NEUROECONOMIC EXPERIMENTS ON THE RELATIONSHIP BETWEEN BRAND TRUST, FINANCING INTENTION AND RISK PREFERENCE IN CROSS-BORDER E-COMMERCE

Xuhua Chen¹, Xiaheng Zhang²

Abstract
Brand trust, risk preference and financing intention are three important influencing factors of the operation of cross-border e-commerce enterprises. To disclose the relationship between these factors, this paper carries out both trust game experiment and financing risk experiment on the neural activities in the dorsolateral prefrontal cortex (DLPFC) of the brain, using the transcranial direct current stimulation (tDCS), which is the latest technology of brain nerve stimulation in the field of neuroeconomics. The results show that the investment behavior of cross-border e-commerce enterprises is based on the trust in their brand, rather than the rational calculation of financing risk; there is no significant causal relationship between the neuron activities in the DLPFC and trust investment behavior in cross-border e-commerce market. The research provides innovative neuroeconomic results on brand building and risk decision-making for e-commerce managers.

Key words: Cross-border e-commerce, Brand Trust of e-commerce, Risk decision preference, Financing Risk Preference, Neuroeconomics, tDCS Technology.

Received: 12-02-19 | Accepted: 1-07-19

INTRODUCTION
In the past two years, under the background of the weak growth of traditional international trade, the growth of cross-border e-commerce market is rapid, which is in marked contrast to the traditional international trade market and plays an increasingly prominent role in economic and social development. Under the comprehensive effects of global economic integration, Internet popularization and mature application of information technology, cross-border e-commerce has gradually become an important force in global economic development. Cross-border e-commerce enterprises continue to emerge, traditional enterprises have also tried to water the cross-border e-commerce market, cross-border e-commerce is favored by venture capital funds.

With the continuous expansion of the market, cross-border e-commerce market competition is becoming increasingly fierce. In order to occupy a dominant position in the market competition, cross-border e-commerce enterprises need to invest a lot of energy, time and funds in marketing activities. Cross-border e-commerce market competition forces brand awareness, but also provides the soil for brand cultivation and maintenance. Brand strategy has become a business tool that can not be ignored by cross-border e-commerce enterprises. Cross-border e-commerce enterprises need to pay attention to cross-border e-commerce brand, so that it can be trusted by consumers and financing objects. (Karimov & Brengman, 2014)
Only in this way can we be in an invincible position in the market competition, and let the enterprise be in a healthy and benign state of operation. In the process of development, cross-border e-commerce enterprises represented by start-ups will often be accompanied by corresponding financing activities, especially the financing of some venture capital funds. Enterprise operation will also be accompanied by many risks, especially cross-border e-commerce transactions because of its many characteristics, will face such problems as platform risk, payment risk, logistics risk, exchange rate risk, policy risk, network risk, financing objects will also have different risk definitions, showing different risk preference behavior. It can be seen that the relationship among brand trust, risk preference and financing intention of cross-border e-commerce will always be one of the focus of attention and research in the economic field.

RELEVANT THEORETICAL BASIS

Trust plays an important role in human economic and social activities. A lot of research work has been done on trust in sociology, economics, psychology and other related disciplines. Worchel believes that trust is when one party relies on the other party’s will when it perceives risk. Lewis and Weigert argue that trust is not only the predictability of behavioral outcomes, but also the confidence of the other party from the perspective of risk. Some scholars describe trust in terms of intention and behavior (Lewis & Weigert, 1985). Some scholars describe trust in terms of intention and behavior (Ganesan, 1994; Mayer, Davis, & Schoorman, 1995). According to Frenzen and Dvai, the social benefits of trust are independent of the benefits customers get from products and can cushion the impact of fluctuations in customer satisfaction (Frenzen & Davis, 2004). The definition of trust is different between the East and the West. The East focuses on credit and honesty, while the West focuses on economic and commercial behavior. Some researchers define trust from different perspectives, such as sociology, psychology and economics.

