Cognitive Decision-making and Public Opinions

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ABSTRACT

The influence of public opinions on emergency decision-making has attracted more and more attention in recent years. Emergency decision-making is characterized by high risk, fuzzy information and time pressure. Public opinions induced by emergency have important influence on people's decision-making preference. Based on the four induced conditions, including positive public opinion, neutral public opinion, negative public opinion and public opinion induced by emergent situations, this paper studies the brain evoked potential information of subjects and proposes a new intuitive decision-making model. The results show that the average scores of the positive opinion group on the positive scale are significantly different, while the scores of the negative opinion group on the negative scale are significantly different. Participants in group of public opinion induced by emergent situations tend to be more adventurous in their decision-making preferences than those in the negative public opinion group. The results of brain information processing of neutral, positive and negative public opinion groups show that both the standard stimulus and deviant stimulus could induce obvious negative deflection in 100-200ms in EEG. In the processing the information induced by emergent situations, amplitude deviation between the standard stimulus and deviant stimulus is smaller, which is perceived as insensitive.

Key Words: Public Opinion, Decision-Making Preference, Decision-Making Model, Electroencephalogram (EEG), Amplitude

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Introduction

Economic development and the growth of national strength have always been the highest goal of human society, and economic prosperity is often at the expense of the environment and human resources for survival (Oka *et al*., 2011). China's rapid development has greatly improved its people's life, but the present situation of environment is disturbing and production safety accidents often occur (Deco and Kringelbach, 2017). At present, the emergencies is happening in a wider and wider field, with higher and higher frequencies, which can lead to serious consequences (Penke *et al*., 2010; Kuznetsova *et al*., 2016). Some scientists recognize that today's decision makers need a decision-making model that is consistent with the characteristics of emergencies, rather than merely applying the traditional decision-making model that is completely rational directly to the emergency decision-making domain (Isel and Kail, 2018; Zaccone *et al*., 2017). The state of public opinion in a society can influence people's decision-making process in the event of an emergency. Public opinion is an attitude or a behavioral response exhibited by an objective thing, which plays a role of bridge in the process of balance and imbalance (Sysoeva *et al*., 2009; Balestrini, 2015). Hence, when a person is in a positive public opinion atmosphere, it means that that current environment balances his demands (Chen *et al*., 2015).

The research of social public opinions originated from the development of psychology (Zheng *et al*., 2016). Social public opinions will produce emotional or physical changes to people

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in the environment, but often these are not enough to create fluctuations in heart, as emotional or physiological changes depend on the attitude of individuals to their environment (Little *et al*., 2015). The process of decision-making is a high-level cognitive process involving cognitive evaluation, physiological responses and phenomenological experience. A good decision is to be able to effectively select solutions and enable decision makers to achieve their goals in a given situation (Flynn *et al*., 2012; Carlson and Guha, 2011). The processing of brain information affects people's decision-making behavior, which can drive people to react to unexpected situations (Morgan, 2014). Based on the four induced conditions of positive public opinion, neutral public opinion, negative public opinion and public opinion induced by emergent situations, this paper studies the brain evoked potential information of subjects, and proposes a new intuitive decision-making model, which provides experimental basis for the future study of emergency decision-making.

Neuroscience research on the influence of public opinion on decision-making

Study on the influence of public opinions on decision-making and decision-making preference

In the early years, researches on decision-making theory neglected the influence of public opinions on decision-making, and it was considered that psychological cognition alone was an important factor influencing decision-making (Gupta and Merchant, 2017). People's decision-making behavior is not completely rational, but partly rational. However, few people have mentioned that public opinion is the factor that influences decision-making, but rather people refer to emotion most, thinking that emotion is an important factor that affects people's decision-making (Khrennikov, 2014). Positive public opinion and negative public opinion can affect people's mood, so the connection between public opinions and cognition and decision-making is also clear. A decision-making process needs to deal with a large amount of information, among which individuals pay different attention to the manifestations of different problems. Different individuals will have different application strategies facing the same decision-making situation, manifested as differences in information processing. It has been found that different information processing results in different decision-making processes and results.

