Subjective Probability and Consumer Behavior

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Abstract

The theory of subjective probability was independently and almost simultaneously discovered in 1926 by Frank Ramsey in Cambridge and Bruno de Finetti in Italy and was later developed in an interdisciplinary form by the researchers in the fields of psychology and economics such as Tversky and Kahneman who were awarded the Noble Prize in Economics in 2002 upon presenting his prospect theory in the field of economics. This theory is today used on an applied basis in all fields from medicine and treatment to politics and economics. In this paper, after describing the literature on subjective probability both from mathematical and cognitive views, the relation between this phenomenon and consumer behavior in the marketing field will be explained by using qualitative research method. Our commentary highlights the need for future research to study the relationship between competitors messages and consumers subjective value.

Key Words: Subjective Probability, Behavioral Economics, Mental Accounting, Consumer Behavior.

Introduction

Subjective probability view was first discovered by mathematicians and was discussed in the 20th century. Mental principles view for mathematical theory shows how probability theory can be developed based on mental approach, especially the complete argument that follows the important theorem of Ramsey and De Finetti. After that, economists engaged in the field with an interdisciplinary approach and an applied view and by borrowing from cognitive topics of psychology. At the beginning of the way of cognitive approach, the issue of cognitive biases was set forth which was highly addressed in the 1960s and 1970s and assisted the scientists to set forth the prospect theory by Kahneman and Tversky (1979). Although prospect theory is still among the first class theories of this field and its more complex versions are developed, it served as the basis for other theories in other scientific disciplines including politics and management. Although the dominant approach in consumer behavior includes the use of cognitive biases by researchers to apply psychological and psychometric topics in marketing issues, in most of the presented works two important concepts are missed. The first concept includes subjective probability and its relation with cognitive biases in individuals' microeconomic behavior subjects in which the literature has been turned to behavioral finance other than dealing with consumer topics. The second concept includes the confusion of subjects of mental formats and cognitive biases, in the manner that they consider framing effects as some type of cognitive biases which is wrong and finally they fall into mistake in establishing a communication with people's consuming behavior. These concepts are separated in the present research. In this research, after reviewing the quantitative and qualitative views on subjective probability, their relation with marketing and consumer behavior will be explained.

Research Literature

Mathematical View on the Theory of Subjective Probability

Ramsey introduces the theory of subjective probability by providing detailed criticisms of Keynes's classic probability view. It seems at that time that De Finetti was first influenced by Keynes. He himself hesitates about the Keynes's view and he does not know what it is about. Later, he describes and criticizes Keynes's views. He states that the relations discussed by Keynes in classic probability do not exist at all. This is because there is little agreement on the fact that which of them is related to the two presumed propositions. Ramsey strengthens his essential argument by this point that in a rational theory we can apparently understand logical relations in completely complicated situations which we are unable to understand them in simple situations. Thus, he considers all about Keynes's rational probability relations as general certain propositions and summing and multiplication rules. Ramsey (1926) states that "It seems that anyone knows geometrical rules but no one can say that whether the assumed object is round or square. I can hardly imagine how such a large portion of general knowledge can be mixed with a small set of special realities. It is correct that there is agreement on special cases, but these cases are always complicated. We all agree that the possibility of a coin to be heads or tails is 50-50, but none of us can exactly determine the implications that form another term for a possible relation that we are going to judge it." Ramsey's hesitations about establishment of probability theory based on rational intuition are strengthened by considering the function of rational intuitions in an inductive inference mode which is less problematic than deductive mode. In a rational inference, probability h is identified with some degree of rationality on the condition of e; i.e., a person who has evidence e at his/her disposal will agree to h to the same degree. Such degree of rational belief is considered the same for all reasonable people. However, in subjective probability inference, rationality presumption that leads to agreement is set aside. For example, although different people (e.g., Ms. A, Mr. b, and person c) are quite reasonable and enjoy the very e evidence, they may have different degrees of belief (it will be discussed in the following that this belief is the same mental value) for h. Therefore, probability is defined as degree of belief of a certain person, in the manner that no probability is set forth anymore and instead, the probabilities of Ms. A, Mr. b, or person c will be discussed. It should be reminded that in the opposite approach (mathematical view of probability), probabilities are considered as figures within an interval of 0 and 1. Therefore, if mental theory is to provide an expressive interpretation of arithmetic, we should find a way to measure the belief degree of a person who believes an event (e.g., E) will occur (for example, belief degree of Mr. b to the effect that it will rain in Tehran tomorrow). These are the issues that stand within the scope of subjective probability theory. Ramsey states that the degree of a belief is something which is understood by its owner. We can imagine that beliefs are different with respect to the emotional intensity attached to them. By degree of belief we mean the intensity of emotion. We cannot attribute the figures to the intensity of emotions because the strongest beliefs we have mostly lack any emotion in practice. No one has any strong emotion about the things he/she considers definite (Ramsey, 1926). To measure the belief of person, Ramsey suggests to propose a betting to him/her and to observe then the least chances he/she accepts. De Finetti (quoted by Moshkani, 2007) confirms this practice as well. Ramsey therefore considers the whole life as a gambling. Whenever we go to a railway station, we bet if a train will move. If we did not believe that, we should not accept the gambling and we should stay at home. In subjective probability theory, Ramsey and de Finetti discuss the theory. But before that, two major principles of this theory, i.e., betting fractions should be explained. First of all, we should provide a presumptive betting situation in which the rate by Mr. b is prepared to bet on E (his betting fraction on E) can be considered as a criterion of his belief in E. Then, we present integrity condition.

