Analysis of Corporate Social Responsibility Decision-making Behavior Based on Cognitive Neuroscience

Bin Wang

ABSTRACT

In order to study corporate social responsibility decision-making behavior from the perspective of brain activities of corporate executives, this paper introduces the method of cognitive neuroscience and the theory of neuroaccounting, to make an in-depth analysis and forecast on corporate social responsibility decision-making behavior using the method of cross-evolutionary derivation in light of the related researches. The results show that the cognitive neuroscience method and the neuroaccounting theory are effective tools to explain the active social responsibility decision-making behavior of corporates, which provide evidence for the combination of corporate social responsibility decision-making behavior and cognitive neuroscience, and references for the related research in the future.

Key Words: Neuroscience, Neuroaccounting, Corporate Social Responsibility, Decision-Making Behavior


Introduction

Due to the rapid development of the market economy and the acceleration of economic globalization, a series of social problems and natural problems have appeared, leading to a growing intertwining and mutual influence between corporates and society. The business environment of the corporate becomes more diversified; the demands of the society and the public on the corporate have been continuously improved; the pursuit of profitability first of the corporate has aroused dissatisfaction in the society, and the corporate is required to actively fulfill its social responsibilities. According to the comprehensive Rankings CSR Ratings of corporate social responsibility rating scores of 2009-2015 in China, as shown in Figure 1, the corporates' awareness of social responsibility has been increasing in China in recent years, but the overall performance is not good, and there is still a big gap between social responsibility awareness and behavior. Enterprise's active fulfillment of social responsibility is the necessary condition of national and corporate's sustainable development, and it is also the direct embodiment of their development level. Thus the study of corporate social responsibility decision-making behavior plays an important role in accounting theory research and practice.

The human brain is an evolutionary result of millions of years of natural selection (Darwin, 1871; Allman, 2000), a central part of the human body, capable of producing tools, art, and music (Wilson, 1999). The brain may be the source of the fundamental tools for making accounting decisions (Dickhaut et al., 2010; Waymire, 2014).

As more and more people's brain neural basis and mechanism have been revealed with the operation of the market economy, is there any ultimate causal relationship between these cranial nerve operating rules and accounting decision-making behavior? To explain this requires direct evidence of how accounting behavior affects decision-making in the brain.
In recent years, the innovation of neuroscience theory and its researches have provided an opportunity for accounting scholars to observe the brain activity of accounting behavior more directly. In particular, the emergence and widespread application of non-invasive brain measurement tools, such as positron emission tomography (PET), functional magnetic resonance imaging (fMRI) and event related potential (ERP), have made it possible for accounting scholars to carry out research on the brain motivation and economic consequences of accounting systems and accounting practices, and a number of accounting literature based on neural data have been initially produced. For example, Dickhaut et al., (2010) proposed three normative mechanisms based on the market transactions in neuroeconomics, including fairness regulation, trust-based reputation, and altruistic punishments, studied the brain-neural motivations for the formation of accounting principles. Barton et al., (2014) linked the stock pricing function of the earnings announcement with the neural reward system in the brain to directly explore the brain's response to the overall market behavior. Based on the neural reward system, Farrell et al., (2014) studied the role of emotional and rational decision-making in investment decisions under compensation incentives, thus providing new insights into the design of compensation plans. These researches have pioneered the accounting research based on the method of neuroscience and formed a new research paradigm. Since then, the number of accounting papers published by top international accounting journals based on neuroscience methods has grown rapidly. However, the research on the relationship between the cranial nerve operation rules and the corporate social responsibility decision-making behavior in the current accounting research has not been found so far, which has seriously affected the development of corporate social responsibility decision-making behavior research based on neuroscience.