This paper adopts the definition of trust from the perspective of behavioral economics (Rushworth & Walton, 2009). That is, when the agent is not promised by the principal, he voluntarily gives the resources to the principal in order to obtain some return.

Brand trust was first proposed by Howard and Sheth in 1969, which is considered to be one of the decisive factors of consumers’ purchase intention (Howard & Sheth, 1968). Bennett and Harrell (1975) also recognized that brand trust was the main factor influencing consumers’ purchase decisions (Bennett & Harrell, 1975). Subsequently, some scholars have studied and verified the relationship between brand trust and consumer purchase (Laroche & Sadokierski, 1994; Chaudhuri & Holbrook, 2001). The study found that the factors affecting people’s brand trust include preference, motivation and belief, hormone-oxytocin and brain neurological basis (Kenning & Plassmann, 2005), as shown in Figure 1. For the measure of trust, psychology adopts the method of questionnaire, while economics adopts the method of behavioral experiment. Through a large number of comparative experiments, it is proven that there is correlation and consistency between the two methods (Hawley & Fujii, 1994).

Brand trust is also believed to provide consumers with a sense of security, thus driving their consumer behavior. For example, Elena and Jose (2001) put forward that brand trust is a sense of security consumers get from the brand, and the brand can meet consumers’ expectations (Delgado–Ballester & Munuera–Alemán, 2001). Huo Yingbao et al. (2004) also proposed that brand trust is a sense of security for consumers when they interact with brands. Based on revenue analysis, brand trust can provide public awareness of brand, promote new product publicity and improve product sales, thereby improving enterprise profits and market competitiveness (Liu, 2006). Negative brand trust will be more destructive than positive brand trust, which will damage the long-term cash flow and stock.
brand trust will also help to attract consumers and increase the value of their consumer assets (Villanueva, Yoo, & Hanssens, 2008). Improve brand trust will also help to reduce crisis expectations and reduce the spread and trigger probability of crisis incentives in the public (Wei & Yang, 2012).

From 1980s to 1990s, the trust game experiment designed by Berg et al. on the basis of behavioral economics and experimental economics became the classical paradigm of trust measurement (Mcknight, Choudhury, & Kacmar, 2002). However, this conclusion deviates systematically from the hypothesis of "rational man" in neoclassical economics. Others believe that trust is essentially equal to venture capital game. However, many researchers such as Houser, Eckel, Fetchenhauer and so on show that trust is not simply equal to risk through behavioral game experiments. Therefore, risk preference theory is proposed to supplement and revise the hypothesis of "rational person" (Kaplan & Nieschwietz, 2015). Of course, a few experimental results show that there is a significant correlation between trust and risk preference, but these theories and studies fail to explain the relationship between trust and risk preference fundamentally. However, with the development of neuroscience, brain imaging technology has been widely used in various fields. Neuroeconomists have been able to use brain imaging technology to explain the neural mechanism of human trust behavior from the level of neural network (Kim, Ferrin, & Rao, 2009). The latest brain nerve stimulation technology offers the possibility to verify the causal relationship between human trust behavior and financing risk preference. In risk decision-making, especially in dealing with sensory, perceptual and emotional information, cortex, limbic system and extensive neuroregulatory system can play a mediating role. In the research of the relationship between brand trust, risk preference and financing intention of cross-border e-commerce, transcranial direct current stimulation (tDCS) is adopted (Lowry, Vance, Moody et al., 2014). Experiments were conducted on subjects. The experimental data obtained by regulating the neurological activity of the dorsolateral prefrontal cortex (DLPFC) of the brain were analyzed (Kaufmann, Weber, & Haisley 2012).

