Analysis of Charitable Donation Behavior Based on Neuroscience

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ABSTRACT

Charitable donation is the material foundation of philanthropy. This paper systematically reviews and combs the research literature on charitable donation behavior and finds that traditional economics has bias between altruistic motivation and rational assumption of charitable donation behavior and actual experience observation, so it is unable to accurately grasp the real motivation of human behavior. The theory of cranial nerve science brings a brand-new research perspective to economics. Altruism motivation, warmth effect and reputation motivation have been proved in the research of cranial nerve science, provide important clues to study the development of motivation tendency of charitable donation behavior, and offer unlimited possibilities for further understanding the internal mechanism of economic behavior.

Key Words: Charitable Donation, Neuroscience, Neuroeconomics, Behavior Analysis

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Introduction

With the development of society, philanthropy has become a kind of culture and idea in the world. The development of philanthropy is a sign of measuring the progress of social civilization. Along with the rapid development of economy, people's charity consciousness is continuously promoted, and the charitable donation amount of all countries in the world continues to increase.

By enumerating the charitable donation amount of the United States and China respectively as the largest developed countries and the largest developing countries in the past six years, as shown in Figure 1 and Figure 2, we can find that both the developed countries and the developing countries have continued to develop philanthropy in recent years. Charitable donation is the material foundation of philanthropy as well as the direct reflection of its development level. Charitable donations have the unique functions which the public finance and the market mechanism do not have, and play an important role in many fields, which has provided the important realistic basis for the research of this paper.

Necessity of Neuroscience Analysis: Exploration and Expansion

Altruistic motivation

Scholars at home and abroad have different opinions on the motivation of people to voluntarily pay their own interests to support and help others and have established the corresponding theoretical foundation. According to neoclassical utility theory and human self-interest preference hypothesis, human charitable donations can be attributed to intrinsic altruistic motivation of individuals (Luo *et al*., 2015). The neoclassical economic model assumes from the

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beginning that people's choices are subject to individual utility maximization. Becker (1974) argues that charitable donations are motivated by a desire to improve the well-being of other people, so that this pure altruistic motivation or preference is internalized into the individual utility function, and the increase in the well-being of other people enhances the individual utility of the donors. Donor utility functions motivated by improving the overall well-being of society can be expressed in the following form:

$$U_i = U_i\left[x_i, x_j\left(= \frac{I_j + h_i}{p_j}\right)\right]$$

X_i and X_j measure the welfare of donor i and recipient j, respectively; I_j denotes the income of the donor j, h_i denotes the donation of the individual i, and p_j denotes the cost per unit benefit of the donor j. In addition, $\partial U_i/\partial I_j = \partial U_i/\partial h_i > 0$, that's, the utility of each unit of income added by the recipient on the donor is equal to the utility of each unit of donation by the donor. Further, Becker (1974) viewed the relationship between the donor and the recipient as a "family," and all members sought to maximize the income or consumption of the family as a whole, not just the personal income or consumption. Therefore, we can consider charitable donation simply as a kind of commodity and put it into utility function: $U_i = U_i (X_i, h_i)$.

However, this altruistic motivation -based model does not fully explain the behavior of charitable donations in real life.

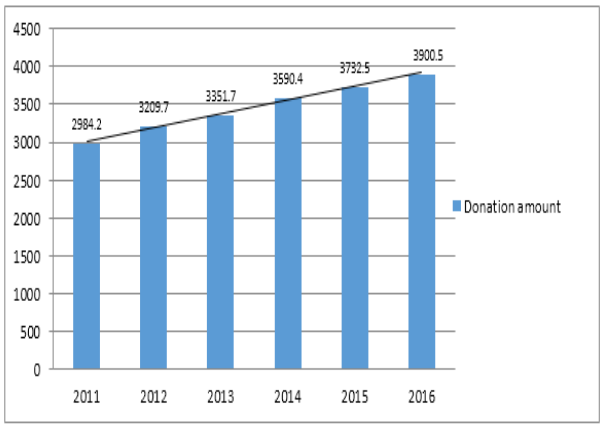

Figure 1. Charitable donation in the United States in the last six years (Unit: 100 million USD)

