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NEUROECONOMICS

Abstract: Neuroeconomics, or neurobiology of decision-making is a new discipline, more precisely, a branch of neurobiology that attempts to understand the neurobiological basis of decision-making. It is an interdisciplinary scientific direction located at the intersection of psychology, neurobiology and economic theory. It is aimed at studying the decision-making process during the selection of alternatives, risk and reward distributions. This science uses economic models to study the brain and advances in neuroscience to create economic models. The article describes the basics of Neuroeconomics. Studies of decision-making mechanisms in different social contexts are presented. It shows the relationship between Neuroeconomics and neurobiology, mentions which areas of the brain are involved in decision-making, and what can lead to further study of Neuroeconomics.

Keywords: neuroeconomics, neurobiology, making decisions, neurons, value solutions, study, brain region, rationality.

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НЕЙРОЭКОНОМИКА

Аннотация: Нейроэкономика, или нейробиология принятия решений, — это новая дисциплина, точнее, раздел нейробиологии,

который пытается понять нейробиологические основы принятия решения. Она является междисциплинарным научным направлением, находящимся на стыке психологии, нейробиологии и экономической теории. Для изучения мозга эта наука применяет экономические модели, а для создания экономических моделей – достижения в области нейробиологии. В статье излагается основы нейроэкономики. Приведены исследования механизмов принятия решений в различных социальных контекстах. Показывается взаимосвязь нейроэкономики и нейробиологии. Говорится о том, какие области головного мозга участвуют в принятии решений, и о том, к чему может привести дальнейшее изучение нейроэкономики.

Ключевые слова: нейроэкономика, нейробиология, принятие решений, нейроны, ценности решения, исследование, области головного мозга, рациональность.

Neuroeconomics is an interdisciplinary direction in science at the intersection of the subjects of economic theory, neurobiology and psychology. Neuroeconomics aims at creating a new model of decision making. The main objectives of the direction are an explanation of the choice when making decisions, the distribution of risk and remuneration. The methodology of Neuroeconomics includes laboratory observations of the economic behavior of the tested people with simultaneous study of the activity of their brain [4].

A surge of interest in Neuroeconomics began in the late 1990s and early 2000s, the first interdisciplinary meeting was organized in 1997 at Carnegie Malone University, organized by the economists Colin Camerer and George Loewenstein. Then, two meetings were held in 2001. One was organized by the Gruter Foundation at Squaw Valley and was dedicated to the intersection of neuroscience and economics. The other was organized at Princeton University by the neuroscientist Jonathan Cohen and the economist Christina Paxson. It was the meeting that laid the foundation for the future creation of a community of Neuroeconomists. In 2003, neuroscientists, economists, psychologists and other specialists who worked in the newly-emerging discipline gathered at Emory University for a three-day meeting, and it was then that they identified themselves as neuroeconomists.

Neuroeconomic research

First Neuroeconomic Studies

The first neuroeconomic studies were conducted by a research with making the simplest perceptual decisions of monkeys by an outstanding neurobiologist William Newsom in the USA. According to this «diffuse model» the process of perceptual decisions begins with neuron detectors that receive information («evidence») about possible alternatives. Then, the information goes to the neuron-integrators, accumulating with time and actually making the decision. In general, the activity of the integrator system reflects the difference between the evidence in favor of each alternative. The decision is made when the activity level of one of the integrator neurons exceeds the «decision threshold» [6].

The first neuroeconomic studies of perceptual decision mechanisms revealed the presence of similar integrator neurons in the temporal regions of the monkey brain cortex (LIP).

Breakthrough neuroeconomics

The breakthrough of Neuroeconomics was connected with the research of Brian Knutson, a professor at Stanford University, who showed how decision-making values are encoded in the brain. He proposed a very simple research paradigm: the subject had to press a button, while on the screen he was presented some keys, information indicating how much money he could get if he performed the task correctly. It turned out that there are areas of the brain that encode the expected value of the solution, the activity there is proportional to the remuneration that a person expects to receive. This seemingly trivial observation has linked neuroscience with economics because in economics, values, or rather, subjective values or usefulness, are the key concept for the decision theory.

Thus, if we understand how value is coded, if we can discover the subjective value of an option for someone, we can predict their decision - they will choose the option with the highest subjective value.

Moreover, neuroeconomic studies have shown that when choosing alternatives, the subjective value was encoded by the neurons of the nucleus accumbens, and the comparison and integration of subjective values takes place in the orbitofrontal cortex.

It turned out that neurobiology gave economists some ways to look into the brain and directly look at internal values when making decisions. It is important as in economics, there are two fundamental theories of value when making decisions, the ordinal value and the cardinal value. The theory of cardinal value suggests that we can award each of the

options a suitable value and choose the option with the maximum value, and this value can be characterized by absolute numbers [2].

Neuroscientists gave economists the opportunity to look into the so-called cardinal values, absolute values, for a neurobiologist, the value of decision making is the total activity of the brain's neurons.

Research by Antonio Damacio

The next important stage in the development of Neuroeconomics was the research of Antonio Damacio. He studied patients with damage in the orbitofrontal cortex. It turned out that the studied group of patients had a high IQ, above average, they were very intelligent people, but they had destroyed these areas of the brain and made very strange decisions. For example, they invested in companies that went bankrupt, invested again and again in these companies, these people often lost their jobs, had problems with their families and friends. Antonio Damacio often characterizes the problems of such people with high intelligence, but with violations in the orbitofrontal cortex as an example of choosing a meeting place in a restaurant with friends. For us, this is a very simple task as we choose the place that is interesting for all participants. A patient with disturbances in the orbitofrontal cortex begins with an endless rational search for alternatives. This is a hyper-rational person who cannot make a quick optimal decision. It turned out that the orbitofrontal cortex is important for the integration of information about alternatives, our memories and our emotional sensations about this alternative. The orbitofrontal cortex integrates information for and against the decision and people with disabilities in this area, despite a high IQ, cannot make optimal decisions [1].

The Impact of the social environment on decision making

The social environment also plays an important role in decision making. We use the example from the work of Vasily Klyucharev in 2009 where people were asked to rate the attractiveness of several individuals and then they were shown what other subjects thought about these faces. Suppose a person says: «This person pulls on 6 on a 10-point scale». And the group said it was 8 out of 10, that is, in their opinion, a very attractive face. Having learned about this, a person changes their assessment from 6 to 7. This is a very good example of social conformity: after you learn what the group thinks about something, you change your point of view [3].

California University of Technology Studies on the Prefrontal Cortex

The final line of research that formed Neuroeconomics is a study conducted at the California University of Technology on the prefrontal cortex, the frontal areas of the cortex. It turned out that they are able to engage and be responsible for self-control.

For example, these areas are particularly active for people who are on a diet and can resist the temptation. It turned out that these areas affect the orbitofrontal cortex and areas associated with the neurotransmitter dopamine which encodes values [5]. Self-control can modulate the values encoded in other areas of the brain.

Thus, the conducted researchers within this area have shown the dependence on the greatest activity of various brain areas (cognitive or limbic), decisions can be made either rationally or emotionally.

A rational system of the brain presents opportunities for making optimal decisions when there is a certain amount of time and the emotional system facilitates making faster and more adequate decisions.

Neuroeconomics tries to fulfill the next functions: explain decision-making as the activity of our brain, explain some evolutionary trends in our behavior, find similarities in decision-making by man and animals with which we dispersed millions of years ago, understand how our decision is influenced by genes, hormones to create some integrative new theory of decision-making.

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