Definition of betting fractions (q) in subjective probability theory

Suppose two people take part in a betting, Mr. a and Mr. b. Mr. (a) wants to measure Mr. b's belief degree in an event such as E. For this purpose, he makes Mr. b bet on E with him based on the following conditions:

Mr. b should select a number like q (called with his betting fraction on E) and then Mr. a selects the opposite condition S. If E occurs, Mr. b should pay Mr. a the amount qS against S. The amount S may be positive or negative, but |s| (absolute value of S) should be small as compared to Mr. b's wealth; otherwise, Mr. b will never bet on all his wealth. Under such conditions, q is considered as a criterion of Mr. b's belief degree in E. The important point is that when b selects q, he does not know if the presumption opposite S will be positive (which corresponds to his betting to the order of event E) or negative (which corresponds to his betting against event E). If b knows that S is positive, it will be advisable for him to select q to the smallest amount as much as possible. And if he knows that S will be negative, it will be advisable for him to pick q to the largest possible amount. The important point is that in both situations, q will not correspond to his actual belief degree. But if he does not know if S is positive or negative, he has to modify q according to his actual belief. This selective strategy against the opponent in terms of an event which is based on the belief of an individual is called betting fraction in subjective probability (Gillies, 2000).

The only difference between the views of Ramsey and De Finetti is related to the betting fractions for a desirability for which gambling is established. Ramsey says that it should be of monetary quantity material, but De Finetti believed that it is difficult to select for betting a number which is neither so large which is larger than or equal to the wealth of either of the parties (otherwise, no wise individual would be ever interested in gambling by all his wealth) nor is so small that remains no motivation for the game. Moreover, the person may not be directly asked of his wealth. Instead, he suggests the game value in terms of qualitative units to be used, e.g., preferring two hours of swimming than one hour of swimming plus one hour of study and generally, game value is substituted by these utilities. Of course, Ramsey has questioned the feasibility of such a utility (Gillies, 2000). It should be noted that it is necessary to determine subjective value (the extent should which be determined to influence the individuals' minds); otherwise, subjective probability will not be formed.

Integrity

It should be reminded in integrity that the first problem in subjective approach was how to measure belief degree so that subjective probability occurs. Therefore, there is a second problem here:
Second problem: If subjective theory is to offer an interpretation of standard mathematical probability theory, the belief degrees (betting fractions) should then apply to the principles of probability standard. Why?

Suppose that belief degrees of an individual are quite arbitrary and they are not applicable to any of the principles of probability. If Mr. b has to bet on a series of events (E1…….En), his betting fractions are considered integral if and only if Miss a cannot select turns S1……Sn such that she wins anyway. If it is contrary to this, it is said that she has planned a certain loss in the gambling against Mr. b. It is evident that Mr. b wants his bets to be integral, i.e., he wants to avoid his loss under any circumstances. This condition (integrity) is both necessary and sufficient for betting fractions to apply to the principles of probability subject. This issue forms the contents of Ramsey- De Finetti theorem. Therefore, an individual who lacks any mental stability in ordinary situations and do not act according to a rational principle (requesting for maximum options from among other options), has breached from integrity principle (quoted by Moshkani, 2007).

Ramsey-De Finetti Theorem in Subjective Probability Theory

A series of betting fractions is integral if and only if they apply to the principles of probability.
This rational condition therefore results in subjective probability theory (belief degree) to be placed in the normative (rational) approach at least to the extent it applies to this condition. De Finetti has discussed this theorem in his paper entitled "Foresightedness: Its Logical Rules, Its Principles". Logical rules here are derived from integrity condition. It is natural that integrity does not determine a unique rational belief

degree; instead it offers a broad range of options. In this way, some of subjective resources are necessary for probability. For this reason, De Fenitti sometimes refers to compatibility instead of integrity because we must ensure that different belief degrees are matched and in this way we can prevent the paradox of facing with a definite loss in gambling (we can be reasonable).