In the behavioral experimental study, in order to verify whether risk preference will affect the investment and return behavior in cross-border e-commerce brand trust, some researchers tested the trust, trust and financing risk preference of the subjects through standard BDM trust game experiment and venture capital game experiment (Apicella, Dreber, Campbell et al.). The results show that there is no significant correlation between trust investment and financing venture capital, and financing risk decision-making behavior can not explain the participants' trust investment behavior, trust is not a rational calculation similar to risk (Drichoutis & Nayga, 2015).

**BRAIN SCIENCE RESEARCH ON BRAND TRUST, RISK DECISION PREFERENCE AND FINANCING INTENTION**

**Brain Imaging Study on Brand Trust, Risk Decision Preference and Financing Intention**

With the development and popularization of brain imaging technology, it is possible to study the essence of brand trust, risk decision preference and financing willingness from the neurological level of brain by using magnetic resonance imaging technology. It is found that the brain regions related to human trust include prefrontal cortex, amygdala, cingulate gyrus and striatum, while the amygdala, orbital gyrus, septal nucleus accumbent and anterior thalamus are activated in financing risk decision-making, and play a certain role in promoting or inhibiting people’s choice of financing risk decision-making. (Feng, Zhao, & Donnay, 2013; Levin, Xue, Weller et al., 2012; Elliott, Newman, Longe et al., 2003; Takahashi, 2013)

**Brain Stimulation of Brand Trust, Risk Decision Preference and Financing Intention**

The development and maturity of transcranial direct current stimulation (tDCS), the latest technology of brain nerve stimulation in the field of neuroeconomics, enables people to stimulate and study the nerve activity in specific brain regions independently. This also provides technical support for the causal relationship among brand trust, risk decision preference and financing willingness decision-making in specific brain regions. Many researchers have found that trust game experiment (Stanton, Mullette-Gillman, Mclaurin et al., 2011). Regulating dorsolateral prefrontal lobe (DLPFC) and orbitofrontal cortex has some effects on trust decision-making in humans. In the risk game experiment (Patton & Jøsang, 2004), when adjusting bilateral DLPFC, left DLPFC (IDLPFC) and right DLPFC respectively, people will make different risk decision-making behaviors. These results all prove that there is a causal relationship among brand trust, risk decision preference or financing willingness decision-making in specific brain regions.
However, previous experiments have separated brand trust, risk decision preference and financing willingness, which can not directly explain whether there is a causal relationship between factors. This paper uses tDCS technology to regulate DLPFC (rDLPFC with unilateral stimulus test) which simultaneously affects brand trust, risk decision preference and financing willingness decision-making. The participants are tested by both trust game experiment and financing risk experiment to verify whether the brain region can affect brand trust, risk decision preference and financing willingness decision-making at the same time, and whether there is causal relationship among the factors.

NEUROSCIENCE RESEARCH ON BRAND TRUST, RISK DECISION PREFERENCE AND FINANCING INTENTION OF CROSS-BORDER E-COMMERCE

Experimental Technology and Target Range
In order to study the relationship between brand trust, risk decision preference and financing willingness of cross-border e-commerce, 60 subjects were divided into three stimulation groups, 20 in each group, using neuroeconomic transcranial direct current stimulation (tDCS). Half of men and half of women, with an average age of about 31, belong to the universal group in cross-border e-commerce market. The basic situation and the location of stimulation points in each stimulation group are shown in Table 1. Stimulation time is 20 minutes, stimulation current is 2 mA. Sponge sheet is fixed in the corresponding target area of the subject’s head by bandage. No stimulus cap is allowed to be removed during the whole experiment. In order to ensure the quality of the experiment and the accuracy of the data, the subjects can not do anything unrelated to the experiment, just rest quietly.

Experiments Tasks and Steps
The participants will complete two tasks on the computer according to the requirements: trust game experiment and venture capital experiment. Each experiment consists of 10 participants and 2 participants in a group. The participants will sit in the seats with partitions and curtains to ensure the anonymity and privacy of the experiment.

