

# Impact of Cognitive Bias on Improvised Decision-Makers' Risk Behavior: An Analysis Based on the Mediating Effect of Expected Revenue and Risk Perception

XUE Yaowen<sup>[a]</sup>; SUN Suqing<sup>[b],\*</sup>; ZHANG Pengzhu<sup>[c]</sup>; MENG Tian<sup>[b]</sup>

<sup>[a]</sup>Professor, Doctoral Supervisor, School of Economy and Management, Shanxi Normal University, Linfen, China.

<sup>[b]</sup>School of Economy and Management, Taiyuan University of Science and Technology, Taiyuan, China;

<sup>[c]</sup>Antai College of Economics & Management, Shanghai Jiao Tong University, Shanghai, China.

\*Corresponding author.

**Supported by** the National Natural Science Foundation of China (71273159); Shanxi Soft Science (2014041005-2).

Received 5 February 2015; accepted 10 May 2015

Published online 26 June 2015

## Abstract

The impact of cognitive bias on improvised decision-making is studied based on the prospect theory and risk-benefit theory. We propose the hypothesis: Cognitive bias affect the improvised decision-makers' risk behavior through impacting his judgment on expected revenue and risk perception. Through collecting the data of decision-makers from various levels, we get the following results by Pearson correlation analysis and multielement regression analysis. Firstly, the framing effect can increase decision-makers' judgment and the expected revenue can increase the improvised decision-makers' risk behavior, that is, the expected revenue has a mediating effect on the relation between the framing effect and the improvised decision-makers' risk behavior. Secondly, the risk perception can increase the improvised decision-makers' risk behavior, overconfidence and representativeness bias can decrease the improvised decision-makers' risk perception, availability bias can increase the improvised decision-makers' risk perception. Thirdly, the risk perception completely mediated the relationship between overconfidence and improvised decision-makers' risk behavior, but partially mediated the relationship among representativeness bias, availability bias and improvised decision-makers' risk behavior.

**Key words:** Emergency; Improvised decision-making; Cognitive bias; Risk perception; Expected revenue

Xue, Y. W., Sun, S. Q. Zhang, P. Z., & Meng, T. (2015). Impact of Cognitive Bias on Improvised Decision-Makers' Risk Behavior: An Analysis Based on the Mediating Effect of Expected Revenue and Risk Perception. *Management Science and Engineering*, 9(2), 31-42. Available from: URL: <http://www.cscanada.net/index.php/mse/article/view/6843> DOI: <http://dx.doi.org/10.3968/6843>

## INTRODUCTION

Once emergency happening, the person improvised behavior such as decision-makers' intention, intervention and instruction can influence the trend of the events, i.e. the decision-makers' improvisations ability of performance and the resilience is very important (Jing, 2011). Under condition of high risk and uncertainty, decision-makers may well cause the decision-risk behavior because of their cognitive bias, which may be lead to harmful results (Mary & Crossan, 2000). Therefore, exploring the path and mechanism of the effect of cognitive bias on improvised decision-making under emergency, and distinguishing the process of the complex improvised decision-making when emergency occurred, can play an important role in improving the ability of improvised decision-making and in reducing the decision-making faults.

## 1. LITERATURE REVIEW

The prospect theory argues that people make decisions through the subjective judgment of expected revenue and the losses under the condition of uncertainty (Tversky & Kahneman, 1973). Yates and Stones (1992) believe that the loss, extent of the damage and the uncertainty relationship among the losses are the three key elements of risk (Yates & Stone, 1992). In the same way, Weber

proposed the psychology model of risk-benefit (Weber & Hsee, 1998):

$$\text{Risk Preference } (X) = a[\text{Expected benefit } (X)] + b[\text{Perceived Risk } (X)] + c .$$

The left side of the equation represents risk behavior. For individual decision-making, expected revenue and risk perception are influence factors of risk behavior. Although improvised decision-making is a type of uncertain or risky decision, which is influenced by political considerations, cultural background and people's cognitive ability, the decision-making is still the process of weighing the pros and cons (Liu & Yan, 2011), which is impacted by expected revenue and risk perception.

The judgment of expected revenue and risk perception is the major concern of decision-maker in the improvised decision-making process, both of which will inevitably be affected by cognitive bias. The main theoretical basis is as the following: under the circumstances of uncertainty, individuals are easily affected by representativeness bias, availability bias, anchoring bias and framing effect, leading to some risk behaviors ((Tversky & Kahneman, 1973; Zheng, 2007; Liu, Shen, Li, & Zhang, 2010). Kahneman and Tversky (2008) believe that if the "anchor" is wrong, then the estimate of decision expected revenue would be wrong. Meng (2011) believes that the framing effect can influence managers to judge expected revenue in the risk decision-making process. Combs and Simon (1956) point out, such as overconfidence, illusion of control and representation are the cognitive bias which are the most closely related to the risk perception of managers. Combs and Slovic (1997), Liu et al. (2012) verify that risk perception of individual under emergency is affected by availability bias, representativeness bias and framing effect. Janis (1982) believes that under the crisis condition, the potential destruction which is caused by decision-makers' overconfidence cannot be ignored. Wang (2009) believes that the cognitive bias such as representative bias, overconfidence and availability bias will cause underpriced risk and arbitrary behavior appeared in the process of management decision.

The research of cognitive bias' influence on decision-making under emergency mainly focuses on the theory research. Empirical research of cognitive bias' effect on decision-making mostly focuses on the field of business management. There is a shortage of study which is based on empirical research of cognitive bias' effect on improvised decision-making under emergency. This paper expects to illustrate two problems on the basis of literature review: Firstly, anchoring effect and framing effect impact improvised decision-making by influencing the judgment of expected revenue; Secondly, representative bias, overconfidence, availability bias and framing effects impact improvised decision-making by influencing risk perception of decision-makers.