The valency dimension of public opinions has two sides, including positive public opinion and negative public opinion. If the valence dimension is zero, it means that it is neutral public opinion. Positive public opinion or negative public opinion will affect people's decision-making preference. Even if there is no specific induced condition, there will be the same decision-making results under the existing public opinion conditions (Galperina *et al*., 2016). People's decision-making preference is related to self-relevance. People's decision-making behavior is more adventurous under negative public opinion state, compared with the states of neutral public opinion and positive public opinion. The emergency is a typical type of event, for which decision information is scarce and the time is urgent, so it is very difficult to make a fast and accurate decision in such a state. Therefore, people's decision-making in an emergent situation is more difficult and there are more responsibilities and greater risk. Thus it is necessary to carry out corresponding experimental research. Figure 1 shows a new intuitive emergency decision-making model.

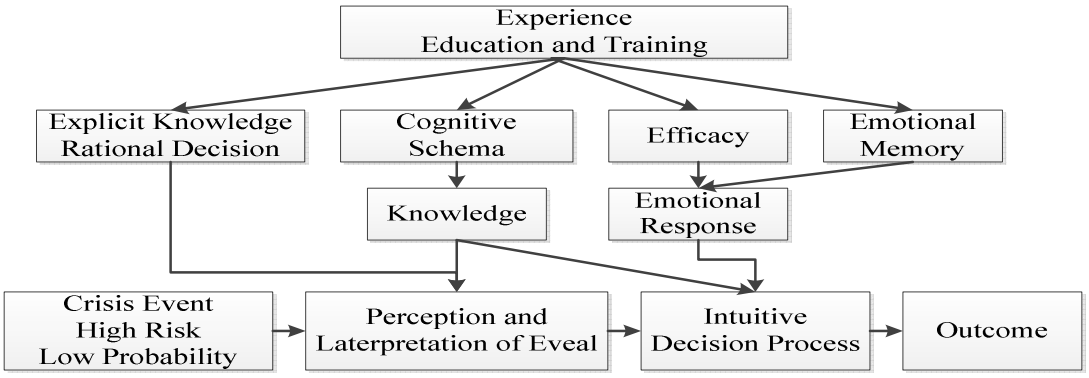

Figure 1. Emergency decision-making model

Brain mechanism of public opinions affecting decision-making

The impact of public opinions and public opinion memory on decision-making behavior can be revealed through the study of neuroscience theory (Ascione *et al*., 2016; Wichchukit and O'Mahony, 2010). People's unconscious bias in making decisions often involves the influence of public opinion memory, which also affects people's responses to the current public opinion. Although we may not be aware of the role played by the memory of public opinion from the present situation, it can still enable people to clearly recognize the experiences of the public opinions when making mistakes and draw lessons from the experience. Electroencephalogram can record the electrical activity of human brain, different event evoked potential stimulation will be expressed through brain waves. There are three kinds of responses to event-related potential: P2, N2, and late positive components. Although there is brain evoked potential component for the cognition and understanding of public opinion stimulation, the event-related potential related to public opinion processing can reflect the influence of public opinion preference on information processing of brain.

Research process

Research design

Public opinions always exist with cognitive process, which have very important influence on decision-making. Previous studies have been conducted through stimulation and induction, but if the same approach is used in this article, public opinions will be separated from its context. If the actual decision is ignored, the critical situation will induce negative emotions of the decision-maker as the emergent decisions are often made in a certain situation. Through comparative analysis of relevant literature on public opinions and emergency decision-making, this paper determines the influences of the public opinions on emergency decision-making preference and the brain mechanism, studies decision-making preference through cognitive experiment, and studies the brain mechanism using brain evoked potential test technology to determine the relevant research methods and experimental techniques. The research design of this paper is shown in Figure 2. This experiment explores the public opinion state induced by the emergent situation for the first time, which is reflected by the influence of an inherent public opinion state on the preference in emergency decision-making, which is more in line with the actual decision-making background.