(1) Trust Game Experiment
In order to test the trustworthiness and trustworthiness of the subjects, this paper adopts the standard trust game experiment. In the experiment, each participant needs to take turns to play the role of principal and agent. The role will be endowed with the same initial endowment (10 chips). When acting as the principal, the trust investment decision (with X chips) made by the participants is the trustworthiness of the subjects. A person will have 3X chips, and predict how many chips can be returned by the other party’s agent (set up Y chips). The amount of return measures the credibility of the subjects. When the error between the actual value and the expected value is less than 1, an additional reward chips will be obtained. As an agent, the decision of the amount of return should be made according to the investment situation of the principal. At the end of the experiment, the final remaining chips of the principal and agent are calculated.

(2) Financing Venture Capital Experiments
The tasks and steps of financing venture capital experiment are basically similar to those of trust game experiment. The difference is that all subjects will play the role of principal in the experiment. The amount of financing venture capital they make is the risk preference of the subjects, while the other role is called intermediary. The role is played by computer, that is, the principal receives the Y value of the returned chips after making investment decisions. How much is determined randomly by the computer according to the uniform distribution probability. In addition, the self-risk preference type questionnaire was also conducted for each participant. The risk preference type was divided into 0-5 six types, 0 represented very cautious, and 5 was very risky.

Analysis of experimental results
(1) The Relationship between Trust Investment, Financing Venture Capital and Individual Self-reported Risk Types in order to verify the

<table>
<thead>
<tr>
<th>Type of Stimulus</th>
<th>Stimulus Points</th>
<th>Number of subjects</th>
<th>Average Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yang stimulus group</td>
<td>Anode: Rdlpfc(F4), Cathode: Visual cortex (Oz)</td>
<td>20</td>
<td>31.15</td>
</tr>
<tr>
<td>Yin Stimulus group</td>
<td>Anode: neural cortex (Oz), Cathode: Visual Rdlpfc (F4)</td>
<td>20</td>
<td>31.42</td>
</tr>
<tr>
<td>Pseudo-stimulus group</td>
<td>30s Yang or Yin stopped after stimulation</td>
<td>20</td>
<td>31.21</td>
</tr>
</tbody>
</table>
Table 2. Correlation between trust and risk among the three stimulus groups

<table>
<thead>
<tr>
<th></th>
<th>Pseudo-stimulus group</th>
<th>Trust group</th>
<th>Yin group</th>
<th>Pseudo-stimulus group</th>
<th>Trust group</th>
<th>Yin group</th>
<th>Pseudo-stimulus group</th>
<th>Trust group</th>
<th>Yin group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trust</td>
<td>Correlation coefficient</td>
<td>1</td>
<td>—</td>
<td>—</td>
<td>-0.175</td>
<td>0.102</td>
<td>-0.056</td>
<td>0.183</td>
<td>-0.016</td>
</tr>
<tr>
<td></td>
<td>P value</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Risk</td>
<td>Correlation coefficient</td>
<td>—1</td>
<td>0.102</td>
<td>-0.056</td>
<td>0.313</td>
<td>0.574</td>
<td>0.745</td>
<td>0.332</td>
<td>0.912</td>
</tr>
<tr>
<td></td>
<td>Bayesian factor</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>0.237</td>
<td>0.272</td>
<td>0.345</td>
<td>0.357</td>
<td>0.217</td>
</tr>
<tr>
<td>Readme</td>
<td>Correlation coefficient</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>0.183</td>
<td>-0.016</td>
<td>-0.112</td>
<td>0.422*</td>
<td>0.422*</td>
</tr>
<tr>
<td></td>
<td>P value</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Bayesian factor</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>0.332</td>
<td>0.912</td>
<td>0.556</td>
<td>0.024</td>
<td>0.664</td>
</tr>
</tbody>
</table>

relationship between trust investment, financing venture investment and individual self-reported risk types, the data collected by the subjects in the experiment are analyzed. Table 2 shows the statistical results. After correlation analysis, the following conclusions are drawn:

1) From the results of stimulation and pseudo-stimulation experiments, we find that there is no significant correlation between trust and risk preference and self-reported risk preference, but there is a significant correlation between trust and self-reported risk preference.