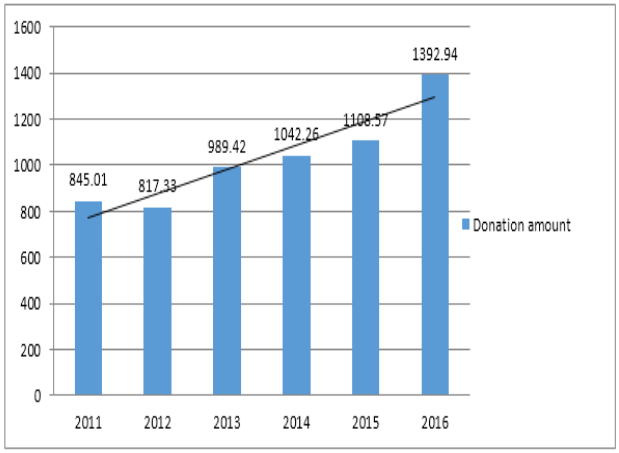

Figure 2. Charitable donation in China in the last six years (Unit: 100 million RMB)

The basic assumption of all the economic models of altruistic behavior considers that charitable donation is a rational response to people's preferences and constraints.

Rational issue

Although economic models can easily account for self-interest behaviors, they do not adequately account for behaviors constrained by moral norms or strong emotional reactions (Greene *et al.*, 2001).

The rational economic man hypothesis of modern economics is one of the most controversial hypotheses. From the basis of neuroscience, neuroeconomics studies the relationship between human reason and decision-making mechanism, deepens and expands the understanding of rational behavior, pays more attention to the understanding of sensibility, and thus consummates and develops the theories of traditional economics.

Traditional economics holds that rationality should be the best way for people to achieve certain behaviors. Obviously, from an evolutionary point of view, pleasure and pain are the basic driving force of human behavior, and to get pleasure and avoid pain is the basic pattern of human behavior. The rationality defined in this sense is reasonable and stable. But the study of cognitive neuroscience finds that this criterion is only a part of the whole system that affects human behavior, so it is observed that "irrational" behavior should be normal, and this "irrational" behavior can be reasonably explained through neuroeconomics. Many scholars think that the system of the actor in reality deviates from the rationality of the standard definition.

Neuroscience believes that the human dopaminergic system and its related emotional responses play an important role in the process of exploring the world. This is different from the complete rational hypothesis in economics, which holds that emotional factors should be completely eliminated in the process of selection. With the cooperation of other related systems, the emotional system can constantly strengthen the current experience to update the previous memory, so as to form the basis of future choices. With the rapid development of information technology, some advanced devices for observing the cognitive and conscious activities of human brain have made great progress. With the continuous improvement of these devices, it is possible to interpret the economic behaviors of human beings at the level of brain science, especially the difficulties which are difficult to solve in the past economics. This also brings a brand-new research perspective to economics, and then produces the neuroeconomics. The hypothesis of economic man in traditional economics has experienced the development from "complete rationality" to "limited rationality." At the level of brain mechanism, neuroeconomics finds evidence on the rule of neural activity of the "incomplete rationality".

Emergence and development of neuroeconomics

Modern economics based on the hypothesis of "rationality" has made great progress in logical positivism, but its empirical positivism has been developing slowly, and there is a deviation between people's empirical observation and the hypothesis of traditional economic theory. Experimental economics and behavioral economics challenge the "rational" hypothesis of traditional economics by experimental means and methods, but their methodology is also questioned. There is a certain difference in fitting between the artificial experimental environment and the economic behavior of the real world. The underlying reason is that when we study behavior and decision-making, the brain, the organ that determines behavior and mind, is still a "black box" for us.

With the development of brain science and neural science and technology, on the premise of no damage to brain, we can deeply observe the different characteristics of brain in the process of decision-making and interaction, and explore the cross discipline of human economic behavior mechanism- - neuroeconomics emerges as the times require. In December 2000, the name of Neural Economics was used for the first time in a workshop at Princeton University, and gradually became widely recognized later. Neuroeconomics can be divided into two major categories by topics: (1) to determine the neural processes in the decision-making process, in which the standard economic model can well predict behavior; and (2) to study "anomalies", in which the standard model d cannot predict behavior well. These models have been proven to be only crude predictions of human behavior with counterexamples which are easy to be found.

