GENERATION MECHANISM OF ANCHORING EFFECT IN ECONOMIC MANAGEMENT JUDGMENT: AN ANALYSIS BASED ON EVENT RELATED POTENTIAL

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Abstract

During economic management, correct judgement is the basis for high-quality decision-making. However, the decision-maker may be thronged by irrelevant information under the anchoring effect, leading to irrational judgement and decision. This paper aims to determine the generation mechanism of anchoring effect in economic management judgment. First, the basic theories on economic management judgment and anchoring effect were analyzed based on decision-making neuroscience and literature review. Then, the event related potential (ERP) was adopted to conduct noise assessment experiments. Based on the experimental results, the cognitive mechanism of anchoring effect in economic management judgment was analyzed from the aspects of behavioral and neural activity under common value judgment situations in economic management. The results show that, in economic management judgement, the anchoring effect is essentially the process of semantic priming and cognition of related brain regions, and decision-makers are easily influenced by anchor information. The research results provide an important theoretical basis for reducing anchoring effect and making correct decisions in the judgment process.

Key words: Economic Management Judgment, Anchoring Effect, Decision-Making Neuroscience, Event Related Potential (ERP).

INTRODUCTION

In the field of economic management, decision-making is considered to be the core and focus of management, and some management experts have put forward the view that “management is about decision-making”. It cannot be overlooked that judgment is the basis for decision-making, and only by making correct judgments can we make correct decisions (Dhami & Thomson, 2012). In real life, managers are often affected by many internal and external factors, so it is difficult to make correct judgment. Therefore, how to improve managers’ judgment ability and reduce judgment errors becomes an important issue in the field of economic management.

Some studies have shown that managers are people with limited reason, so in the process of judgment it is inevitable that judgment bias will be generated because of their inability to reject the heuristic of thinking (Carter, Kaufmann, & Michel, 2007). The anchoring effect is the most frequent and the easiest-observed and presented phenomenon that affects the managers to make the correct judgments. Therefore, many scholars believe that reducing the influence of anchoring effects on judgments will improve managers' judgment ability and decision-making efficiency (Otway & Von Winterfeldt, 1992).

Previous researchers have studied the judgment bias from the perspective of phenomena, until the recent 30 years have
people begun to study the mechanism of judge bias, as the technologies such as decision-making neuroscience, brain imaging technology and computer simulation continuously develop and get mature. Although a lot of theoretical research results have been accumulated, so far, the academic community has not reached a consensus on the mechanisms behind the anchoring effect, and it is lacking in the study of the mechanisms at the neuroscience level (Maoz, Rutishauser, Kim et al., 2013).

Based on the above analysis, in order to expand the theoretical basis of the anchoring effect at the level of cognitive processes and neuroscience, and provide managers with optimization recommendations in the practice of economic management judgment, this study endeavors to use the method of decision-making neuroscience experiment to study the generation mechanism of anchoring effect in economic management judgment, allows the subjects to complete the value judgment situation test commonly used in economic management through the noise assessment task (Wu, Cheng, & Lin, 2008), and summarizes and analyzes the behavioral data and ERP data collected during the experiment. It is found that the anchoring effect in economic management judgments is actually the process of semantic priming and cognition of brain-related brain regions, and managers are easily influenced by anchor information.

**ANCHORING EFFECT IN ECONOMIC MANAGEMENT JUDGMENT**

**Bias in economic management judgment**

In the field of economic management, managers must make correct decisions based on existing relevant information to determine the current state of things and their status in order to complete the decision. However, this process is often influenced by many other factors, causing bias in managers’ judgments. Studies have shown that in the economic management judgment process, managers are generally affected by judgment heuristics and biases, and anchoring effects are widely found in economic management judgments (Minati, Grisoli, Franceschetti et al., 2012).

Anchoring effect in economic management judgment

*Anchoring effect*

There is no uniform definition of the anchoring effect. Combining relevant references (Rollwage, Comtesse, & Stemmler, 2017), this study believes that “anchor” is the value standard that the manager prescribes for things before making judgments. Thus, the anchoring effect refers to the phenomenon that when the manager makes a judgment, he will compare the judgment target value with the value of the "anchor" so as to make a judgment value close to the anchor value (Gandolla, Ferrante, Casellato et al., 2011).

**Generation mechanism of anchoring effect**

In order to study the mechanism of anchoring effect, the researchers have studied and discussed it from different perspectives. Among them, the most widely discussed and influential ones are the insufficient adjustment theory from the adjustment perspective and the selective accessibility model from the priming perspective (Koivisto, 1997).

(1) Perspective of adjustment

The insufficient adjustment model explains the anchor from the cognitive perspective. It holds that the anchor is the initial judgment value of the manager in the uncertain situations, and then he will use the initial value as a reference to make a final judgment value based on the analysis and judgment of subsequent relevant information. However, the adjustment of this process is often insufficient. Regardless whether the initial value is reasonable or not, the manager will be anchored by it, and then gives a judgment that he considers it to be reasonable or feasible (Seghier, Lazeyras, Pegna et al., 2004). The anchor may be a self-generated anchor or an external anchor (generated in the experiments). Simmons et al. proposes an anchor adjustment model for integrated self-generated anchors and external anchors based on the study of self-generated anchors (Ma, Li, Shen et al., 2015). The experiment on the adjustment model finds that the excitation factors will enable people to know the adjustment direction, thus they will make more adjustments on the anchor value and it will be easier for them to determine the adjustment direction of the self-generated anchor.