Therefore, the study introduces the method of cognitive neuroscience and the theory of neuroaccounting, to make an in-depth analysis and forecast on corporate social responsibility decision-making behavior based on cognitive neuroscience by using the method of cross-evolutionary derivation in light of the related researches, which provide evidence for the combination of corporate social responsibility decision-making behavior and cognitive neuroscience, and references for the related research in the future. This study first summarizes the development of cognitive neuroscience theory and research tools, and then analyzes the main theoretical sources and connotation features of neuroaccounting and explores the necessity of analyzing corporate social responsibility decision-making behavior based on cognitive neuroscience, and then explains the reasons why corporates actively fulfill their social responsibility decisions from the perspective of cognitive neuroscience and finally it puts forward the prospects for the combination of cognitive neuroscience and corporate social responsibility decision-making.

![Figure 1. Distribution of corporate social responsibility](image)

**Development and Research Tools of Cognitive Neuroscience**

Cognitive neuroscience is developed on the basis of neuroscience and cognitive Science.

**Functional regions and cognition of the human brain**

Brodmann (1909) used cell staining to divide the whole cortex into 52 regions, and the corresponding functional subdivision is still applicable to date. As shown in Figure 2, Zone 4 is the movement zone I, Zones 1, 2 and 3 belong to the feeling zone I, Zone 17 is the viewing zone I, and Zones 41 and 42 belong to the listening zone and so on.

The basic assumptions of cognitive neuroscience about the relationship between the (cognitive) functions of the brain and the brain's functional regions are as follows. Complex brain functions can be broken down into simpler and more common processes, and the regions for these simple processes can be anatomically located and studied relatively independently.
Complex brain functions (such as cognitive-based awareness and thinking, etc.) are usually accomplished by a combination of multiple brain functional regions.

In general, the process of brain activity, whether simple or complex, is usually closely related to certain behaviors. Therefore, cognitive neuroscience has “accidentally” entered the field of researches on the brain physiological basis of some important behavior of human beings and is used to interpret many classical behaviors of human society from the perspective of brain science. Therefore, the cross development of cognitive neuroscience with many social sciences involving human behavior, especially with accounting, psychology, sociology, economics and management science, is inevitable.

Measurement techniques of brain activity
At present, there are two major types of non-invasive devices for studying brain activity (especially cognitive activity), one is imaging devices for recording magnetic induction changes of brain activity, mainly including PET device, MEG recording device, single photon emission tomography (SPECT) device, optical imaging device, and MRI and fMRI equipment and so on. Such devices have a good spatial resolution but a slow overall brain scanning speed and a low temporal resolution. The other is the measurement device that records the changes in brain voltage in time dimension, mainly consisting of the device with ERP analysis technology. This type of devices has a high temporal resolution, but a low spatial resolution due to the influence of skull and scalp impedance. At present, fMRI and ERP are the most mature and widely used techniques for measuring brain activity. These two technologies each have advantages and disadvantages and cannot be completely substituted for each other at present.

In the 1970s, China began to study the application of ERP, and introduced fMRI in the mid-1990s. After entering the 21st century, interdisciplinary brain science and cognitive science research institutions continue to emerge.

Necessity of Cognitive Neuroscience Analysis: An Exploration Based on Neuroaccounting
Main theoretical sources of neuroaccounting
The comprehensive findings from psychology, neuroscience, and neuroeconomics have been refined into a number of important theories, which become the main theoretical sources of accounting research based on neuroscience methods, and also lay the theoretical basis for the combination of corporate social responsibility decision-making and cognitive neuroscience.

1. Preference theories in risk decision-making
   1) Regret Theory
      Loomes and Sugden (1982), and Bell (1982) independently proposed Regret Theory. According to the theory, the sensation that a decision maker will experience when the outcome of his choice may not be as good as the outcome of another choice, is called “regret”. When facing a decision, individuals might anticipate regret and thus incorporate in their choice their desire to eliminate or reduce this possibility. In contrast, the sensation that a decision maker will experience when the outcome of his choice maybe better than the outcome of another choice is referred to as rejoice. The sensation of rejoice is usually much stronger than that of regret. Therefore, in order to avoid the regret that current choices may cause, people tend to make more conservative decisions.

