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Decision-making under Uncertainty: A Cognitive Approach

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Abstract

Conventional economics believes that individuals are rational in their decisions and based on five factors such as: considering all known options; using the maximum amount of available information; determining the precise weight -albeit subjective- of the costs and potential benefits of each option; accurate calculation -albeit subjective- of the various possible consequences; and the maximum amount of common sense considering all factors; are seek to make sensible decisions. However, these factors have not always been fully established, perhaps even Individuals may be exposed to the uncertainty that jeopardizes decision making. This is an applied and developmental research, with the type of library study and using the new findings of cognitive science, he explains how to make decisions under uncertainty. The findings of this study indicate the role of OPFC in decision making, especially in the face of emotional factors and complex decisions that all made by the PFC. In the face of risks of uncertainty, both of VPFC and VS sectors are active. The striatum is associated with the loss aversion of people. Also, the role of the striatum in learning and habit formation can also be mentioned; so that information about uncertainty transmits through the striatum to the PFC section and because the striatum transmits information to the brain via dopamine neurons, so by repeating behavior and receiving a reward, that behavior has become a habit, then belief Systems and mental models have been formed. Repeating uncertainty ultimately disrupts an individual's cognitive system, creates irrational beliefs and increases people's uncertainty.

Keywords: Cognitive Science, Prefrontal Cortex, Uncertainty.

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1. Introduction

Among the most prominent studies on the origins of underdevelopment, there may not even be one case that has not spoken about the decisive role of insecurity. However, ef-forts to decode this issue and the mechanisms to overcome it are insufficient. Perhaps this is the first step in re-highlighting this issue, which for many reasons nowadays has been highlighted in other parts of the world, too. Also, given the rank order of macro-level studies over micro-level and development levels over the macro-level, it is necessary to go beyond the mere economic viewpoint and to study uncertainty and hazards that it makes in people's decision making, from developmental level, and with an interdisciplinary approach.

Early models of how people make decisions are called classical decision theory. Most of these models are designed by economists, statisticians, and philosophers, not psychologists. As such, these patterns reflect the power of the economic perspective. An example of this power is the ease of designing and applying mathematical patterns to human behavior. Among the early patterns of decision making designed in the twentieth century were the economic man and woman model. This template was based on three assumptions: First, decision-makers are fully aware of all the possible choices about their decision and the likely outcomes of their choice. Second, they are infinitely sensitive to the small differences between decision options. Third, they are perfectly rational in their choice. But the other patterns that emerged in explaining individuals' actions, provided more opportunity to apply the psychological characteristics of the decision-maker; so that the subjective expected utility theory was put forward. According to this theory, the purpose of human action is to seek pleasure and to avoid pain. Based on the subjective utility theory, individuals in their decisions seek to maximize enjoyment (point to positive benefit) and minimize pain (point to negative benefit). So each person uses two calculations about probabilities: Subjective utility (a calculation based on one's judgment), not objective criteria about weight (value) of utility, and Subjective probability (calculation based on individual estimates), not objective statistical calculations [1]. For most decisions, there is no perfect choice for everyone. Therefore, in order to predict an individual's optimal decision based on the expected benefit theory, one only needs to know the expected mental benefits of that person. These benefits are based on subjective estimates of probabilities and weighting of costs and benefits. In this way, one can predict the optimal decision of individuals. This prediction is based on the belief that individuals based on five factors seek to make sensible decisions: The first factor is to consider all possible options, given that there may be unpredictable options. The second factor is to use the maximum amount of information available, given that some related information may not be available. The third factor is determining the exact weight - albeit subjectively - of the costs and potential benefits of each option. The fourth factor is precise calculation - albeit subjective - of the possible consequences, given that one cannot be sure of the consequences. The fifth factor is the maximum amount of common sense taking into account all the factors listed above.

In the early 1950s, some scholars challenged the concept of unlimited rationality in human choices. These researchers found, with ample evidence, that humans do not always make the right decisions. They also found that individuals usually incorporate mental considerations into their decisions. Researchers also found that human beings are not rational in their decisions. However, they are not particularly irrational. Rather, they follow bound-ed rationality. In other words, humans are rational within their