## 2. THE PUTTING FORWARD OF THE HYPOTHESIS THAT IMPROVISED DECISION-MAKING IS IMPACTED BY COGNITIVE BIAS UNDER EMERGENCY

### 2.1 The Relationships of Cognitive Bias, Expected Revenue and Improvised Decision-Making

#### 2.1.1 The Effect of Expected Revenue on Risk Behaviors of Improvised Decision-Making

Government official is the economic subject that has the motivation and purpose. The main goal is the power and utility maximization (Liu & Yan, 2011). In the process of improvised decision-making under emergency, decision-makers may consider their own benefits. Decision makers' personal benefits, include their own achievements, reputation, status, and material benefits. At the same time, decision-makers also regard what will not bring personal position and reputation damage as future "income". Research shows that: when confronted with emergency, decision makers may change their behavior because of their own interests. Facing revenue, they will generally take a decision-making behavior with risk aversion. In the case that the related decision-makers can't ensure the success of the decision, they think no loss of personal interest as "income". Therefore, in order to avoid the negative effects of mistakes in decision-making, and to take into account of their own responsibility in the accident responsibility system as well as the influence of their achievement and position, they think the best practice is sticking to the known solutions, namely a risk aversion for risk behavior of improvised decision-making.

**Hypothesis 1: The expected revenue has an impact on the risk behaviors of improvised decision-making.**

#### 2.1.2 The Influence of Cognitive Bias on Expected Revenue

Anchoring effect means that decision makers put the certain "value" as a reference point when they make judgments. The values of the expected revenue are estimated according to the reference point. Therefore, if the "anchor" is wrong, the estimate of the expected revenue will be wrong. Due to the differences in environment and their own experience, "anchor" setting is different, and the judgment of expected revenue will surely be different (Kahneman, 2008). In the process of improvised decision-making, on the one hand, if the decision results which deal with the similar previous events is regarded as the "anchor", which were once successful responded without benefits, or which were mistakes and had been punished, when dealing with similar emergency again, decision-makers' psychological utility of the expected revenue is lower than the actual value. On the other hand, if the decision environment is thought as the "anchor", in the strictly punishing system,

being constrained by achievement or post, most people become more straight and instinctive. When they make weighing of interests, improvised decision-making will be thought as less beneficial.

**Hypothesis 2a: Anchoring effect will reduce decision-makers' subjective perception of the expected revenue.**

Framing effect is the mental process that personal experience, memory and knowledge will affect one's problem expression approach, and then relocate one's understanding of the problem (He & Jin, 2010). When confronted with emergency, decision-makers make an improvised decision-making according to their own experience and the information provided by subordinates and staff officers, and they generally tend to accept the framework of similar incident disposal method, thinking that the event will be well controlled, and can bring the promotion of the position and the better reputation; or due to the particularity of emergency, decision-makers may take no loss as "income".

**Hypothesis 2b: Framing effects will increase decision-makers' subjective perception of the expected revenue.**

## **2.2 The Relationship of Cognitive Bias, Risk Perception and Improvised Decision-Making**

### **2.2.1 The Influence that Risk Perception Makes on Risk Behavior of Improvised Decision-Making**

Risk and uncertainty are the characteristics of improvised decision-making under emergency, the judgment that decision-makers make the risk perception can affect risk behavior occurrences of the improvised decision-making. Risk perception includes evaluating the possibility of the occurrences of risk behavior in improvised decision-making and the subjective evaluation of the negative results (Liu, 2011). The study is shown that: the level of risk perception will increase the individual's risk-taking tendency. High-risk perception is easy to bring the decision behavior with low risk. When unexpected events occurred, decision-makers tend to overestimate the risks, they would try to take existing plans and solutions for decision-making. (Best, 2000), or complacent or inadequate response to reality, so that they missed the best time to handle the emergency.

**Hypothesis 3: risk perception has an impact on the risk behaviors of improvised decision-Making.**

### **2.2.2 The Effect of Cognitive Bias on Risk Perception**

(a) Representativeness bias and risk perception.

Representativeness bias means making judge with the analogy method, which is likely to make decisions relying on the small samples because of decision-making uncertainty (Busenitz & Barney, 1997). In the process of improvised decision-making under emergency, facing the uncertainty of the scene and information and the time pressure, the effects of representativeness bias on

the judgment of risk embody in two aspects: firstly, it is difficult for decision-makers to understand the failure cases and reasons of previous decisions, therefore, to take a successful and positive case as their reference will lead to over optimism in dealing with emergency process. Secondly, the scheme is accumulated over a long period of time, and also the same thinking patterns also make decision-makers form positively attitudes and reduce their perception of risk.

**Hypothesis 4a: Representativeness bias is negatively associated to risk perception of improvised decision-makers.**

(b) Overconfidence and risk perception.

Overconfidence is that people show overly optimistic self-confidence on their ability, knowledge and projection for the future (Zhou & Zhao, 2009), so that decision-makers overestimated favorable factors but underestimated the negative factors. In the process of improvised decision-making, decision-makers on one hand will increase their confidence according to the prior successful experience, on the other hand they will make assumptions based on the collected information, but it is difficult for them to recognize the uncertainty of hypothesis and result in blindly underestimating the risks.

**Hypothesis 4b: Overconfidence is negatively associated to risk perception of improvised decision-makers.**

(c) Availability bias and risk perception.

Availability bias is that, decision-makers affected by memory and knowledge tend to overestimate the information that is gotten quickly, memorized, imaged and extracted easily. At the same time, decision-makers tend to overlook the key information which is difficult to discover and imagine, and underestimate the probability of the information (Zhou, 2008). In the process of improvised decision-making under emergency, decision-makers evaluate the disadvantage relying on imagination after decision-made. For example, when dealing with such a sudden event, decision-makers tend to think that improvised decision-making may bring demotion and discipline, or decision-makers cannot imagine consequences, then decision-makers may overestimate the risk because of psychological anxiety, which leads to decision-makers' reluctance to adventure.

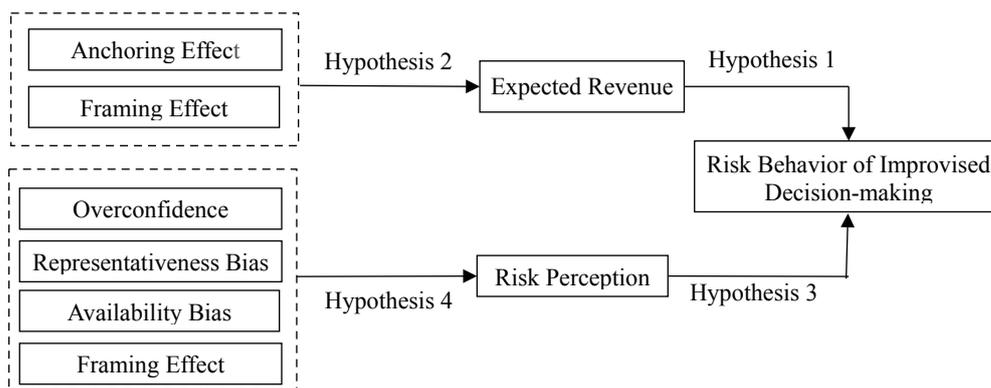
**Hypothesis 4c: Availability bias is positively associated to risk perception of improvised decision-makers.**

(d) Framing effect and risk perception.