2) Prospect Theory
   The theory was created in 1979 and developed in 1992 by Tversky and Kahneman. It proposes that people adopt a risk-averse attitude to gains and a risk-preference attitude to losses. In addition, Ellsberg (1961) found that individual would rather bet on an alternative where the probability distribution of the outcomes was known over one where the probabilities were unknown, a phenomenon which is known as ambiguity aversion (Camerer and Weber, 1992; Fox and See, 2003). The ambiguity aversion can lead to people’s decision-making bias (Fox and Tversky, 1995; Chow and Sarin, 2001).
3) Mental Accounting Theory
Thaler (1980, 1999) proposed the Mental Accounting Theory. The mental accounting describes the cognitive process whereby people code, categorize and evaluate economic gains and losses. The theory holds that because of the different attitudes towards the risk of gains and losses, the same income can gain more pleasure when it is divided into smaller parts and multiple gains, and the total pain when multiple losses are brought together is less than the total pain of multiple losses.

(2) Reversal of values and behavioral theory
1) Impulsion and Altruistic Punishment
The behavior that people choose to achieve a smaller interest immediately because they cannot wait patiently for a greater one to arrive, is called impulsion (Cardinal et al., 2004). Impulsion is shown by an act for temporary interest, such as an impulse purchase at the time of procurement. An obvious example in an aversive situation is Altruistic Punishment, which means that when people face inequities, they will punish others at the expense of their own interests.

2) Framing Effect
Framing Effect refers to the cognitive bias in which people react to a particular choice in different ways depending on how it is presented, e.g. people’s risk preference depends on how the option is described. The rejection rate under the loss framework is higher compared to the income framework (De Martio et al., 2006; Sarh et al., 2013). With fMRI techniques, researchers find that the human brain invokes different brain regions when dealing with gains or losses (Kuhnen and Knutson, 2005; De Martio et al., 2010).

3) Fear and Evasion
In the aversive scenario, people prefer the greater aversion of the early arrival rather than the relatively weaker aversion of the late arrival. The pain caused by the expectation of aversion before such aversion comes is called fear (Leowenstein, 1987; Caplin and Leahy, 2001). When the outcome of aversion is expected to arrive, the brain region, which is usually associated with physiological pain, is activated as if this expected process is indeed painful (Berns et al., 2006). For this reason, people will make some related behaviors, which is called evasion.

(3) Theory of Mind and Empathy Theory
Both Theory of Mind and Empathy Theory belong to the theories for understanding and inferring others and are all related to the role of the mirror neurons system. For example, when you see someone being pricked, the “mirror neurons” react as if you are being pricked yourself. But the Theory of Mind and Empathy Theory rely on two different neural circuits (Blair, 2005; Singer, 2006).

(4) Reward System and Theory of Reward Expectation Deviation
Incentive constraint is one of the core issues in economics and management research. Cognitive neuroscience reveals the neural basis of these mechanisms. Dopaminergic neurons in the midbrain can encode reward stimulus and correlate with economic decisions. However, dopamine does not simply respond to rewards or average economic value, but only respond to those rewards that deviate from the forecast, that is, respond to the difference between the actual reward and the expected reward (referred to as reward expectation deviation) (Fiorillo et al., 2003; Bayer and Glimcher, 2005; Tobler et al., 2005). The above findings provide new connotations for the incentive constraint theory.

(5) Theory of Emotional and Rational Decision-making
The impact of emotion on decision-makers is particularly significant and difficult to mitigate or eliminate (Kahneman and Frederick, 2004, 2005 & 2011), resulting in two distinct types, emotional decision-making and rational decision-making. These two kinds of decision-making correspond to two kinds of cognition: comprehensive cognition and analytical cognition. Emotional influences are contained within comprehensive cognition and rational influences are contained within analytic cognition. Emotional decisions often result in higher decision-making costs, especially in the case of agency issues in the economic field. Rational decision-making can reduce the adverse effect of emotion on decision-making to a certain extent.