(2) Perspective of priming

Selective accessibility model (Angelidis & Ibrahim, 2011) is derived from a theory called confirmatory hypothesis testing. The model considers that in most cases, manager cannot set
the anchor value and final judgment value through past category knowledge. Instead, he constructs a model in the mind and finally determines the judgment value by activating the semantic information consistent with the anchor value. It is required that the semantic information must be related to the judgment goal, and the strength of the anchoring effect is related to whether the manager pays attention to the semantic information related to the anchor value.

**Anchoring effect based on semantic priming**

In the process of economic management, the manager needs to use external information as a reference and comparison standard to make judgments, which may become anchors in the judgment process, affecting managers' judgments. Moreover, due to the manager's own incapability or over-reliance on untrue or invalid anchor information, judgment errors are caused (Esch, Schmitt, Redler et al., 2010). Therefore, the present study considers anchor as a semantic priming mechanism that can enter and influence manager's cognitive processing process.

**Related neurological studies on anchoring effects**

At present, the neuroscience research in the field of anchoring effect is still relatively lacking. Many foreign researchers have tried to use functional MRI, ERP and other methods to study the relationship between anchoring effect and neural activity from a neurological perspective (Sanfey, 2010). However, the Luo Yuejia research team in China conducts the most direct discussion and research on the neural mechanism of anchoring effect and they use event-related potential technology to make relevant experiments on the self-generated anchor and external anchor. It is found that the ERP component of LPC and N300 event-related potentials is related to the anchoring effect, which will be affected by the reliability and feasibility of the anchor, and in the case of external anchor, the anchoring effect is caused by semantic priming (Clarke, 2013).

**GENERATION MECHANISM OF ANCHORING EFFECT IN ECONOMIC MANAGEMENT JUDGMENT**

**Experimental objective**

With the anchoring effect generation mechanism in economic management judgment as the research objective, this experiment adopts the ERP research method in decision-making neuroscience to verify the semantic priming mechanism of anchor in the common value judgment situations in economic management judgment from the behavioral and neural levels. The purpose of this study can be divided into two aspects: one is to study whether the anchoring of random irrelevant information will affect the value judgment, and the other is to analyze the generation mechanism of anchoring using ERP data.

**Experimental method and process**

A total of 19 college students (11 males and 8 females) are selected as the experimental subjects, which are recruited through platforms such as the campus forum and selected according to the experimental requirements. In the experiment, the subjects are required to complete the following noise assessment task. Randomly select noise segments from 55 noise segments with the same degree of distaste, and then given a trial hearing for each noise segment for 4 s, and ask them to determine what the Withholding Tax Allowance (WTA) they would be willing to accept if they are to listen to the noise again at four times the volume.

Due to the different levels of unpleasantness generated by each person receiving noise, their acceptable levels of WTA are also different. Thus before the formal experiment, it is necessary to determine the range of 40 high anchors and 40 low anchors (0-30) in the formal experiment through preliminary experiments. The scores exceeding 30 will be denoted as 30.

**Figure 1. Experimental electrode distribution**
Figure 2. Participants environment

During the experiment, all the subjects wear a 64-channel electrode cap, with the electrode distribution as shown in Figure 1. The laboratory is an acoustically and electrically shielded space, wherein the subjects sit in front of a computer monitor. As shown in Figure 2, 90 trials are performed, in which the high, medium, and low anchors account for 40, 10, and 40, respectively. In order to facilitate the subjects’ adjustment and rest, the experiment is conducted in 4 rounds. After the noise is over, the subjects determine and submit the WTA value according to the classic two-phase task of anchoring effect by adjusting the 0-30 number axe appearing on the screen. The ERP data of subjects in this process will be recorded by Acurie software and presented by E-Prime2.0 software program.

At the end of the experiment, the subjects select the number (between 1-90) representing the number of the experiment on the computer, determine the WTA value of this experiment, and compare the WTA value with the price on the card N that the subjects take in the price box (Between 1 yuan and 15 yuan). If WTA > N, the subjects will neither get compensation nor listen to noise. If WTA ≤ N, the subjects will get compensation of value N, and also listen to the noise segment whose noise volume is 4 times the volume of the selected segment.