Whether the cases are different types of events in the same field or the same types of events in different yields, the scenario and frame presenting is different, which leads to the individual decision-makers difference of perception to risk. When decision-makers think it is a threat because of the expression of frame representation, they tend

to overestimate the risk, in turn, which will tend to be conservatively improvised decision-making. However, if they think it is a chance, they tend to underestimate the risk, which leads to improvise behavior with risk. Especially in China, where dealing with the expression of scenario representation is always in a positive way, decision-makers tend to underestimate the risk and then make a risk improvised behavior.

**Hypothesis 4d: Framing effect is negatively associated to risk perception of improvised decision-making.**



**Figure1**  
**Influence Model of Cognitive Bias on Risk Behavior of Improvised Decision-Making**

### 3.2 Data Collection

Decision-maker is the person who has selective action on the orientation, methods and results of decision-making because of the power that he owns. When emergency occurs, the enterprise preparing for the emergency, must report it to the relevant department and cooperate with them. Generally, whether the government departments or enterprises, middle or senior managers are main leaders who have the right to make and revise decision. However, because of the particularity of the emergency, many basic level leaders need to change their roles for improvised decision-making. Therefore, this paper considers that the high level, medium level and basic level leaders are all main subjects of the improvised decision-making. Thus, most respondents are leaders of government organizations, relevant enterprises and institutional sectors. In the survey process, we ensure that the respondents consistent with this article research object, namely who has certainly right to make decisions. According to respondent sources, this paper divides them into administrative districts, public welfare institutions, state-owned enterprises and other enterprises.

The main method of questionnaire survey is schedule visits. In order to ensure the reasonability of the design of questionnaire survey, we design questionnaire by referencing the measure methods of cognitive bias by relevant experts and adding the characteristics of decision-

## 3. RESEARCH DESIGN OF THE EFFECT OF COGNITIVE BIAS ON IMPROVISED DECISION-MAKING UNDER EMERGENCY

### 3.1 The Construction of Research Model

Based on the relationship between cognitive bias, risk perception, expected revenue and risk behavior of improvised decision-making which were proposed by hypothesis in §3, we construct the influence model of cognitive bias on the risk behavior of improvised decision-making, which is shown in Figure 1.

makers in our country under emergency .Before the questionnaires are formally issued, a small scale research has been conducted. There are 78 questionnaires issued to the MBA students in Taiyuan University of Science and Technology. 53 valid questionnaires have been collected. After reliability and validity analysis, we found that the variables, cognitive bias and risk behavior of improvised decision-making, are designed reasonably while both of risk perception and expected revenue extract two factors which don't have clear structure. Therefore, after revision of the questionnaire, one question is deleted in risk perception and two in expected revenue, there are 18 questions retained in the final questionnaire. At last, 218 questionnaires are issued and 137 valid after eliminated unreasonable questionnaire, which is over 5 times than the number of questions, according to the frequently quoted suggestion by Nunnauy (1967), which can effectively guarantee the empirical research of this paper. In this paper, we use SPSS17.0 to do statistical analysis and multiple regression analysis.

### 3.3 Measure Method of the Variables

In this paper, we set some questions for each variable. We use the Likert five point scale to analyze the variables (1 elicits "completely disagree", 2 elicits "partial disagree", 3 elicits "uncertainty", 4 elicits "partial agree", 5 elicits "completely agree"), namely availability bias, anchoring

effect, representative bias, expected revenue, framing effect, risk perception and risk behavior of improvised decision-making, except overconfidence.

### 3.3.1 Cognitive Bias

#### 3.3.1.1 Overconfidence

Referencing the measure of RUSSO (Russo & Schemaker, 1992)<sup>1</sup>, we set up four questions (Table 1), each question provides two options A and B, requiring decision-makers to take the first reaction as choice, then to measure the confident level. The questions include common sense and knowledge related to daily emergency, in order to reduce the deviation caused by individual unfamiliar to unrelated areas. After each question is answered, every decision-maker required to choose confidence level from 50% to 100%. The individual decision-maker's confident value is the average of confident level minus the proportion of right choice, and the "0" is the critical value, the higher the score, the more confident.

#### 3.3.1.2 Representative Bias

Compositing the practical situation of improvised

decision-making under emergency, on the basis of research of representative bias on management decisions, we set two situational questions C5 and C6.

#### 3.3.1.3 Availability Bias

Referencing the measure methods of availability bias by Kahneman, Tversky et al. (1973) and Best (2000), compiling the decision-making problems which are suitable for China's national conditions, we set the items C7 and C8.

#### 3.3.1.4 Framing Effect

Referencing the research of Tversky et al. (1973) and Sun (2005), and combining the individual characteristics of decision-makers under emergency, we set C9 and C10 as scenario questions about framing effect.

#### 3.3.1.5 Anchoring Effect

According to the study of anchoring effect in foreign and Wang Jun's research (Wang, 2009) for anchoring effect on decision-making in the process of enterprise management, we set C11 and C12 as scenario questions about anchoring effect which is related to emergency.