Connotation and characteristics of neuroaccounting
(1) Connotation of neuroaccounting
Neuroaccounting refers to a cross-discipline based on traditional accounting theory that
explains and predicts the theory and method of accounting practice, which studies the cognitive laws and brain mechanisms that underpin the accounting phenomenon and accounting behavior, and reveals the underlying causes of the occurrence, development and change of accounting phenomena and accounting behavior from the perspectives of brain functions and neural mechanisms, combining cognitive neuroscience theory, psychology theory, and behavior theory, and using cognitive neuroscience methods and research tools as well as their innovative data sources.

(2) Basic characteristics of neuroaccounting

Based on traditional accounting theory, neuroaccounting incorporates cognitive neuroscience and its brain measurement techniques, and applies the data of cranial nerve activity when participating in accounting activities and the research method of cognitive neuroscience at the level of cranial nerve mechanism, with focus on the neurological and physiological basis behind human accounting practices. It provides direct neurological evidence for accounting behavior and accounting phenomena and greatly enhances people’s understanding of the cranial nerve mechanism behind accounting behavior and financial behavior and the synergy between accounting principles and human brain evolution, thus to provide a better explanation to the research proposition of accounting branch fields such as corporate social responsibility. Compared with traditional accounting theory, the basic characteristics of neuro-accurate accounting have changed in the following 5 aspects: (1) behavior subject, from economic man hypothesis to social person hypothesis; (2) theoretical basis, from economics to cognitive neuroscience; (3) research perspective, from economic mechanisms to cognitive and cranial neural mechanisms; (4) research focus, from accounting economic consequences to accounting information and accounting behavior themselves; (5) accounting practice, from emphasizing extrinsic motivation to emphasizing both intrinsic motivation and extrinsic motivation.

Corporate Social Responsibility Decision-Making Behavior: Evidence Based on Cognitive Neuroscience

Corporate social responsibility is essentially a decision-making process, thus it is closely related to cognitive neuroscience. Antoine et al., (1997) published Deciding Advantageously before Knowing the Advantageous Strategy in Science, which found out the influence of subconsciousness on decision-making through the measurement of SCRs, and then proposed a decision-making model modified by subconsciousness. The subconsciousness influences the decision-making through two ways: first, it influences the decision-making indirectly through the role of “reasonable strategy” and “rational choice of future outcomes”; secondly, it directly influences the decision-making. These influences are all confirmed by behavioral studies combined with measurements of changes in SCRs. Therefore, the decision-making behavior of corporates actively fulfilling their social responsibilities can be reasonably explained by cognitive neuroscience.

Gehring and Willoughby (2002) published The medial frontal cortex and the rapid processing of monetary gains and losses in Science, which designed a gambling game experiment according to the Prospect Theory and Regret Theory of behavior school, wherein the subjects were asked to choose between “5” and “25”. When the feedback result showed a green color, it meant that the subject won the selected amount of money. When the result showed a red color, it meant that the subject lost the selected amount of money. The ERP method recorded the negative wave that occurs about 200ms after the feedback information is given – MFN. Combined with behavioral experiments, they found that risk preference decisions occurred in the event of expected loss, which provides neurological evidence for a series of behavioral experiments conducted by Kahneman, Nobel laureate of 2002 in economics. The results are shown in Figure 3. From the results of this experiment, we can draw the neuroscience basis that managers will increase the social responsibility behavior of corporates in case of loss.

Amodio et al., (2004) published Neural Signals for the Detection of Unintentional Race Bias in Psychological Science, a paper in the field of neuropsychology in essence, which found that unconscious (subconscious) bias had a stronger ERP EEG signal (error-related negative wave ERN). It is of general enlightening significance for the corporate to actively fulfill its social responsibility decisions, as shown in Figure 4.
Kuhnen and Knutson (2005) published *The Neural Basis of Financial Risk Taking* in *Neuron*, which compared the interaction between the peanut-like region of nucleus accumbens (activated during excitement) and the anterior thalamus (activated during anxiety) through the participants’ cash adventure game experiments. The results show that the evoked nucleus is activated in the first two seconds of the risk decision-making. When the subjects chose conservative betting, the hypothalamus is more active. The results of this study explain the neurologic basis of people making risk-taking decisions and this basis directly influences corporate social responsibility decision-making behavior, so that the reasons why the corporate actively fulfills its social responsibility can be explained from the perspective of cognitive neuroscience.