Ramsey-De Fenitti theorem is a significant achievement and it clearly reveals the superiority of subjective theory over rational theory. While in rational theory one can justify the principles of probability only by an ambiguous and satisfactory recourse to intuition, in subjective theory they can be accurately proved by the very reasonable condition of integrity. At the end, it should be noted that Ramsey attributes subjective probability theory to the domain of theory of games and believes that it should not be reviewed in the issue of probability (quoted by Moshkani, 2007).

iii. Principles of Subjective Probability

If E, F, ….E1, …. are the signs of events in whose occurrence we believe and Ω is an event of certainty occurrence degree which should occur, then there will be three subjects of probability.
1) For each E, $0 \leq P(E) \leq 1$ and $P(\Omega)=1$
2) If E1,….En incompatible events, in which occurrence of two events is not possible and at least one of them should occur, then

$$P(E1)+....+ P(En)=1$$

Which is reminded in probability as addition rule.
3) According to the multiplication rule, for each pair of events E&F:
$$P(E\&F)= P(E \mid F) \, P(F)$$

Theory of Behavioral Economics in Subjective Probability Theory

In behavioral approach, the theory of subjective probability is rooted in the literature of judgment and decision making. It took a long time to provide a model to take a reasonable decision under risky and uncertainty conditions until the expected utility theory was developed. But that theory failed in some cases to offer a justification for the irrational behavior of individuals in probabilities and resulted in emergence of newer theories such as prospect theory which will be discussed later. Generally, subjective probability is psychologically viewed in a more applied manner. Subjective probability in that approach has resulted in Judgment and Decision Making Psychology branch. In that approach, subjective probability is viewed as a representation of decision (figure 1) that finally results in decision.

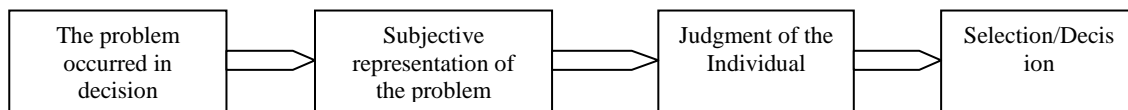| The problem occurred in decision	→	Subjective representation of the problem	→	Judgment of the Individual	→	Selection/Decision

Figure 1) Role of Subjective Presentation in Judgment and Decision Making

Until the late of 1970s, Subjected Utility Theory (SEU) was the dominant theory in the field of decision making especially under risky conditions. This theory is a model of normative (rational) behavior originating from economics and mathematics and assumes that decisions should be adopted that first of all different situations of facing with that is collected and secondly, the utility of each situation should be subjectively measured along with the reasonable probability of its occurrence (Ranyard, Crozier and Svenson, 1997). In other words, utility theory is an effort for subjective inference of value of utility of options. This theory may be used both in making decisions under risky conditions and in uncertainty situations (Bell, Raiff, and Tversky, 1988). Several findings emphasize that we systematically violate SEU theory under risky and uncertainty conditions. In this regard, cognitive biases are considered as the most

important factor. One of the most controversial paradoxes known in decision making is Allais Paradox. Allais (1953) presented a presumptive decision making scenario and showed that when we explain two options with another two options (including some amount of money and the probability of wining it) equal to them in two different forms, namely table and explanation, we will see contrasting choices, in the manner that if option one is selected in the table-based form, most individuals do not select the third option if it is equivalent with the first option in the explanatory form. Therefore, manipulation and framing of the problem has resulted in paradox/different options contradictory to SEU theory. This paradox was the point of addressing the effect of value, subjective probability and descriptive theories such as prospect theory (Baron, 2008).

Prospect Theory (PT)

According to Tversky and Kahneman, another approach was needed to reduce the differences between behavior and SEU theory to produce new theories and to provide justifiable reasons for the findings. Such theory may almost be used for all the available data under risky and uncertainty conditions in decision making. It is very important to know that PT is descriptive and not normative. PT well describes the deviation of our choices from SEU. It is directly related to situations such as Allais Paradox in which we need to select an option from among probable consequences.
Consider the following problem:

Do you accept this bet?
-        The chance to win US$ 150.00 is 50%.
-        The change to lose US$ 100.00 is 50%.

Does your choice change if your total amount of money is less than US$ 100.00?
Few people accept betting on plan 2. Experimental evidences indicate that most people do not accept the betting unless the chance to win is at least two times the chance to lose (Tversky and Kahneman, 1992). Of course, the answer to the second question is negative. Now, consider another problem:

Which one do you choose?

  -        You will certainly lose US$ 100.00; or
  -        The chance to win US$ 50.00 is 50%.
  -        The chance to lose US$ 200.00 is 50%.

Does your decision change if your total amount of money is more than US$ 100.00?

It seems in plan 3 that betting is more attractive than the certainty of lose. Experimental results indicate that tendency to riskability is observed among most of those who respond to such choice (Tversky and Kahneman, 1979). Here too, the idea that the chance of US$ 100.00 in the entire money influences on tendency cannot be taken seriously. Plans 2 and 3 have strongly different tendencies. This difference is a framing effect. When we speak about the final wealth, the problem has only one difference and it is that all the figures in plan 3 are less than US$ 100.00.