**Table 1**  
**the Questionnaire Design of Cognitive Bias**

| Bias type                | Questions  |
|--------------------------|--|
| Overconfidence           | C1. In 2012, which reason causes the highest death roll in security accident?<br>A Coal-mining accidents B Traffic accidents Confidence level (%)  |
|                          | C2. In 2011, India locates __ in global GDP ranking.<br>A. Global top 10 B. Global 10-20 Confidence level (%)  |
|                          | C3. In 2012, which has the highest incidence of infectious diseases?<br>A. Virus hepatitis B. Pulmonary tuberculosis Confidence level (%)  |
|                          | C4. In 2008, which district has the most serious natural disasters?<br>A Philippines B China Confidence level (%)  |
| Representative-ness bias | C5. In the last three years, the emergencies in many companies were usually settled successfully. Thus, I predict that the problems will be solved smoothly in the future work.  |
|                          | C6. The company in which I work has many perfect emergency management methods which have been used to solve the emergency successfully at present. I predict these methods still have widely applicability in the near future.   |
| Availability bias        | C7. In the first half of 2013, iphone has higher sales growth rate than Samsung mobile phone in China.   |
| Framing effect           | C8. Traffic accidents, homicide cases and tornado can cause more deaths than diabetes, gastric cancer and struck by lightning.   |
|                          | C9. Nowadays, the economic losses due to economic crimes committed by the leaders of state-owned enterprise are more than the losses caused by decision-making mistakes and mismanagement.   |
| Anchoring effect         | C10. When confronted with crisis which is not only emergent but also the fault related to the position and fame directly, the decision-makers would mostly rely on the information and suggests offered by subordinates and experts.   |
|                          | C11. Influenza virus H1N2 is a high infectious respiratory disease caused by the newly emerging influenza virus. In 2 months, 102 countries have appeared confirmed cases, among which the United States, Mexico and Chile have more serious epidemicsituation. The WHO representative in China, Dr. Hans Anders Troedsson believes that the effect of human being of the virus is unpredictable because of the special combination of the virus A H1N1. After analysis, three institutes of Medicine consider that the worldwide possibility of the Virus A H1N1 is 70%-90% in the next 5 years. Thus, some country predicts that another outbreaks possibility of the virus A H1N1 throughout global is 75%-85% in the next 5 years. |
|                          | C12. Violations and misconducts happen more or less in the government work. People are accustomed and most departments have more tolerance and forbearance to these behaviors.   |

Exploratory factor analysis is carried out on the cognitive bias scale (Table 2), Four factors are extracted, and projects of factor loading are between 0.67 and 0.85; the factor structure of each variable agrees with the factor structure of the questionnaire. All the cumulative variance contribution rate is more than 66%. Through analyzing of the correlation

matrix, all the correlation coefficients among the different problems of the same variable are above 0.43. According to reliable analysis, it is illustrated that this scale has a good structure validity and high consistency. At the same time, all the Corrected Item-Total Correlation (CITC) of items are higher than 0.43, so all the items are retained.

**Table 2**  
**Validity Analysis and Component Matrix of Cognitive Bias**

| Variable                | Cronbach's Alpha | Item | Correlations | CITC  | Component | Cumulative% of variance |
|-------------------------|------------------|------|--------------|-------|-----------|-------------------------|
| Representativeness bias | 0.699            | C5   | 0.542        | 0.452 | 0.823     | 77.079                  |
|                         |                  | C6   |              | 0.452 | 0.805     |                         |
| Availability bias       | 0.610            | C7   | 0.436        | 0.439 | 0.835     | 71.925                  |
|                         |                  | C8   |              | 0.439 | 0.671     |                         |
| Framing effect          | 0.691            | C9   | 0.549        | 0.549 | 0.844     | 66.597                  |
|                         |                  | C10  |              | 0.549 | 0.838     |                         |
| Anchoring effect        | 0.703            | C11  | 0.525        | 0.525 | 0.848     | 68.853                  |
|                         |                  | C12  |              | 0.525 | 0.830     |                         |

Note. Extraction method is Principal Component Analysis. Rotation method is Varimax with Kaiser Normalization. The same in the following.

### 3.3.2 Risk Perception, Expected Revenue, Risk Behavior of Improvised Decision-Making

Referencing the measure method by Simon et al. (2005) to scene simulation on risk perception, according to the measure method by Meng (2011) on risk behavior of decision-making, in the light of the theory analysis of Maslow's hierarchy of needs and ERG theory, we set questions to measure the expected revenue in decision-making from the aspects of incoming, security, reputation, development. We put the three variables into the same situation to measure. In this paper, by setting mining accidents as the scenario, we analyze the decision-makers' behavior of decision-making, risk perception and expected revenue after the accident. The questionnaire design shows in Table 3.

By analyzing to the scale, in Table 4, three factors are extracted, and the projects most factors loading are between 0.7 and 0.85, and the factor structure of each variable agree with the factor structure of the questionnaire. All the cumulative variance contribution rate is more than 60%. Through analyzing of the correlation matrix, all the correlation coefficients between different problems about the same variable are above 0.3. According to reliability analysis, it is illustrated that this scale has a good structure validity and high consistency. All variables of the Corrected Item-Total Correlation (CITC) are greater than 0.3; however, once deleting any item about the variable of expected revenue and risk perception, the Cronbach's alpha is less than the whole alpha, so we keep all the items.

**Table 3**  
**The Questionnaire Design of Risk perception, Expected Revenue and Risk Behavior of Improvised Decision-Making**

Recently, for one thing, government enhances supervisory control of the safety problem in enterprise and enacts severe punishment system; for the other, the false reports of the media usually cause more negative attention to the enterprise's safety problem. A is a state-owned coal enterprise, which is the leading large state-owned enterprise in this city. It's known that it has been invested with nearly 1.8 billion Yuan. Around the enterprise, an industrial park established, a batch of power plant and a coalwashery has been set up. At present, the total investment reaches billions of Yuan, and it makes a considerable contribution to the local economy.

Recently, there was a major gas accident. B, one of the government leaders who was in charge of this business area, arrived at the scene of the accident for the first time and was in charge of the rescue plan together with the mine manager. There were 13 people trapped in the mine during this crisis. 3 hours passed but the cause of accident is still unknown. There were several plans at hand, but the plans need to be studied and demonstrated by expert groups, even consult superior leaders for instructions. Being pressed for time, if they can't eliminate the danger and come to their rescue in the mine immediately, not only the hope of rescue the miner became smaller, but more seriously, it could lose all the 1.8 billion investment. Protecting the mine became especially important. However, B found that, it would need 6 hours to get the instructions from superior leaders. Though keeping waiting can lessen the responsibility, the state of the accident is still uncertain during the waiting time. It may bring more serious consequences than carrying out rescue. Meanwhile, deciding to rescue has great risks as well. Once an accident happens during rescue, it would fail to rescue or even cause more serious problems. Demotion would be the punishment and even criminal responsibility would be undertaken. If you were B, what would you do:

| Variable                                    | Items  |
|---|--|
| Risk Behavior of Improvised Decision-making | D1. There are some accompanying experts and the mine manager supporting you to rescue. Will you come into rescue immediately?  |
|   | D2. Supposing that a few people in the expert group and the rescue team don't agree to rescue immediately, considering that it still has some time till the situation becomes worse and they should postpone the rescue plan without the order from superior leaders. Will you accept this suggestion? |
| Risk Perception                             | F2. You consider that the risk would be higher after you make the decision.  |
|   | F3. You consider that you will face tremendous economic losses and reputation damage.  |
|   | F4. You consider that it's more possible to fail after you make decision.  |
| Expected Revenue                            | P1. If this slippery problem can be solved successfully, it's reasonable to bring higher bonus.  |
|   | P2. If the accident can be settled perfectly, higher social status and reputation will be gained.  |
|   | P3. If the accident can be in control in a short time, most people will think that the decision-maker possesses capability and wisdom.   |