Birnberg (2011) attached great attention to the latest advances in neuroeconomics and the emerging accounting literature based on neuroscience, pointed out that neuroeconomics had important implications for the study of behavioral accounting, and took studies on compensation incentives, corporate social responsibility, and pro-social behavior as examples to emphasize the enlightenment of neuroeconomics results and methods on accounting research and analyze the difficulties and countermeasures of accounting research based on neuroscience methods. Birnberg *et al.* (2012) further expanded and refined the above opinions, discussed the latest achievements in neuroeconomic research and its application prospects in behavioral accounting research in depth, and pointed out that accounting scholars should closely follow the research field and overcome difficulties in accounting research based on neuroscience through cross-field cooperation. From these research results, we find that it is necessary to combine the study of corporate social responsibility decision-making behavior with cognitive neuroscience and neuroaccounting. Thereby the evidence of neuroscience for corporates to actively perform social responsibility decision-making has emerged.
Based on the dual process theory, Farrell et al. (2014) studied how incentive mechanisms affect managers’ investment decisions and provided direct neurological evidence and behavioral evidence. The study uses both fMRI and traditional experimental method to observe the activation of brain regions for emotional decision-making and rational decision-making under fixed compensation contract and performance compensation contract respectively. The results show that incentive contracts can reduce the bias in decision-making and guide managers to make better economic investment decisions. The active investment decision-making of corporate social responsibility has also found evidence based on cognitive neuroscience.

Strombach et al. (2015) further studied the neural mechanisms of performance-based compensation incentives and provided evidence that monetary incentives would affect performance and those changes in monetary incentives would be reflected by the Dopaminergic reward system. The study uses fMRI to directly measure performance and cognitive processes, and tests whether monetary incentives change the neural mechanisms that perform tasks. The research results show that performance compensation does not directly affect the performance by adjusting the neural activities in the brain regions associated with task execution, but it affects the reward system in the task implementation process. Therefore, for corporates that cannot guarantee long-lasting performance compensation due to the unstable environment, care must be taken when adopting a performance-based compensation system, because once performance-based compensation cannot be lived up to, there will be great reverse incentives. The study of the neural mechanism of performance-based compensation incentives provides an explanation basis for managers to actively perform corporate social responsibility decision-making behavior.

Prospect

Neuroaccounting is the discipline that most likely incorporates corporate social responsibility and pro-social decision-making behaviors into the theoretical framework of cognitive neuroscience. The first evidence at play is that the rewarding neural circuit that transcends money is revealed. In the existing economics and accounting theories, the incentive mainly takes the money as the intermediary, but few studies adopt the non-monetary incentive. Through the study of the neural reward circuit that controls the secretion of dopamine and takes the midbrain as sources, cognitive neuroscience finds that the reward circuit is the common basis of different stimulus enhancements. There is no great difference in the consumption of money and other products in the reward circuit. The incentive sources can be studied through the reward circuit. The second evidence lies in that prosocial behavior is reliably revealed as a neural basis for human intrinsic motivation and reward function. Cognitive neuroscience discovers that pro-social behaviors, such as reciprocity, cooperation, trust, altruistic punishment and donation, are intrinsic motives of human beings and have strong motivational functions. Therefore, neuroaccounting helps to explore the requirements of social responsibility, accounting integrity and other pro-social behaviors on accounting reports, and helps and promotes the improvement of accounting reports, so as to strengthen the ability of accounting reports to disclose information on social responsibility, sustainability, and social ethics, which will become an important area of neuroaccounting research. Accounting is rooted in ethical behavior, thus good ethics can promote economic efficiency (Arrow, 1972; McCloskey, 2007). In addition to the study of accounting fraud and earnings management in related fields, the research on the functions and contributions of accounting in ethics, social responsibility and sustainable development is expected to make some theoretical breakthroughs.

References

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