constraints [2]. In mainstream economics, there is a simplistic notion of the mind that the mind is merely a repository for data storage. In this notion, data is constantly updated as a result of interaction with the outside world and the mind compares and deduces on the basis of these new data. Of course, all of this is Implicit. In mainstream economics, there is no word of mind. But the mind, or anything that causes reason, is known as an inference based on a set of data. Reflecting this idea in mainstream economics is the acceptance of beliefs in the world that the world is a set of variables bound by current information and the solution of problems is formulated according to these variables. This is, of course, a reasonable summary, which can be used in any science. But if it is to reach deeper layers of science, it's worthy to go beyond that. So it is necessary to look at the mind and the process of cognition from deeper layers, In other words from the perspective of cognitive science [3]. But conventional economics, on the basis of its own assumptions, has neglected the role of beliefs and mental models in decision-making and ignored their implications. So, it has been unable to understand and analyze some of the economic issues. From the North's point of view, neoclassical economists basically do not ask questions about the structure that human beings impose on themselves to bring order in the environment and thus reduce uncertainty. Also, the dynamic nature of the world in which we live is not a concern for them. He believes that humans have more Pervasive motivation to make their environment more predictable and trying to reduce uncertainty about what we do not have the necessary documentation and information about its possible consequences is one of these motivations [4]. McDougall also argues that many of the results of classical economists are inconsistent with reality precisely because they are based on false psychology assumptions. According to his idea, in order to create an economic theory, gaining knowledge about the human mind and how it works, is an essential part of the requirements [5]. Generally, in a complex economic adaptation system, understanding micro-level behaviors are very important to understand the behavior of the whole system. Just for the sake of mathematical ease, for over a hundred years, economics was formed on the basis of a model of human behavior that nowadays, most economists find that model very simple and in contradiction with much evidence. But today, partnerships with psychology, computer science, and cognitive science have created a new model of economic man. This model assumes human beings with patterns of inductive rationality. This model assumes that human beings have models with inductive rationality that are capable of making decisions and learning in complex and highly changing environments over time. Real human beings are neither completely selfish nor completely altruist. But their behaviors are set to work on social media, rewarding partner agents and punishing abusers [6]. Therefore, it seems that more comprehensive insights should be used to better understand the consequences. In this context, cognitive science comes to the aid of economics and given that it has an interdisciplinary perspective in explaining various phenomena and also applies the findings of other sciences, such as psychology, computer science, anthropology, neuroscience and philosophy of mind, it can do the best analyze of behavior of economic agents, especially when they are faced with uncertainty. This is an applied and developmental research, with the type of library study and using the new findings of cognitive science, he explains how to make decisions under uncertainty.

2. Uncertainty and Decision-Making

According to the North et al., the mind comes to an understanding of mental models by receiving different senses by receiving the symptoms and translating them so that by receiving feedback from the surrounding environment and repeating those feedbacks, the belief system is created in person and as a result, his motivational system forms [7]. North believes that learning from the physical environment and linguistic, social, and cultural (Human environment) experiences are the major factor of reducing uncertainties; because in a world full of incomplete understanding, uncertainty is dependent on knowledge and institutions [4]. The word "cognition" is associated with thinking as well as with learning, and this is what makes us a human being. Gaining experience and useful knowledge to guide behavior, in responding to environmental and intrinsic phenomena, is an essential ability for survival and life satisfaction. Cognition refers to the ability to process information, to recognize, to apply knowledge, and to modify priorities. Cognition is associated with reasoning, learning, understanding and getting meaningful results in problem-solving and basically it is in the area action of the prefrontal cortex [8]. In cognitive psychology, which deals with how the brain relates to mind and behavior, the prefrontal cortex (PFC) as a center for mental processes is specifically examined [9]. Also nowadays it is accepted that the PFC is associated with multiple cognitive functions [10]. For example, the OFC is responsible for integrating reward information and calculating the value tag. the VLPFC's task is to retrieve and maintain linguistic and visual-spatial information; multitasking and maintenance of future intentions is the responsibility of the APFC; the ACC is responsible for monitoring the situation of paradox response and error detection; and the VMPFC assesses the impact of an action or action, such as an emotional one; the DLPFC also handles selection of responses, elimination of inappropriate responses, working memory management, brainstorming, uncertainty removal and sustained attention [8]. It should be noted that the prefrontal cortex is directly related to each distinct functional unit of the brain. This region is associated with the highest levels of perceptual integration and it is also related to the Premotor cortex, the Basal Ganglia, and the Cerebellum, that they are all involved in aspects of Motor Control and movements. The PFC also is related to the Dorsomedial Thalamic Nucleus, which is considered the highest level of the intra-thalamus integration and with the Hippocampi and the Medial Temporal Structures that are critical for memory, and also with the Cingulate cortex that thought to be vital for the excitement and dealing with uncertainty. . Furthermore, the PFC is associated with the amygdala, which regulates most emotions and social cognition, and with the hypothalamus, which is responsible for controlling the Homeostatic Functions of the body's vital balance. Eventually, the prefrontal cortex is also well connected with brainstem nuclei involved in wakefulness, arousal, and alerting, sleep regulation and REM dreams. These unique connections make the Frontal Lobes exceptionally suited to coordinate and integrate the activity of other brain structures [11]. In the studies such as (Tom and et al., 2007), (Brooks and et al., 2010), (Pammi and et al., 2015) and (Pammi and et al., 2017), The Loss Aversion in various uncertainties has been studied. The findings indicate that in the uncertainty situations, two parts of VPFC (Ventromedial Prefrontal Cortex) and VS (Ventral Stratum) are activated. So, the Striatum is associated with the loss aversion of individuals and the Ventromedial Prefrontal Cortex affects the loss aversion of individuals. As in all the above studies could be considered, the loss aversion of uncertainty has affected the prefrontal cortex. Thus, according to the cognitive sciences approach, it can be concluded that uncertainties can