Neuroeconomics has not only promoted the empirical study of economics to a new height, but also influenced more and more deeply the fields of microeconomics such as behavioral economics and experimental economics (Hu, 2014). The progress of neuroscience technology has established a solid foundation for economics to expand its research boundaries and achieve new research breakthroughs. For the behaviors that economic models can successfully predict, neuroscience can reveal the neural processes behind them. For some abnormal behaviors that cannot be explained by economic models, the real reasons of these behaviors can be found through the research of neuroscience, with different behavior hypotheses put forward. The new model can normalize these behaviors so as to better the economic theories.

In terms of research methods, neuroeconomics has widely adopted various measurement techniques of neuroscience and psychology, including positron emission computed tomography, single photon emission computed tomography, functional magnetic resonance imaging, transcranial magnetic stimulate and pupil dilation technique, brain imaging equipment for recording changes in electromagnetic induction within the brain, and techniques for monitoring physiological responses of subjects to various external stimuli. Through the application of these techniques, we can observe and measure the changes of brain neuromaterial of economic behavior, compare the basic rules of human brain activity in making economic decision, and find out the neural mechanism of an economic behavior.

Behavioral economics can be seen as an intermediate stage from traditional economics to neuroeconomics. By research methods of cognitive neuroscience, the study of the conscious

Table 1. Relationship and Difference among Traditional Economics, Behavioral Economics and Neuroeconomics

	Traditional Economics	Behavioral(Cognitive) Economics	Neuroeconomics
Hypothesis	Limited rationality under complete rational or conditional constraints	Limited rationality of the behavioral level	Limited rationality of neural level
Model	Individual preference deciding the behaviors	Mental deciding behavior	Brain mechanism deciding behavior
Variables	Deterministic model with senseless variables	Sensory variables, combining cognition	Measurement perception and cognitive quantification
Decision processing	Controllable processing	Controllable processing with an emphasis on the role of cognitive system	Controllable and automatic processing, with interaction between cognitive and emotional systems

basis of behavior in behavioral economics has developed to the stage of neuroeconomics (Ma and Wang, 2006). The relationships and differences between them are shown in Table 1.

In a sense, some basic assumptions of economics need to be revised in conjunction with the research results of neuroscience. Perhaps a more complete economic model should take fully into account the limitations and complexity of human brain functions. One of the advantages of neuroeconomics over behavioral economics is to take into account factors such as emotion. The research of neuroeconomics not only verifies the existing economic theories to a certain extent, but also lays a theoretical foundation for the establishment of new and more perfect economic theories. The study of neuroeconomics will play an important guiding role in greatly promoting people's understanding of human decision-making behavior and human brain function, and thus helping to formulate more effective reward and punishment measures to improve people's well-being and work efficiency.

Is charitable donation a rational choice: evidence based on neuroscience

In the study of traditional economics, checking the motivation of charitable donation is mainly indirectly to infer from the act of charitable donation itself, or analyze the result of the questionnaire by means of questionnaire survey, both of which are only indirect inference. There is an unintentional neglect or deliberate cover-up between the behavior and motivation of the subjects, which cannot accurately grasp the true intrinsic motivation of the subjects' behavior.

For neuroscience, it is hard for people to "hide" or "beautify" true activity in their brains (Luo *et al*., 2015). Compared to other research methods, neuroscience can provide us with more direct and effective evidence for exploring the real motivation behind charitable donation behavior.

Animal experiment data in recent years have shown that specific brain regions, such as the ventral striatum and nucleus accumbens, and in some cases the insular and orbital frontal cortex, respond to the individual's basic needs.

The direct evidence for rational behavior analysis of charitable donations comes from a study by Moll *et al*., (2006), who used functional magnetic resonance imaging (fMRI) to explore the neuroscience basis of human charitable donations. The study found that when people donate to charity anonymously, the ventral tegmental area, dorsal striatum and ventral striatum of the midbrain are all activated, and these brain regions are also activated when people get money rewards, the so-called mesencephalic marginal reward system. This finding suggests that altruistic philanthropy and self-altruistic self-rewards are a satisfaction for humans, and that the two seemingly contradictory behaviors share the same reward system in the brain structure, and because the region is activated when the subject gives an anonymous donation, This finding is consistent with the hypothesis of "warm-glow" effect of charitable donation, in which people get inner satisfaction because of the act of charitable donation itself, instead of the opinion of others or social approval.