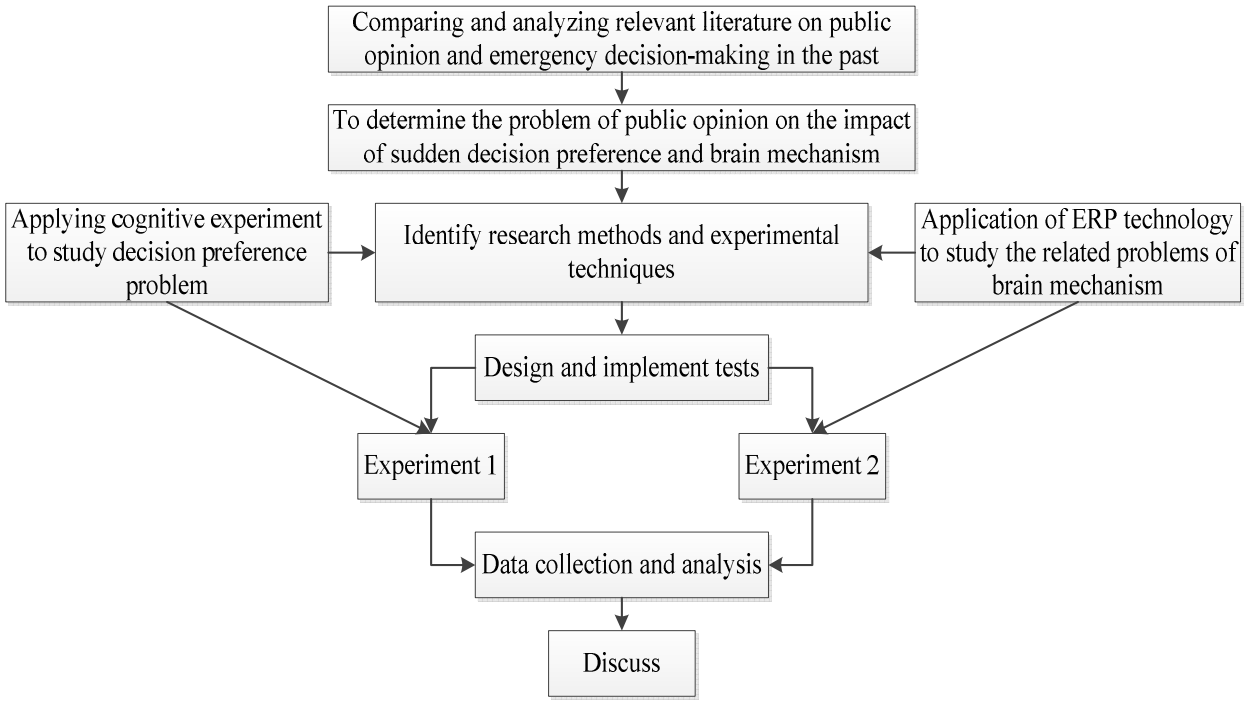

Figure 2. Experimental research ideas diagram

Experimental procedure

This paper discusses the influence of different public opinion states and those induced by emergent situations on emergency decision-making preference and information processing of the brain. In this experiment, four influencing factors are designed, including positive public opinion state, neutral public opinion state, negative public opinion state and public opinion state induced by emergent situations. The single-factor inter-subject design method is adopted. In this experiment, 200 college students are recruited with payment, and 50 are randomly assigned for each influencing factor. All of them have undergone stability and sensitivity analysis before the experiment, to exclude the influence of personality factors. The inducing materials consist of 70 positive photographs, 70 neutral photographs and 70 negative photographs respectively. 70 pictures consistent with the public opinion state upon occurrence of the emergency are selected for the emergent situation group. There are two options for each emergency: conservative decision and adventurous decision. In the brain information processing experiment, 200 subjects are divided into two groups: Group 1, neutral-positive-emergent group, and Group 2, neutral-negative-emergent group. The brain evoked potential experiment uses an extended 64-lead cap with a 15-20 head positioning system, which consists of a brain evoked potential amplifier (Neurone Model Black amplifier) and a neuron electrode cap (Ag/AgCl64 lead Neurone electrode cap), with a sampling frequency of 500Hz. The electrodes (reference electrodes) with relatively zero body potential are placed on the left and right sides of the breast.