Analysis method of experimental data and results

Behavioral data analysis methods and results
The WTA of each subject under three conditions of high, medium and low anchor is averaged, and repeated measurement analysis of variance (ANOVA) is performed and Greenhouse-Geisser or Bonferroni correction is carried out according to different situations. Table 1 shows the statistical results of behavior data under different anchor conditions, and the significant statistical results between each of two groups under different anchoring conditions are as follows: \( P_{\text{high anchors}, \text{low anchors}} < 0.001, P_{\text{high anchors, medium anchors}} = 0.001, P_{\text{medium anchors, low anchors}} = 0.002. \)

Through the analysis of the WTA statistical results under different noise assessment anchoring conditions, it can be found that there are significant differences in WTA under three different anchoring conditions, the value of WTA increases with the increase of anchoring condition, that’s, WTA (high anchoring) > WTA (medium anchoring) > WTA (low anchoring), and WTA is closer to the digital anchor value. The results of the study indicate that WTA is affected by the anchoring effect.

Table 1. Behavior statistics under different anchoring conditions

| Anchoring conditions | Mean | Standard error | 95% confidence interval |
|----------------------|------|----------------|------------------------|
| High anchor condition | 14.177 | 1.232 | 11.587 - 16.765 |
| Anchor conditions    | 12.503 | 1.101 | 10.189 - 14.821 |
| Low anchor condition  | 10.575 | 0.988 | 8.503 - 12.649 |

Methods and results of ERP data analysis

The ERP data collected during the experiment are preprocessed and statistically analyzed using Neuroscan and SPSS21 software, the ERP components are subject to repeated measurement analysis of variance and Greenhouse-Geisser or Bonferroni correction is performed according to the actual situations. The results are as follows:

(1) Results of ERP data analysis when the digital anchors appear
Figures 3 and 4 show the P2 waveforms of representative FZ points under the conditions of high anchor and low anchor when random digital anchors appear and LPP waveform of the CPz point. Tables 2 and 3 show the statistically significant results of repeated measurement variances for P2 and LPP amplitudes.
by high anchor and low anchor, the P2 and LPP components in the EPR component show significant fluctuations. According to the repeated measurement analysis of variance, the main effects of the anchor value of P2 and LPP components are not significant, while the rest are not. The amplitude of P2 and LPP components caused by high anchor conditions is greater than that of low anchor conditions.

(2) ERP data analysis results during the playback of the noise

Through the analysis of the above figures, it is found that when the subjects are stimulated by high anchor and low anchor, the P2 and LPP components in the EPR component show significant fluctuations. According to the repeated measurement analysis of variance, the main effects of the anchor value of P2 and LPP components are not significant, while the rest are not. The amplitude of P2 and LPP components caused by high anchor conditions is greater than that of low anchor conditions.

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When the subjects hear noise, the significant fluctuations will appear in the N1-P2 complex wave in the ERP component. Table 4 shows the statistical significance of the variance of repeated measurement of N1-P2 wave amplitude. Except that the electrode main effect is significant, the rest are not significant, and only the amplitudes of FCZ and CZ points are significantly different.

Table 3. LPPP component repeated measurement of variance results

| Significant degree                      | F   | P    |
|----------------------------------------|-----|------|
| The main effect of anchor value        | F (11,198) | 0.196 |
| The main effect of the electrode       | F (11,198) | 0.196 |
| The interaction between anchor value and electrode | F (11,198) | 0.719 |

Figure 5. The interactive effect of anchor value and hemisphere on theta ERS

Figure 5 shows the results of interaction analysis of ERS energy differences in theta bands generated in different brain regions under high anchor and low anchor conditions after the noise
is played. It can be seen from the figure that the interactive effect between the anchor value and the right hemisphere is significant.

CONCLUSIONS
The anchoring effect is a common and stable judgment bias existed in economic management judgments. In the process of economic management judgment, affected by anchoring effect, the irrelevant information often affects economic management judgment, leading to judgment errors. Therefore, with the generation mechanism of the anchoring effect in economic management judgment as the research object, this study conducts an experimental study on noise assessment from the perspective of decision-making neuroscience, and draws the following conclusions:

(1) The analysis of behavioral data shows that there are significant differences in WTA given by subjects under different anchor values, which indicates that WTA is affected by anchoring effect.

(2) According to ERP data analysis, subjects who receive a random digital anchor will activate amplitude fluctuations in P2 and LPPP in the ERP component. The greater the anchor value, the greater the amplitude will be. After hearing the noise, the subjects activate the ERS in the N1-P2 complex wave and theta frequency band. Although the different anchor values have no significant difference in the amplitude of the complex wave, but high anchor conditions can induce greater theta band energy and have a significant relationship with the right hemisphere, suggesting that the high or low value of anchor may cause the difference between the semantic information and perceived information of the degree of pain in ERP characteristics and neural activities.

(3) According to the results of behavioral data analysis and ERP analysis, the anchoring effect in economic management judgments is actually the process of semantic priming and cognition of brain-related brain regions, and managers are easily influenced by anchor information. Therefore, in order to make a correct judgment, it is necessary for the manager to adopt critical thinking to all kinds of information in judgment, and to consider the relevance and reliability of information carefully, so as to reduce the anchoring effect in judgment.

Acknowledgement
The Ministry of Education Humanities and Social Sciences Research Youth Foundation; Emotional Transference or Exclusivity? An Emotional Attachment Approach to Brand Extension for Cultural and Creative Products; 17YJC630174.

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