As to whether charitable donations and monetary rewards are based on the exact same neural connections, by comparing brain activity in both cases, individuals have more pronounced activation of the brain's Brodman 25 region and associated septum structure during charitable donations than did monetary rewards. A further study finds that the activation of the ventral striatum and medial frontal lobe caused by charitable donation is related to the actual amount of donation. This indicates that the brain region related to the utility of calculating gain and

loss is also responsible for calculating the utility of donation amount.

Based on the above analysis, we find that people's charitable donation is not only sympathetic to the weak (altruistic motivation), but also can obtain self-satisfaction from the behavior itself (warm-glow effect motivation).In brain science experiments, Waytz *et al*., (2012) examined the relationship between altruistic behavior (charitable donation) and reflex, which connects the nervous system on the emotional ability of humans to understand others, thus verifying the driving effect of pure altruistic motivation on donation behavior. The results suggest that the study of activity in the dorsolateral prefrontal cortex can predict charitable donations.

Harbaugh *et al*., (2007) made a distinction between the two motivation levels by examining the difference in the degree of activation of the reward brain regions, specifically the nucleus accumbens, caudate nucleus and cerebral island, under two different conditions of compulsory and voluntary donations, as shown in Figure 3.

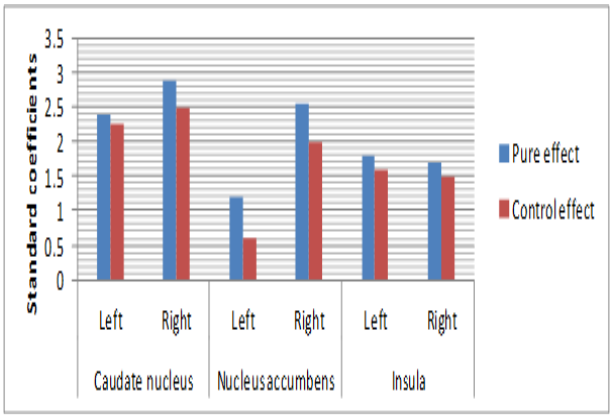

Figure 3. Activation intensity induced higher under voluntary conditions

The activation intensity of these brain regions is higher under voluntary conditions. Additional neural activity of voluntary donations still exists after the actual benefits have been controlled. The results show that when donation occurred regardless of compulsory or voluntary donation, the brain nerve activity is the same as that of money reward, and the degree of brain nerve activity and the sense of satisfaction of individuals under the condition of voluntary donation are significantly higher than that of compulsory donation. This fact confirms that the motivation of people's charitable donation includes not only the rational decision-making of pure altruism model and the concern for the recipient, but also the warm-glow effect of personal participation in helping the recipient.

In addition to altruistic motivation and warmth effect, reputation motivation has also been demonstrated in neuroscience. Izuma et al. (2010) conducted a neural association analysis of charitable donations using fMRI technique. The study, which is conducted separately with or without observation, shows that the activity of the ventral striatum of the brain is significantly regulated due to the observation of the other person on the behavior prior to deciding whether to donate. Striatal activity is particularly active when donations are made under the observation of others (social rewards are available) and when donations are not made without the observation of others (social costs are not paid and material rewards are available). This shows that the donation behavior observed by others will increase the effectiveness, that's to say, it confirms the importance of reputation motivation to donation behavior.

Motivation is the driving force of behavior, but motivation is a psychological feeling in the body after all. It's often difficult to observe and verify the motivation, and thus difficult to analyze the motivation of donation to anticipate people's donation behavior. Therefore, it is necessary for us to broaden our vision on the conditions under which people are willing to donate and how much they will donate, and provide important clues for studying the development individual motivation tendency in charitable donation by learning from the theories of cranial nerve science.

Prospect

Psychology is the function of human brain, and human economic behavior has its corresponding neural mechanism. Neural evidence is expected to identify the direct and true motives behind altruistic behavior. From the economic data analysis and the experimental results, there are great individual differences in charitable donation, some individual differences can be analyzed and explained by such variables as gender, income or educational level, and quite a large part of remaining differences need to be analyzed by means of the theories and technologies of neuroscience. Although the current research on neuroeconomics has not completely opened the black box behind economic behavior, the application of neuroscience to

economic research undoubtedly offers unlimited possibilities for further understanding the internal mechanism of economic behavior.

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