Tversky and Kahneman have reviewed several pairs of options of this type in the initial descriptions of risky choices and have come to the conclusion that rapid change from risk incompatibility to riskability may not probably be explained by an applied function for wealth. Apparently, tendencies are determined through tendency to profit and loss and are related in definition to reference point; however, in the theory of Bernoulli (1954) and his followers, they have not used a reference point. Therefore, Tversky and Kahneman offered another theory of risk in which utility factor includes profit and loss. Perspective theory (Tversky and Kahneman, 1979) contains this idea that tendencies rely on resources and include parameters

which are necessary for this hypothesis. Distinguished predictions of perspective theory follow performance function type which is shown in figure 2.
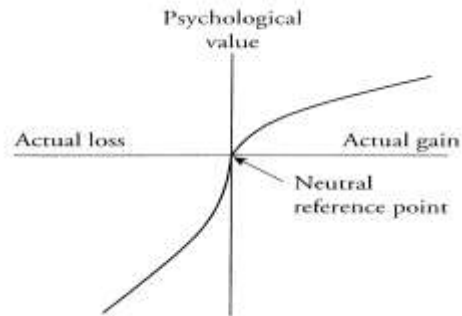

Figure 2) Value Function of Prospect Theory (Kahneman and Tversky, 1979)

Performance function is determined in the profits and losses and has four characteristics:

1) It is concave in the scope of profit and prefers to be far from any risk;
2) It is convex in the scope of losses and prefers to be risk taker;
3) Above all, function in that is strongly related to the point of preference and loss avoidance - it is faster for losses as compared to profits and its coefficient is almost 2-2.5 (from the viewpoint of reference independence); and
4) Several studies indicate that performances can be approximated well within two fields in terms of exponential function which are both lower than unit (Tversky and Kahneman, 1992).

The main idea of prospect theory – value-based performance is related to reference point and loss avoidance – can be useful for economists because Thaler (1980) has used that to explain low-risk options. In general, loss avoidance is a kind of breach from customer theory and Thaler has defined that as Endowment Effect: The highest amount people pay to get a good thing is usually less than the least amount they pay for a part of that when they get it. Sale price is usually two times or higher than purchase price (Tversky and Kahneman, 1991). This is a very simple interpretation: A good thing is more valuable when it may be lost as compared to when it is considered as a probable profit. PT as the modified form of SEU is constituted of two main parts:

- A part that deals with probabilities;
- A part that deals with utility (i.e., psychological value).

PT contains an assumption in which we multiply subjective probability by utility in decision making and we give a higher weight to utility. According to PT, we deviate from probabilities and we think about changes from a basic point.

Probable part in PT

PT essentially begins with this principle that we do not behave probabilities in the way they are presented, instead we distort them. This distortion is made based on an algebraic function which is called pi function or the Greek letter π by Tversky and Kahneman. Instead of multiplication of utility by probability (P) they suggested that it would be better to multiply that by π (subjective value) (P)π . π is the weight applied for utility of each event as a function of P based on prospect theory (figure 2) (Baron, 2008).
For example, he set forth the issue of betting in which some people prefer to receive the definite amount of US$ 30.00 other than to receive an amount of US$ 45.00 with a probability of 80% (although based on SEU, the second one is more valuable).
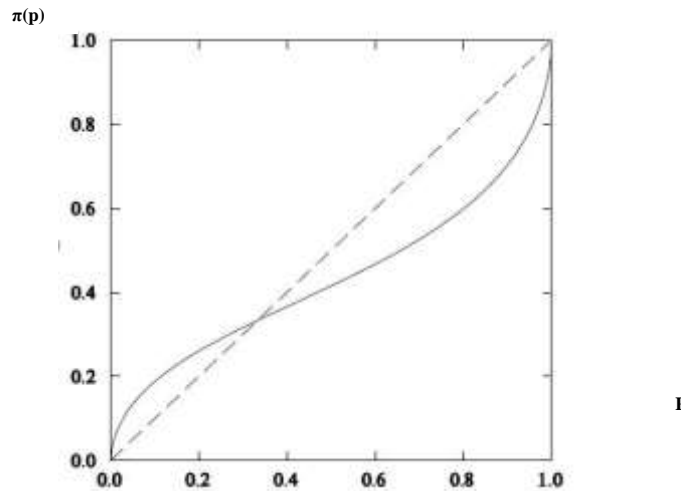
Figure 3) The weight imposed on utility of each consequence as a function of probability of consequence occurrence based on PT (Baron, 2008)

On the other hand, they preferred an amount of US$ 45.00 with a probability of 20% to an amount of US$ 30.00 with a winning probability of 25% because they believed that they could get US$ 15.00 more with a higher risk of 5%. The preference of definite US$ 30.00 to probable US$ 45.00 is called Certainty Effect because people had been attracted by the absolute certainty of US$ 30.00 in their decision, i.e., (1.00) π is much more than other P values. Except for very low values, certainty is automatically attractive.