**Table 4**  
**Validity Analysis and Component Matrix of Risk Perception, Expected Revenue and Risk Behavior of Improvised Decision-Making**

| Variable                                    | Cronbach's Alpha | Item | Component | Correlation        | CITC  | Cronbach's Alpha if item deleted | Cumulative % of variance |
|---|------------------|------|-----------|--------------------|-------|----------------------------------|--------------------------|
| Risk Perception                             | 0.702            | F2   | 0.687     | F2 and F3 is 0.331 | 0.468 | 0.574                            | 62.851                   |
|   |                  | F3   | 0.801     | F2 and F4 is 0.583 | 0.671 | 0.604                            |                          |
|   |                  | F4   | 0.751     | F3 and F4 is 0.403 | 0.461 | 0.495                            |                          |
| Expected Revenue                            | 0.719            | P1   | 0.795     | P1 and P2 is 0.490 | 0.468 | 0.585                            | 64.033                   |
|   |                  | P2   | 0.714     | P1 and P3 is 0.477 | 0.671 | 0.645                            |                          |
|   |                  | P3   | 0.801     | P2 and P3 is 0.500 | 0.414 | 0.656                            |                          |
| Risk Behavior of Improvised Decision-making | 0.663            | D1   | 0.810     | 0.436              | 0.336 | -                                | 71.799                   |
|   |                  | D2   | 0.799     |                    | 0.436 | -                                |                          |

#### 4. EMPIRICAL ANALYSIS OF THE EFFECTS OF COGNITIVE BIAS ON IMPROVISED DECISION-MAKING UNDER EMERGENCY

##### 4.1 Descriptive Statistical Analysis

According to the test scores and rating scale results we can know that the mean value of anchoring effect is equal to 3.47; the mean value of framing effect is equal to 3.657;

the mean value of representative bias is equal to 4.04, and the mean value of availability bias is equal to 3.46, which proves that the bias that belong to above average level indeed exist in the participants. Frequency analysis is carried out on the decision-makers' overconfidence, and only 11 decision-makers confidence level is less than zero, showing that overconfidence is widespread among the decision-makers. The mean value of respondent confidence level is equal to 0.45, which also verifies the view that people have overconfidence in the field of psychology.

**Table 5**  
**Descriptive Statistical Analysis and Correspondence Analysis of Cognitive Bias, Expected Revenue and Risk Behavior of Improvised Decision-Making**

| Variable                                    | Mean  | Variance | Anchoring effect | Framing effect | Expected revenue | Risk behavior of improvised decision-making |
|---|-------|----------|------------------|----------------|------------------|---|
| Anchoring effect                            | 3.47  | 1.124    | 1                | -0.102         | -0.105           | 0.082                                       |
| Framing effect                              | 3.657 | 1.226    |                  | 1              | 0.357**          | 0.191*                                      |
| Expected revenue                            | 3.153 | 1.264    |                  |                | 1                | 0.363**                                     |
| Risk behavior of improvised Decision-making | 3.993 | 0.698    |                  |                |                  | 1   |

Note. \*\*\*  $P < .001$ , \*\*  $P < .01$ , \*  $P < .05$ .

**Table 6**  
**Descriptive Statistical Analysis and Correspondence Analysis of Cognitive Bias, Risk Perception and Risk Behavior of Improvised Decision-Making**

| Variable                                    | Mean  | Variance | Overconfidence | Representativeness bias | Availability bias | Framing effect | Risk perception | Risk behavior of improvised decision-making |
|---|-------|----------|----------------|-------------------------|-------------------|----------------|-----------------|---|
| Overconfidence                              | 0.45  | 0.78     | 1              | 0.386*                  | -0.122*           | -0.215*        | -0.460**        | -0.410**                                    |
| Representativeness Bias                     | 4.04  | 0.493    |                | 1                       | -0.329*-          | 0.243*         | -0.512**        | -0.393**                                    |
| Availability bias                           | 3.46  | 1.430    |                |                         | 1                 | 0.135*         | 0.409**         | 0.515**                                     |
| Framing effect                              | 3.657 | 1.226    |                |                         |                   | 1              | 0.268**         | 0.191*                                      |
| Risk perception                             | 2.737 | 0.737    |                |                         |                   |                | 1               | 0.456**                                     |
| Risk behavior of improvised decision-making | 3.993 | 0.698    |                |                         |                   |                |                 | 1   |

From the two paths of “cognitive bias → expected revenue → risk behavior of improvised decision-making” and “cognitive bias → risk perception → risk behavior of improvised decision-making”, Table 5 and Table 6 show the results of correlation analysis between variables, preliminarily getting the following conclusions:

(a) Expected revenue is associated to risk behavior of improvised decision-making, and the correlation coefficient is .363, preliminarily supporting for the hypothesis 1;

(b) Anchoring effect is unassociated to expected revenue, hypothesis 2a isn't verified;

(c) Framing effect is associated to expected revenue, and the correlation coefficient is .357, preliminarily supporting for the hypothesis 2b;

(d) Risk perception is significantly associated to risk behavior of improvised decision-making, and the correlation coefficient is 0.456, preliminarily supporting for the hypothesis 3;

(e) Significant associations exist between overconfidence, representativeness bias, availability bias, framing effect and risk perception, the correlation coefficients are -.460, -.512, .409 and .268, preliminarily supporting for the hypothesis 4.

According to the analysis we can see that the correlations also exist between the framing effect, overconfidence, representativeness bias, availability bias and risk behavior of improvised decision-making, and the correlation coefficients are .191, -.410, -.393 and .515.