have inevitable effects on the human cognition system. Because those concepts that are related to uncertainty, activate the striatum. The striatum has sent this information to the PFC and through the extensive association that PFC has with other parts of the brain, the occurrence of such conditions, especially if be repeated, leads to different behaviors -Conscious or unconscious- in the individual.

This can be also explained by the use of hormones. In general, two major functions for the brain can be conceived that are fundamental to the behavior of all humans: The Re-ward Approach (Pleasure-Seeking) system and the Loss Aversion (Pain-Avoidance) system. These two motivational systems can be activated or deactivated independently of each other. When facing potential gains or losses, one can use either or both of these systems in the decision-making process. Receiving a potential reward from the environment activates the brain's rewarding attitude. The search, evaluation, and motivational pursuit of potential rewards are coordinated and tailored by the reward system that this is caused by dopamine or the Pleasure Chemical of Brain. Rapid valuation of opportunities and threats to the peripheral environment is facilitated by the reward system. The second fundamental motivational flow controls loss aversion. The loss aversion system is activated when potential threats around the individual are identified by the brain. According to Bechara, Damasio, and Damasio (2000), intense activities of the loss aversion system lead to mental experiences and physiological symptoms of anxiety. Anxiety and fear are emotions that overwhelm the loss aversion system and the pessimistic and disturbing thoughts are the cognitive consequences of activating the brain-damaging system. For example, Coates and Herbert (2008) found that the experience of market fluctuations raises Cortisol levels (one of the stress hormones) in trading. Symptoms of activation of the sympathetic nervous system, including tremor, sweating, rapid heartbeat, shortness of breath, and pupil dilation are manifested when faced with a threat or experience of fear. Because reward and loss systems influence one's thoughts and consciousness, often it automatically leads to direct behavior on one's thinking and character. Therefore, it can be concluded in cognitive science that facing uncertainty, has inevitable effects on the human cognition system and the persistence of uncertainties can lead to mental illness and irreversible cognitive impairments. He will no longer be able to make accurate and reasoned reviews that their wise conduct should be based on them. Accordingly, the individual will have irrational beliefs and that will affect his current choices [4].

3. Summary and Conclusion

The present study aims to complement conventional ideas and to explain how decision-making in uncertainty situations is. One of the findings is the role of PFC, especially OPFC in decision making; especially when emotional factors are involved in the decision-making process. Findings are representative that complex decisions are all made by the PF Cortex. This fragment is associated with multiple cognitive functions. Another finding of this study is the role of the striatum in the formation of cognitive habits in individuals. The striatum has access to the cognitive areas of the brain involved in decision making (including the prefrontal cortex) as well as the brainstem involved in motor control. The striatum receives information through the Dopamine neurons of the midbrain or brainstem. Thus, by combining the reward (dopamine) with any particular context, the habit is created by the striatum. Habits

are formed by repeating a particular neural pathway leading to re-warding and since habit formation is a kind of gradual learning, learning happens in humans. Once the habit is formed, in the future less action potential is needed for the para-dox to be dismantled.

Accordingly, it can be assumed that if this neural pathway undergoes a sudden change-information rain, in other words- what will occur in this order of the brain- mind and behavior interactions. The findings representation that exposure to risks arising from uncertainty, VPFC, and VS will be activated. So that the VS independent of the type of uncertainty, is associated with the loss aversion of individuals and the VPFC affects the loss aversion of them. The striatum has sent this information to the PFC and through the extensive association that PFC has with other parts of the brain, the occurrence of such conditions, especially if be repeated, leads to different behaviors -Conscious or unconscious- in the individual. Therefore, it can be concluded in cognitive science that uncertainties have inevitable effects on the human cognition system and the persistence of uncertainties can lead to mental illness and irreversible cognitive impairments. He will no longer be able to make accurate and reasoned reviews that their wise conduct should be based on them. Accordingly, the individual will have irrational beliefs. Therefore, investigating the effects and consequences of the macro-level and developmental level of uncertainty which is more important is one of the suggestions for future studies.

Conflict of interest

No competing financial interests exist.

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