Certainty effect exists in the field of losses as well. People accept risk to avoid definite losses in order to achieve a definite winning. Another point about π is that people have the highest sensitivity to changes in the probabilities near to zero (impossible) and one (certainty) borders (figure 3). Sensitivity to these changes reduces upon getting far from those borders. Therefore, an increase of 0.1 in the probability of winning a profit has a higher effect on the decisions. Once the probability of wining changes turns to 1 from zero (turning from impossible to possible) as compared to when probable changes turns e.g., from 0.4 to 0.7 (turning of a possibility to a higher possibility). As for buying lottery ticket to Hawaii for example, if there are totally 10 tickets, most of the people pay a higher price for the first ticket if they have already no ticket (to provide for themselves the possibility of winning), or they pay a higher price for the tenth ticket if they have already prepared the ninth ticket (to guaranty winning) as compared to when they pay for the fourth ticket if they have already prepared the third ticket (increase of winning possibility is modified).

Principle of Invariance is another case that utility theory could not define that but PT justified that well. This principle states that the choice of one person should not be dependent on the situation of that person and no on the way through which the issue is described. When we can have two equal descriptions of one condition, we should have similar choices. This principle is sometimes violated. Violation of this principle is called Framing Effects because choice is dependent on the format in which the problem is presented and not on the information alone (Tversky and Kahneman, 1981). The question here is that is Certainty Principle reasonable? And that why should not we give a higher weight to probability in definite consequences? The answer is that certainty effect is not reasonable first because it leads to decisions which are subject to the manner in which a problem is presented (or to the manner in which everybody presents and describes that for himself/herself). Secondly, our feelings about certainty for a phenomenon are often, if not always, a coefficient, or more accurately, an artificial product of the manner of describing the problems. For example, receipt of US$ 30.00 may be a definite consequence until money is our only goal in life although US$ 30.00 may be a tool for achieving another goal.

Overweighting and underweighting the probable amounts

Another characteristic of function π in describing subjective probabilities includes overweighting the lower probabilities. For example, the probability of 0.1 for wining nothing is larger in our mind than what it should be. For example, the difference of winning probability of 0.9 to 0.8 (0.1) has a lower weight than the difference of probability 0.0 to 0.1 (0.1) although they are normatively equal. This phenomenon justifies the reason for paying money for lottery and life insurance in air travels although they are in contradiction (in insurance, we pay an amount to another person to risk while in lottery we pay an amount so that another person lets us risk). We may cause much entertainment for us concerning low chance of winning and crash of aircraft due to overweighting to low probabilities. Many people tend to spend one dollar to win US$ 1,000.00 with a winning probability of 0.001 while they have less tendency in betting with a higher probability of winning. People generally avoid risking; however, they act with risk in lower probabilities. Another example in this regard includes the finding of Schwalm and Slovic (1982). They showed that only 10% of subjects tended to use safety belt when they were told that death probability in each trip was 0.0000025 but when it was announced that death probability during the entire period of driving was 0.01, only 39% tended to fasten seatbelts. Although this probability is almost equal to 0.0000025, people consider such low probability as zero. Therefore, it is not the case for them how many times they travel when the intended probability is low (Baron, 2008).

Utility in PT

Based on PT, people often evaluate consequences based on a basic point which is presumption condition. Basic points are different and they depend on how the problem is presented that it leads to different decisions. Therefore, this utility is actual and not based on experience and it is a decision utility. Bernoli viewed the utility of financial losses or profits for an individual as a function of his total wealth after occurrence of profit or loss, i.e., if a person had US$ 1000.00 before and obtained US$ 30.00, then the added utility obtained from winning US$ 30.00 would be

$$u(\$1030) - u(\$1000)$$

In contrast, Tversky and Kahneman assume that we consider utility evaluation of US$ 30.00 alone, i.e., u($30) without addressing our total wealth. They believe that our decisions enjoy an independent value function for profits and losses (figure 3).

PT Formula

$$U = \sum_{i=1}^{n} w(p_i)v(x_i) = w(p_1)v(x_1) + w(p_2)v(x_2) + \ldots + w(p_n)v(x_n),$$

Where Pi is the probability of occurrence, W is the visual value of the intended phenomenon, V is the value or subjective probability of event and U is subjective utility of the individual.