Results

Influence of different public opinion states and those induced by the emergent situation on the emergency decision-making preference

Table 1 shows the public opinion evaluation scale completed before the experiment, which is used as the baseline of public opinion state of the subjects. On the positive and negative scale, the variance of scores of all four group are homogeneous, which means, that there is no difference in the average scores of the four groups on both the positive and negative scales, and the public opinion state of the subjects is at the same level. As can be seen in the descriptive statistics and test of the public opinion induction results of the four groups of subjects in Table 2, the scores of the positive public opinion group in the positive and negative scale tests before and after the experiment show no difference; the positive public opinion group has a significant difference in their average scores on the positive scale, but there is no obvious difference in their scores on the negative scale; the difference in the average scores of the negative public opinion group on the positive and negative scales are exactly opposite to those of the positive public opinion group, that is, that is, there is no significant difference in scores on the positive scale, and there is a significant difference in scores on the negative scale; the scores on the positive and negative scales of the group of public opinion induced by emergent situations are consistent with those of the negative public opinion group.

Two options are set in the emergent situation. Assume that the conservative option is set to 1 and the adventurous option is set to 2. The lower the total scores of each group, the more conservative the decision is. Table 3 shows descriptive statistics and tests of the total scores induced by the 4 emotional groups. It can be seen that the average scores of the neutral public opinion group and the positive public opinion group do not show any difference, while there is great difference in the scores of negative public opinion group and those of the emergent situation induced group, and there are also significant differences compared with the former two groups. The average scores of the emergent situation

Table 1. Descriptive statistics and test of PORS scale scores before each experiment

Scales name	Groups	M	F	p
PA(positive)	Neutral opinion group	11.10±1.50	1.10	0.21
	Positive opinion group	11.41±1.37		
	Negative opinion group	11.77±1.63		
	Sudden public opinion group	11.01±1.54		
NA(negative)	Neutral opinion group	11.03±1.88	0.44	0.72
	Positive opinion group	10.73±1.39		
	Negative opinion group	10.99±2.01		
	Sudden public opinion group	11.39±1.36		

Table 2. Descriptive statistics and test of emotionally induced results

Groups	Scales name	M	Absolute value	P
Neutral opinion group	Before the PA experiment	11.19±1.50	0.67	0.49
	After the PA experiment	10.79±1.55		
	Before the NA experiment	11.03±1.88	0.69	0.37
	After the NA experiment	11.15±1.10		
Positive opinion group	Before the PA experiment	11.41±1.37	35.64	0.00
	After the PA experiment	31.85±2.83		
	Before the NA experiment	10.73±1.39	1.73	0.10
	After the NA experiment	11.33±1.36		
Negative opinion group	Before the PA experiment	11.77±1.63	0.07	0.83
	After the PA experiment	11.73±0.83		
	Before the NA experiment	10.89±2.01	2.76	0.00
	After the NA experiment	24.99±2.41		
Sudden public opinion group	Before the PA experiment	11.01±1.63	0.69	0.51
	After the PA experiment	11.39±1.30		
	Before the NA experiment	11.39±1.36	26.58	0.00
	After the NA experiment	23.57±1.64		

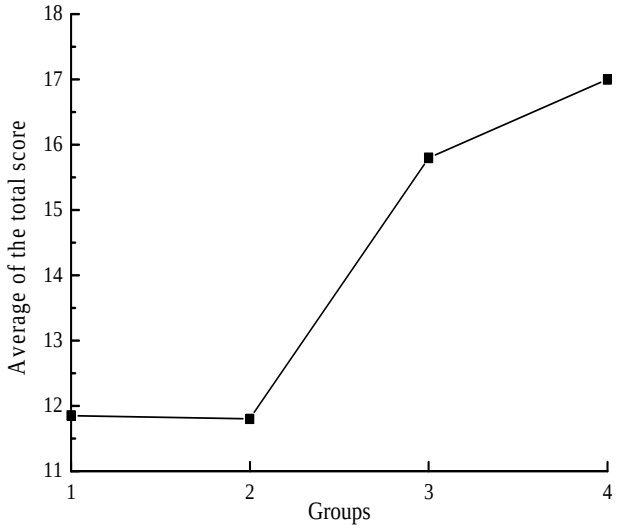

Figure 3. The average of the scores for each group

Table 3. Descriptive statistics and tests of the total scores of the groups induced by public opinions