## 4.2 Hypothesis Tests and Multiple Regression Models

According to the influential model of cognitive bias on the risk behavior of improvised decision-making and correlation analysis, we can see that expected revenue and risk perception play a mediating role in the relationship between cognitive bias and risk behavior of improvised decision-making. This paper, referring to the procedures about multiple regression and measure method of mediator proposed by BARON (Baron & Kenny, 1986), establishes seven models from two paths and verify the influence model of cognitive bias on the risk behavior of improvised decision-making with three steps, then tests and analysis the mediation of risk perception and expected revenue.

### 4.2.1 The Test Result 1: The model of “Expected revenue and Risk Perception—Risk Behavior of Improvised Decision-Making”

**Model 1:** We take the risk behavior of improvised the decision-making as dependent variable, the risk perception and expected revenue as independent variables. The results of regression analysis is shown in Table 7 in which the  $F$  is equal to 22.111 and that performs significantly by .000,  $R^2 = .248$ ,  $Adj-R^2 = .237$ . The model is significant and its imitative effect is better. The standardized coefficients of prospective earnings is

0.218 ( $P=.008$ ), which means the expected revenue is the influence factor of risk behavior of improvised decision-making. The standardized coefficients of risk perception is 0.371 ( $P=.000$ ), which also means the risk perception is the influence factor of the risk behavior of improvised decision-making. And hypothesis 1 and 3 are verified further.

**Table 7**  
**The Regression Analysis Results of Risk Perception, Expected Revenue and Risk Behavior of Improvised Decision-Making**

| Variable                  | Risk perception | Expected revenue |
|---------------------------|-----------------|------------------|
| Standardized coefficients | 0.371***        | 0.218**          |
| $F$ -statistic            | 22.111***       |                  |
| $R^2$                     | .248            |                  |
| Adjusted $R^2$            | .237            |                  |

### 4.2.2 The Test Result 2: The Path Model of “Cognitive Bias and Expected Revenue of Risk Behavior of Improvised Decision-Making”

From the Pearson correlation coefficients we can see that the anchoring effect is uncorrelated to improvised decision-making. Thereby, framing effect is the only cognitive bias in this path model.

(a) The regression result analysis of the framing effect and risk behavior of improvised decision-making model.

**Model 2:** Testifying the relationship between the framing effect and improvised decision-making. The regression result indicates that the  $F$  is equal to 5.137 which performs significantly ( $p = .025$ ),  $R^2 = .037$ ,  $Adj-R^2 = .030$ , but the independent variable could not nicely explain the dependent variable. However, we only use the regression to verify the correlation, the standardized coefficient of framing effect is 0.191 that performs significantly ( $P = .037$ ).

(b) The regression result analysis on framing effect and expected revenue model.

**Model 3:** We see the expected revenue as a dependent variable, the framing effect as an independent variable. The regression result indicates that the  $F$  value is 17.308 and perform significant ( $P = .00$ ),  $R^2 = .127$ ,  $Adj-R^2 = .121$ , and the model performs significantly as a whole, and the fitting effect is excellent. The standardized coefficient of framing effect is 0.357 ( $P = .000$ ), which demonstrates that the framing effect will influence the decision-makers' judgment to expect benefit, and also verify the hypothesis 2a further.

(c) The regression result analysis of the framing effect, expected revenue and risk behavior of improvised decision-making.

**Model 4:** We put the framing effect, expected revenue in one model as independent variables to regression analysis, which indicates that  $F = 10.555$  and performs significantly ( $P = .000$ ),  $R^2 = 0.136$ ,  $Adj-R^2 = 0.123$ . The model performs significantly as a whole, and the

fitting effect is excellent. The standardized coefficient of framing effect is 0.071 ( $P=.410$ ), and there is no significant relationship between framing effect and improvised decision-making. But the model 2 verifies the framing effect is associated to improvised decision-making. The standardized coefficient of expected revenue in this model is equal to 0.338 ( $P=.032$ ), which

demonstrates that the expected revenue is significantly associated to risk behavior of improvised decision-making. And enhanced the  $R^2$  in model 2 from .037 to .136, the Adj- $R^2$  from .030 to .123, thereby, we believe that the expected revenue completely played a mediation role between framing effect and improvised decision-making<sup>1</sup>.

**Table 8**  
**The Regression Analysis Results of Cognitive Bias, Expected Revenue and Risk Behavior of Improvised Decision-Making**

| Model                |                     | Model 2                                     | Model 3          | Model 4                                     |
|----------------------|---------------------|---|------------------|---|
|                      |                     | Risk Behavior of Improvised Decision-making | Expected Revenue | Risk Behavior of Improvised Decision-making |
| Variable             |                     |   |                  |   |
| Independent variable | Framing Effect      | 0.191*                                      | 0.357***         | 0.071                                       |
|                      | Expected Revenue    |   |                  | 0.338***                                    |
|                      | <i>F</i> -statistic | 5.137*                                      | 17.308***        | 10.555***                                   |
| Regression results   | $R^2$               | .037  | .127             | .136  |
|                      | Adjusted $R^2$      | .030  | .121             | .123  |

**4.2.3 The Test Result 3: The Path Model of “Cognitive Bias, Risk Perception — Risk Behavior of Improvised Decision-Making”**

(a) The regression result analysis of the cognitive bias — risk behavior of improvised decision-making model.

**Model 5:** Study on the relationship between cognitive bias and risk behavior of improvised decision-making. This paper put the four dimensions of cognitive bias as independent variables which includes overconfidence, representative bias, availability bias and framing effect, and takes risk behavior of improvised decision-making as the dependent variable. The regression result (Table 9) indicates that the  $F = 17.335$  and performs significantly ( $P=.00$ ),  $R^2 = .344$ , Adj- $R^2 = 0.325$ , and the model performs significantly as a whole, and the fitting effect is excellent. The standardized coefficient of overconfidence is -0.171 ( $P=.037$ ), which demonstrates that the correlation between overconfidence and improvised decision-making is negative. The standardized coefficient of representative bias is -0.199 ( $P = .013$ ), which demonstrates that representativeness bias is negatively associated to risk behavior of improvised decision-making. The standardized coefficient of availability bias is 0.373 ( $P=.00$ ), which demonstrates that availability bias is positively associated to risk behavior of improvised decision-making. The standardized coefficient of framing effect is 0.019 ( $P=.802$ ), which demonstrates that framing effect is uncorrelated to risk behavior of improvised decision-making in this model.

