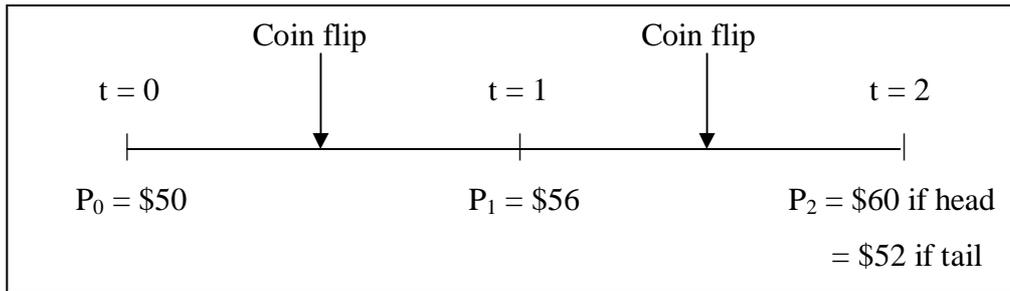
Occupation:    Unemployed  
                 Student  
                 Employed  
                 Self-employed  
                 Retired



Problem 4

At  $t=0$ , you bought a share of stock A for \$50 per share. At  $t=1$ , the experimenter flipped the coin: if it was a head, you would “win” and the stock price would be \$56; if it was a tail, you would “lose” and your stock price would be \$44.

Fortunately, the coin flip gave a head. Now your stock is worth \$56. You have a chance to sell your shares through a private transaction to another investor or wait until the second coin flip and sell your share at  $P_2$ . So, you have two options:



Option A: sell your share to another investor through a private transaction for  $\$X$ .

Option B: wait until the second period to sell your share at the second period stock price  $P_2$ .

The experimenter will flip the coin again, and the stock price will be \$60 if it is a “head” or \$52 if it is a “tail”.

Which stock price  $\$X$  in Option A will make you exactly indifferent between the two options?

Please indicate your minimum selling price  $\$X$ .

Problem	Answer
1	
2	
3	
4	