2) Through the data of pseudo-stimulus experiment, it is found that there is a positive correlation between the degree of risk obtained in the game measurement experiment and the results obtained in the questionnaire survey, which shows the consistency and validity of the two measurement methods.

3) The experimental data of the stimulation group showed that in the financing venture capital experiment, when the tDCS stimulation acted on the prefrontal cortex brain area, there was a difference between the subjects risk preference degree and the self-reported risk preference degree, indicating that the stimulation may change the decision-making of venture capital behavior, but the subjects’ self-reported risk preference degree was not significantly affected by the stimulation.

(3) The relationship between risk preference and neurological activity in prefrontal cortex and brain region

By using the method of variance analysis, the trust of the subjects in the three stimulation groups was compared and analyzed. The results were as follows: F(2,87)=0.102,p=0.901,η^2_p=0.002. There is no significant difference in trust investment between different stimulus groups. As shown in Figure 2, it is the trust investment of different stimulus groups. The results showed that tDCS stimulation of prefrontal cortex and brain area did not change the confidence of the subjects, and there was no significant correlation between the two.

Figure 2. Trust investment in different stimulus groups
Figure 3. Difference between trust investment and financing risk investment in different stimulus groups

Using the method of variance analysis, this paper makes a comparative analysis of the financing venture capital decision-making in the three stimulus groups. The results are as follows: F(2,87)=8.187, p<0.001, η²_p=0.0142; Bayes sian factor=55.8. There was a significant correlation between different stimulation groups in the decision-making of financing venture capital behavior. The average value of financing venture capital in three groups was positive stimulation group > pseudo stimulation group > negative stimulation group, and there was no significant correlation between the latter two groups (p=0.954). The results showed that tDCS positive stimulation of prefrontal cortex and brain area could make the risk decision-making behavior of subjects conservative.

CONCLUSION

Taking the relationship between brand trust, risk decision preference and financing intention of cross-border e-commerce as the object of study, this paper uses transcranial direct current stimulation (tDCS) technology in neuroeconomics to conduct an experimental study on the level of brain neuron network. Through comparative analysis of experimental data, the following conclusions are drawn:

1. Through the experimental data of the subjects in three stimulation groups, we found that trust in cross-border e-commerce brand has no significant correlation with risk decision preference and financing intention. For cross-border e-commerce brand trust investment is not based on risk preference and financing risk of rational decision-making, there are different manifestations and neural basis between them.

2. Using tDCS to stimulate the prefrontal cortex neurological activity did not change the participants' trust investment behavior, which indicated that there was no significant causal relationship between the prefrontal cortex neurological activity and trust investment behavior in cross-border e-commerce market. That is to say, the prefrontal cortex neurological activity did not make financing behavior related to cross-border e-commerce market because of cross-border e-commerce trust.

3. Using tDCS to stimulate neurological activity in prefrontal cortex and brain can change people’s preference for risk decision-making and decision-making behavior in financing risk decision-making. When people are in cross-border e-commerce market, they will make different financing decisions because they face different risk decision preferences.

Acknowledgements

This work is supported by Pre research project of Yiwu Industrial and Commercial College of “Study on the development of cross-border electricity supplier and The Belt and Road fusion strategy: taking Yiwu as an example’’(YY-SB-201701);research Project of Classroom Teaching Reform in Yiwu Industrial and Commercial College "Research on Practical Teaching Reform of Cross-Border E-Commerce Entrepreneurship Course Based on Deep Integration of Industry and Education”(2017kg08)

Key scientific research projects of Yiwu Industrial & Commercial College “Research on Brand Trust, Financing Intention and Investment Risk Decision Preference of Cross-border E-commerce Based on Neuroeconomic Experiments” (ZD2019CY180-01)

REFERENCES