(b) The regression result analysis of the cognitive bias—risk perception model

**Model 6:** We see the risk perception as dependent variable, and take the four dimensions of cognitive bias as independent variables. The regression result (Table 9) indicates that the  $F$  value is equal to 20.154 and performs significantly ( $P=.00$ ),  $R^2 = .379$ , Adj- $R^2 = .360$ , and the model performs significantly as a whole, and the fitting effect is excellent. The standardized coefficient of representative bias is -0.341 ( $P=.000$ ), which demonstrates that the representative bias will reduce decision-makers’ risk perception. The standardized coefficient of overconfidence is -0.234 ( $P=.04$ ), which demonstrates that the overconfidence will also reduce decision-makers’ risk perception. The standardized coefficient of availability bias is 0.177 ( $P=.025$ ), which demonstrates that the availability bias is positively associated to risk perception. The standardized coefficient of framing effect is .094 ( $P=.195$ ), which demonstrates that the framing effect is uncorrelated to risk perception. Thus we verify the hypothesis of 4a, 4b and 4c further; however, hypothesis 4d has not been verified.

(c) The regression result analysis of cognitive bias, risk perception—risk behavior of improvised decision-making model.

**Model 7:** We put the overconfidence, representative bias, availability bias and risk perception into one model as independent variables, and take risk behavior of improvised decision-making as the dependent variable, which indicates that  $F$  is 19.104 and performs significantly ( $P=.000$ ),  $R^2 = .367$ , Adj- $R^2 = .347$ , and the model performs significantly as a whole, and the fitting effect is excellent. The standardized coefficients of overconfidence is -0.0127 ( $P=.126$ ), which demonstrate that overconfidence

<sup>1</sup> Consider the independent variable  $X$ 's influence on the dependent variable  $Y$ , if  $X$  effect  $Y$  through  $M$ , we definite the  $M$  as mediating variable.  $M$  plays an intermediary role between  $X$  and  $Y$ .

is not significant to risk behavior of improvised decision-making in this model. Although the standardized coefficient of representativeness bias and availability bias are  $-0.135 (P=.105)$  and  $0.340 (P=.000)$  which become lower (the standardized coefficient are  $-0.199$  and  $0.373$  in model 5), they are still significant. The standardized coefficient of risk perception is  $0.189 (P=.032)$ , which demonstrates

that risk perception is positively associated to risk behavior of improvised decision-making. Thereby, we consider that risk perception in this model plays a completely mediating role between overconfidence and risk behavior of improvised decision-making, but partially mediating role between representativeness bias, availability bias and risk behavior of improvised decision-making.

**Table 9**  
**The Regression Analysis of Cognitive Bias, Risk Perception and Risk Behavior of Improvised Decision-Making**

| Model                |                         | Model 5                                     | Model 6         | Model 7                                     |
|----------------------|-------------------------|---|-----------------|---|
| Variable             |                         | Risk behavior of improvised decision-making | Risk perception | Risk behavior of improvised decision-making |
| Independent Variable | Representativeness bias | -0.199*                                     | -0.341**        | -0.135                                      |
|                      | Overconfidence          | -0.171*                                     | -0.234***       | -0.0127                                     |
|                      | Availability bias       | 0.373***                                    | 0.177*          | 0.340***                                    |
|                      | Framing effect          | 0.019                                       | 0.094           |   |
|                      | Risk perception         |   |                 | 0.189                                       |
| Regression results   | F-statistic             | 17.335***                                   | 20.154***       | 19.104***                                   |
|                      | R <sup>2</sup>          | .344  | .379            | .367  |
|                      | Adjusted R <sup>2</sup> | .325  | .360            | .347  |

## CONCLUSION

According to descriptive statistical analysis and regression analysis, once emergency condition happening, the judgment of expected revenue and risk perception made by decision-makers will affect risk behavior of improvised decision-making, and the higher the risk perception and expected revenue, the more possibly the risk behavior of improvised decision-making. Meantime, we indicate the effects of cognitive bias on improvised decision-making, as following:

(a) Anchoring effect doesn't have significant correlation to expected revenue and risk behavior of improvised decision-making under emergency. The possible reason is, though the accident responsibility system is strengthened in actual environment, it's hard to identify whether the loss is caused by the wrong decision-making or inappropriate decision. Besides, when facing the emergency, most decision-makers need to think about the human and property rescue in the first place. As long as the attitude is positive, even if the method might be inappropriate, it won't involve the attitude matter when comes to responsibility confirmation. So it won't have much influence on the decision-makers' position. Therefore, when confronting with emergency, it is hard for decision-makers to set the anchor, that is to say there is little time to judge the expected revenue. Through interviewing and surveying we found that most decision-makers usually feel worried about the decision afterwards, which just explains why the decision-makers have no time, no chance and no mind to set the anchor.

(b) Framing effect is significant associated to expected revenue and risk behavior of improvised decision-making, but no significant association to risk perception, which illustrate that framing effect influences the occurrence of risk behavior of improvised decision-making only by affecting the expected revenue judgment and expected revenue plays a completely mediating role between framing effect and risk behavior of improvised decision-making. The possible reason is that, when confronted with emergency, it is difficult for decision-makers to think whether the current framework representation is a threat or an opportunity, so it is difficult to perceive the risk of the events. In general, they will take improvised decision-making by their own experiences and information provided by their subordinates and staff officers, so framing effect mainly affects the decision-makers' judgment of expected revenue under emergency.

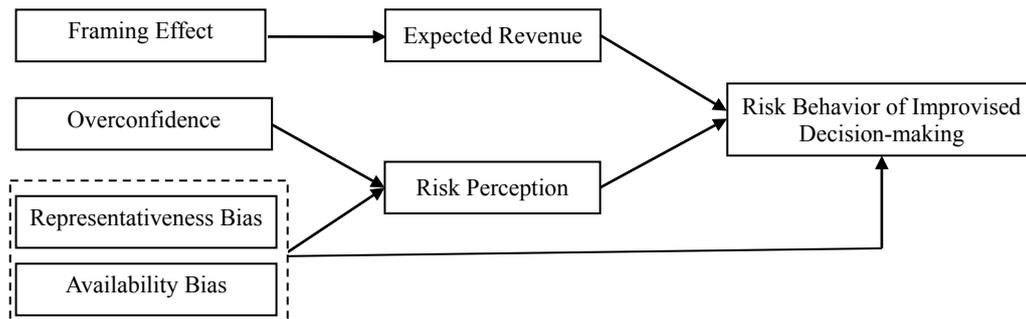
(c) All of overconfidence, representativeness bias and availability bias are significantly associated to the risk perception and risk behavior of improvised decision-making. They are important factors that affect the decision-makers' risk behavior of improvised decision-making.