Horizontal axis (figure 2) is not wealth, but winning (profit) is on the right side and losing (loss) is in the left side of vertical axis of utility. Tversky and Kahneman used V(0) for value instead of u(0) to explain the difference of their theory with SEU. They too confirmed that value function may change due to change in total wealth of an individual. However, they proposed that such effects of total wealth form a small amount. According to PT, people are more interested in obtaining certain profits other than to get probable interests with the same value (or a little bit more). The opposite of this case apply to losses. Profit and loss are evaluated by using subjective resources. Any action based on subjective value and its corresponding losses is more difficult than action based on subjective value and its benefits. Therefore, loss-related undesirable factors are evaluated more than profit-related undesirable factors. For example, loss in the value amount resulted from losing US$ 10.00 is larger than profit in value amount resulted from winning US$ 10.00. For

this reason, most of us do not accept to participate in any betting in which the chance of win and lose is US$ 10.00. It is the characteristic of loss avoidance that plays the main role in describing most of the phenomena in decision making biases. Therefore, people's reactions are different depending on the choice which is classified within the framework of profits or losses. Basically, one of the consequences of a rational decision follows SEU normative theory. As mentioned before, based on normative theory, a rational decision making should not violate invariant principle (Tversky and Kahneman). According to invariance principle, presentation method of a decision scenario in different conditions and situations should not cause any change in the individuals' choice. In formatting however, different choices (even opposite) may be provided by changing the problem in different ways. The reason is that each different format emphasizes on a special type or part of information. Thaler (1980) set forth cash discount in relation to traditional purchase and by credit card. He pointed that different ways of offering prices by credit card and traditional purchase provide different reactions in purchasers in discounting. As for credit card, since a commission equal to purchase price is deducted by bank terminal, people consider such commission as a loss despite the ease it provided to them. In contrast, they consider cash discount in traditional purchase as a net profit. This is because in PT value function, the scope of loss function is deeper than that of profit function. If the customer is given the right to choose, then we can make them interested in using credit cards once we make them understand that there is no discount instead of saying that a commission is deducted. This is because loss is always larger than profit. Therefore, although two formats may be of equal value, they will result in predictable and opposite choices. That is why occurrence probability of events is clear in the type of risky format, but the manipulation caused in the form of problem by formatting changes the risky form of problem in the minds of people to unreliability. Therefore, formatting issues have both characteristics of risk and unreliability. Formatting is one of the most popular and most controversial human issues with several deviations as compared to rational decision making (Thaler, 1999).

Generalization of PT to the consequences in which probabilities are not mentioned

In some of the examples provided in the literature of this research, subjects faced the formats in which numerical probabilities were mentioned. They caused risky situations other than unreliability. These probabilities rarely exit in the real world and we should often make decisions automatically based on the consequences. For example, when we want to make effort in achieving a reward or when we bet on a sport event, we cannot ask anyone to tell us the related probability. PT can be generalized to these cases (Fox and Tversky). People analyze the intended event in decision making in their values and beliefs. They make decisions such as if they allocate probabilities to their beliefs. But the probabilities are sub-additive.

It means that if we have two events, namely A and B, subjective probability allocated to their unified amount (A or B) P is less than P(A)+P(B) (while they should not be reasonably different). Sub-additive situations in implicit probabilities are found once in which subjects in different situations imagine definite equality amounts. For example, Fox and Tversky (1998) asked basketball fans to have a series of choices from among different monetary amounts and betting. If a team (from among 8 participant teams) won, its selected was paid US$ 160.00 in betting. In this way, researcher could infer the value set by the subject for the betting. Based on SEU theory with reduced utility margin, the value of bets for all the eight teams should be totally less than the 160-Dollar prize and people should avoid risk and not interested in betting for events with low probabilities.

In comparison, sub-additive principle allows us to have an opposite order because the subjects consider more weighting to their interested team. In fact, Fox and Tversky observed that mean values which were totally US$ 290.00 were quite larger than the 160-Dollar prize. In low probabilities, the effect of sub-additive acts in a way similar to function π in PT. As it was mentioned before, function π leads to the effect of subjective probability in which people are highly sensitive to probabilities near to zero. Therefore, if a person is asked for the level of risk, probable effect is stronger when the risk number is not stated even though the provided probabilities are equal to the amount allocated by individuals to indefinite events.

Methodology

The present research method is a qualitative and is taken from the review of texts in the literature of behavior economics, psychology of decision making and its relation with subjective probability in scientific resources. After reviewing subject literature in the above fields we discuss their connections and applications in consumer behavior field.

Subjective Probability and Consumer Behavior

Among interdisciplinary fields, review of subjective probability (subjective value) encompasses a broad range of cognitive biases (Kahneman et al., 1991). In the following, the instances discussed in the field of consumer behavior will be reviewed. When people face decision making, they provide a mental model in their minds called "Frame". Mental accounts in consumer behavior are created in the minds of people upon facing with a problem. Each mental account will not be closed until it receives the SEU value. For example, a person buys a ticket to watch a football match. The mental pressure for watching that football match always exist in him until he receives the expected value (watching the football match) in the stadium. In fact, avoiding from loss motivates him to watch the match (to receive the product or service). It even encourages him to watch the game live from TV in case of bad weather conditions. This is while that person could for example watch the game from TV. However, the cost that has been already paid by him and the account caused in his mind forces him to watch the game (Arkes and Blumer, 1985). In consumer behavior, this effect which is resulted by payment of cost by the person (this cost is not necessarily of monetary type) before receiving the service is called Sunk-cost Effect. It has been said that loss avoidance effect makes people in negative situations (e.g., poor quality of goods) to select options in which there is threat. Avoiding from negative consequences is so strong that people prefer to accept more risks to increase their receivable value. Therefore, the following scenario is always established:

If existence of 5 is of a positive material < if existence of 5 is of a negative material.

Here, 5 is a presumptive quantity of profit/loss amount understood from two definite and risky options with which the decision maker faces. But inequality is because the individual have a higher mental probability in his mind for the option with negative risky format as compared to the option with a definite positive format and the individual understands the amount higher than value. The amount of such deviation is clearer in unreliability decision making situations. It has a basic effect on mental probabilities in consumer behavior and what is formed by the influence includes sunk-cost effect and Status Quo (Soman, 2004). Status Quo occurs once people's estimation and judgment are based on their initial values and they make the final decision based on those values (Tversky and Kahneman, 1974). A typical example of status quo in the companies includes prediction for purchasing developed product of company by a special group of customers in the market based on their purchase of company products in the past year and addition of 5% as growth rate (Hogarth, 1987). This initial value may have been caused by framing of purchase or it may be the result of an incomplete calculation. In both situations, although comparisons are made for using in the present condition, they are not efficient. In this type of error, final estimation is very close to the initial value (Tversky and Kahneman, 1974). The interesting relation between status quo and understanding from subjective probability appears once people evaluate conjunctive (continuous) and disjunctive events. Estimation of the probability of conjunctive events is often exaggerative while estimation of the probability of disjunctive events is underestimated (Tversky and Kahneman, 1974). This includes an interesting concept in economic and consumer behavior issues especially because conduction of transactions in the market can be formed in terms of a series of conjunctive or disjunctive events(Barbosa and Fayolle, 2008). If we format the individual of purchase process positively and in terms of a series of conjunctive events, it is expected that the probability of its total success is exaggerated (satisfaction with purchase). The reason is that the success resulted from fulfillment of an obligation such as purchase has clearly a conjunctive nature. To fulfill an obligation successfully, each series of events should occur. Even when each of the events is probable, the probability of a general success may be quite low even though the number of events are high.

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Utility acquisition in consumption is a process whose success depends on several relevant individual activities. If this process is framed in terms of a series of critical events, e.g., obtaining income, awareness of needs and demands, selection of product, etc., overall utility of purchase and value acquisition will depend on the individual's success in each of the mentioned critical events. Since the number of events that should occur to guaranty utility acquisition from purchase may be considerably high, the success probability of each of the events may be individually be high as well. If people consider the probability of occurrence of each event as the beginning point of estimation, they will tend in exaggerating for overall probability. Since the comparisons tend to inefficiency, final estimation will be quite close to the initial values. Therefore, exaggeration for the probability of satisfaction with consumption depends on the emphasis put on status quo provided that the required events for purchase (receipt of product) are displayed positively. For example, the individual takes action in purchasing when he/she is happy. Based on PT theory, when necessary actions and events for acquisition of service are formed in terms of a positive issue, they will exaggerate in the probability of utility success which will result that the individual will encourage other people to do the same action. On the other hand, when necessary events are formed negatively until a service is received (failure probabilities), a structure similar to disjunctive structure will emerge. In disjunctive structure, failure in one of the components (e.g., income acquisition) will lead to failure of total structure. A typical example of disjunctive structure is the complicated systems such as nuclear reactor or human body in which if any of the necessary components fail, the overall system will malfunction or will even be paralyzed (Kahneman et al., 1982). In disrupted structures, overall probability of failure is often considered insignificant because the probabilities for failure of its components are usually low and they are given lower mental probability and value. In general, based on PT, when necessary actions and events for consumption are formed in terms of a negative issue, they consider the probability of non-utility in the project to be low (due to the effect of loss avoidance). This phenomenon is the center of many marketing cheats which should be addressed. Another important subject includes addressing the error of new information availability in subjective probability. The more the frequency of something is high in the mind of a person, the higher that person will consider the probability of its occurrence (Hogarth, 1987). It is one of the explorative mechanisms of an individual that has sometimes an effective role in making decisions in unreliability situations (Busenitz and Barney, 1997). Of course, clarification, abnormality and emotionality of the subject also affect the existence phenomenon (Busenitz and Barney, 1997). For example, in his evaluation of utility acquisition a person may deem it probable that he gets no significant value from consumption and since the number of repetition of problems and difficulties in the cognitive system of people is accessed faster and more effective by mind, the person may not consume that specific product for the next time. Existence is a suitable issue to understand intuitive evaluations in the issues related to consumer behavior. Existence is influenced by probability and repetition factors. In the aforesaid example, failure probability estimation by a person may be influenced by several factors that facilitate the recovery of special items in the mind, foster the imaginations and support illusive correlations, e.g., previous acquaintance of an individual with the utility obtained from a specific goods, dissatisfaction of product, etc. Therefore, judgment in consumption highly relies upon availability which provides some type of biases in the subjective probability (Tversky and Kahneman, 1974). Availability is also considered as a factor that affects risk perception because the ease level of people in imagination or reminding of possible consequences in decision making situations may determine perception of the risk relevant to that situation and decision (Tversky and Kahneman, 1974). For example, a specific important concept of revelation entity is an issue that discusses that a low probability risk may increase the level of reminding and imagination of that and as a result, the perceived risk is strengthened disregard of what is indicated by evidences (Slovic et al., 1982). The availability bias may also increase the importance of former experiences in determining risk perception. In consumer behavior, former experiences and exposure to the past clearly affects variables such as overconfidence in utility acquisition (Krueger, 1993, Peterman, 2003). For example, Barbosa and Fayolle found in their research that availability of new information in using the product when it is formed negatively (in terms of failure probability) will increase risk perception (avoiding from risk in purchasing) and as a result tendency to purchasing will reduce even by discounting. On the other hand, in case availability of new information is formed positively (in terms of success probability), it will reduce risk perception followed by tendency to consumption (Barbosa and Fayolle, 2008). Hedonic effect is another