Among these factors, overconfidence appears because the decision-maker is likely to increase his confidence due to previous successful experience or according to the existing information they take assumption as the fact, which will increase the opportunity of the risk behavior of improvised decision-making and make decision-makers have less response to the current situation they cannot find out corresponding solutions because of lack of time.

Representativeness bias is the element that decision-maker is apt to take advantage of the limited information and consider a few typical cases, which is possible to cause risk behavior of improvised decision-making occurrence under emergency. Availability bias is that decision-maker is apt to overestimate the information which is easy to get and extract, but it is more likely to get some negative information under emergency. So the decision-maker is apt to evaluate the information though imagination that may cause the bias of risk perception and affect the occurrence of risk behavior of improvised decision-making. Meanwhile, risk perception plays a completely mediating role between overconfidence and risk behavior

of improvised decision-making but partial mediating role between representativeness bias, availability bias and risk behavior of improvised decision-making, which means representativeness bias and availability bias can affect risk behavior of improvised decision-making in other ways.

Through empirical research, we remove anchoring effect from the path model of “cognitive bias → expected revenue → risk behavior of improvised decision-making” and remove framing effect from the path model of “cognitive bias → risk perception → risk behavior of improvised decision-making”, Figure 2 shows the correct result to hypothetical model:



**Figure2**  
**Positivism Model of Cognitive Bias Affect the Risk Behavior of Improvised Decision-Making**

Though the research is helpful to clarify the effective path of cognitive bias on improvised decision-making, there still exist two disadvantages. Firstly, this paper only focuses on the decision-makers’ cognitive bias factors. In fact, the improvised decision-making under emergency is a complex process, which is influenced by multidimensional factors such as the decision-makers personality, social network, environment, risk propensity. There is more realistic significance to clear the effect of each factor in improvised decision-making and how to bring in these factors to build multidimensional and completely influence model of improvised decision-making under emergency. Secondly, this paper doesn’t distinguish emergency styles in different industries and fields due to the survey difficulty of the research objects. It will be more meaningful to investigate and analyze larger samples from different fields and make a deeper research from different views in the following research.

## REFERENCES

- Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journals of Personality and Social Psychology*, 51(6), 1173-1182.
- Best, J. B. (2000). *Cognitive psychology*. In X. T. Huang (Trans.). Beijing: China Light Industry Press.
- Busenitz, I. W., & Barney, J. B. (1997). Differences between entrepreneurs and managers in large organizations: Bias and heuristics in strategic decision-making. *Journal of Business Venturing*, (12), 9-30.
- Combs, B., & Slovic, P. (1997). Newspaper coverage of causes of death. *Journalism Quarterly*, (56), 837-949.
- He, G.-H., & Jin, Z.-C. (2010). Research to cognitive mechanism of framing effect. *The Journal of Henan Normal University*, (5), 178-181.
- Janis, I. (1982). *Groupthink: Psychological studies of policy decision and fiascoes* (pp.98-101). Boston: Houghton.
- Jing, H.-B. (2011). *The institutional psychological mechanism of China government decision-making: A theoretical framework*. Sun Yat-sen University.
- Kahneman, D., Slovic, P., & Tversky, A. (2008). *Judgment under uncertainty*. China Renmin University Press.
- Liu, X., & Yan, X. (2011). Generation mechanism of emergency decision-making: Links, elements and serial processing. *Journal of Shanghai Administration Institute*, 12(4), 37-43.
- Liu, S.-L., et al. (2010). Research to influence factor and countermeasure of cognitive bias in management decisions. *Modern Management Science*, (1), 24-25.
- Liu, X.-Y., Zhang, M.-S., & Zhan, Y.-C. (2012). Spatial model and preventive mechanism of risk perception. *Journal of Southwest University for Nationalities*, (1), 20-24.
- Liu, H.-C. (2011). The nature of risk and its implication for social risk assessment of government’s policy-making. *The Journal of Shanghai Administration Institute*, 12(6), 91-97.

- Mary, M., & Crossan, J. (2000). Improvisation in action. *Organization Science*, (9), 593-599.
- Meng, D.-N. (2011). *Enterprise's top managers*. Liaoning University.
- Russo, J. E., & Schemaker, P. J. H. (1992). Managing overconfidence. *Sloan Management Review*, 33(2), 7-18.
- Simon, A. (1956). Rational choice and the structure of the environment. *Psychological Review*, (63), 129-138.
- Simon, M., Houghton, S. M., & Aquino, K. (2000). Cognitive bias, risk perception, and venture formation: how individuals decide to start companies. *Journal of Business Venturing*, 15(2), 113-134.
- Sun, D.-Y. (2005). Study of individual and crowd behavior decision under paroxysmal social public crisis. *National University of Defense Technology*.
- Tversky, A., & Kahneman, D. (1973). Availability: A heuristic for judging frequency and probability. *Cognitive Psychology*, (5), 207-232.
- Wang, J. (2009). *The research on management decision of individual cognitive bias*. Liaoning University.
- Weber, E. U., & Hsee, C. K. (1998) Cross-cultural differences in risk perception but cross-cultural similarities in attitudes towards risk. *Management Science*, 44, 1205-1217.
- Yates, J. F., & Stone, R. (1992). *Risk-taking behavior* (pp.1-25). Chic Hester: John Wiley & Sons Ltd.
- Zheng, Y.-M. (2007). Cognitive bias and intervention strategy in the decision judgment. *Statistics & Decision*, (10), 48-50.
- Zhou, A.-B., & Zhao, X. (2009). Decision behavior and cognitive bias—A review of research on the manager overconfidence. *East China Economic Management*, (4), 135-138.
- Zhou, F. (2008). The analysis of cognitive psychology on decision-making cognitive bias. *The Journal of Beijing Administration Institute*, (5), 75-79.