function of psychological paradigm in consumer behavior in view of prospect theory (Soman, 2004; Thaler, 1985) which plays an important role in pricing. This phenomenon borrows from PT the people's level of subjective utility in the fields of profit and loss and proposes four functional principles in pricing and supply method of product to the consumers. As a presumption, it should be noted that receipt of money (price of goods) is considered negative and as a loss and offering discount is considered positive and as a profit. This profit may even include other facilities offered to the consumer by the firm such as payment of money for a product, delivery of two products to the consumer and other promotions.

1) Provide the consumers with losses altogether. This will be more valuable in subjective probability.
2) Provide the consumer with separate profits to provide a higher mental value. For example, due to restricted sources of the firm, it is better to provide the customer with different facilities of purchasing in different times and not to provide them altogether.
3) If we provide the consumer with profits and losses and the losses were much larger than the profits, it is better to separate them such that the small profit removes the negative effect to a high extent. This is called *Silver lining*.
4) In contrast, if profits are much larger than loses, it is better to mix them because due to loss aversion effect, even that small amount will have large effects on the mental value of consumer.

We finish this section with *Penney A Day* (PAD) discussion. Originally, at first the effect of pleasure was set forth claiming that in case of several losses it is better to integrate them in order to reduce loss weight in subjective probability. Gourville (1998) found that when we can divide a loss into very small pieces, it is better to use loss separation. For example, in a charity program, two options for money payment to a charity foundation were offered to people. One option was to pay US$ 00.85 cents per year and the other option was to pay US$ 300.00 for one year altogether. Although the two amounts were almost equal, most people tended to the separated option. Here, two important points are necessary to understand the difference between the principle of a pleasure effect and PAD. The first one includes returning to concepts such as integration and betting fractions that were mentioned at the beginning of this paper and reviewing in order to determine the level of mental value for the person so that it may be attractive for him and he is convinced to the transaction (consumption). The second discussion is that in the first principle, the pleasure of each loss is sufficiently large and the losses should be mixed, but in PAD the losses are so small that an individual considers them nothing in comparison to his income. But as for the second party of the game, when he collects these small amounts from a large population, he will have a considerable sum. It should be noted that in classic probability, all people were equally viewed in calculation, but in subjective probability, the cognitive approach governs as well in which mental value of a person differs from that of another person.

Concluding Remarks and Future Research

Two areas of research are suggested here: the first concern with the application of risky framing of PT. Studies have applied the application of risky choice framing in managerial field (e.g., Barbosa and Fayolle, 2008). No studies have ever measure the risk taking propensity of consumers in consumption of products by risky framing mostly because always the two choices of classic risky framing concerned in the literature while it is possible to make change in manipulation of the choices in order to use it as risk measurement for consumer behavior in uncertain market (Emami and Motevaseli, 2012). By this measurement companies are able to test the true attitudes (subjective value) of their consumers toward their product. For example, to what extent they are willing to be loyal to especial brand in comparison to a substitute products of their competitors? Framing effects has a lot to assist marketing managers in this area of consumer behavior.

Another concern is the application of subjective probability in testing the life cycle of a product. For example: Does the framing manipulation of "price", "packaging" or "promotion" in advertisement affect the period of time that a product is used by end users? And does it differ from one industry to another? Or among male or female consumers? And how is the process? Any answers to these questions help marketing

practitioners to raise their awareness regarding the current intangible atmosphere (i.e., competitor messages) of their market as this awareness enables them to make more rational decisions in an uncertain markets.

In this review paper the application of subjective probability in consumer behavior considered from two main scientific streams of mathematic and psychology. Competitive game of market imply that managers need not only take care of their targeted segments strategically but also be aware of the messages their consumers receive from their competitors. These messages have tremendous effect on subjective probability of the customers and shape the intention of their next purchasing decision making.

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