Groups	M	F	p
Neutral opinion group	11.73±1.10	90.13	0.00
Positive opinion group	11.79±1.15		
Negative opinion group	15.79±1.55		
Sudden public opinion group	16.85±1.35		

induced group are the highest, followed by the negative public opinion induced group, that is to say, the emergent situation induced group is more adventurous than the negative opinion induced group in terms of emergency decision-making preference. Figure 3 shows the average of the total scores of each group, which is the same as the experimental results shown in Table 3.

Effect of information processing of public opinion on automatic information processing of brain in different public opinion states and emergent situations

Table 4 shows the public opinion scales of the two groups. It can be seen that there is no difference between the two groups in the average scores of the positive and negative scales. As can be seen from Tables 5 and 6, which show the descriptive statistics induced by positive public opinions and emergent situations, respectively, compared with the pre-experiment situation, the subjects show obvious difference on the positive scale under the positive public opinion induced conditions, and subjects show significant differences in the negative scale under the emergent situation induced conditions. Figures 4, 5, 6 and 7 are original waveform diagrams in processing neutral, positive, negative public opinions and public opinions induced by emergent situations, respectively. It can be seen that, while the neutral, positive and negative public opinions are processed, the standard stimulus and the deviation stimulus in EEG can induce the obvious negative deflection at 100-200ms, and the positive amplitude of the standard deviation is obviously higher than its negative amplitude. In processing the information induced by an emergent situation, the standard deviation and deviant stimulus have a smaller amplitude deviation, which is perceived as insensitivity. Table 7 shows the comparison of the average area and latency between the two groups. The smallest average area in Group 1 is the emergent situation induced condition, and its corresponding latency is also the shortest; in Group 2, the shortest latency is seen in the neutral picture induced

Table 4. Descriptive statistics and tests of PORS scales before each experiment

Scales	Groups	M	t	p
PA	Group one	10.99±1.29	0.69	0.94
	Group two	11.16±1.13		
NA	Group one	11.04±1.25	1.26	0.77
	Group two	10.44±1.11		

Table 5. Descriptive statistics and tests induced by positive public opinion

Groups	Scales name	M	Absolute value	P
Positive opinion induced	Before the PA experiment	10.99±1.29	46.03	0.00
	After the PA experiment	31.99±1.33		
	Before the NA experiment	11.04±1.25	1.75	0.53
	After the NA experiment	10.49±1.09		

Table 6. Descriptive statistics and tests induced by emergent situations

Groups	Scales name	M	Absolute value	P
Sudden situation induced	Before the PA experiment	10.99±1.29	0.13	0.78
	After the PA experiment	10.95±1.18		
	Before the NA experiment	11.04±1.25	44.78	0.00
	After the NA experiment	21.69±1.38		

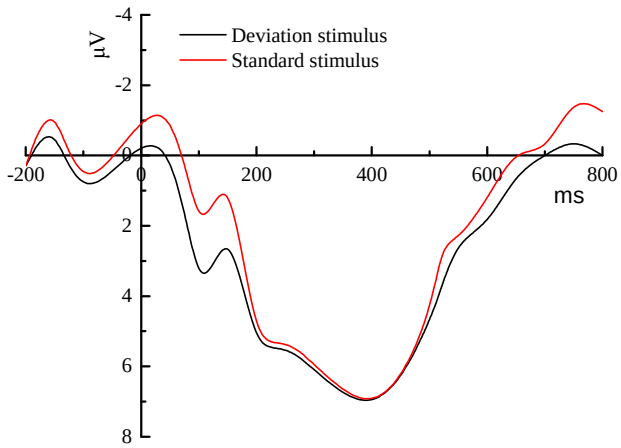

Figure 4. The original waveform diagram in the processing of neutral public opinion information

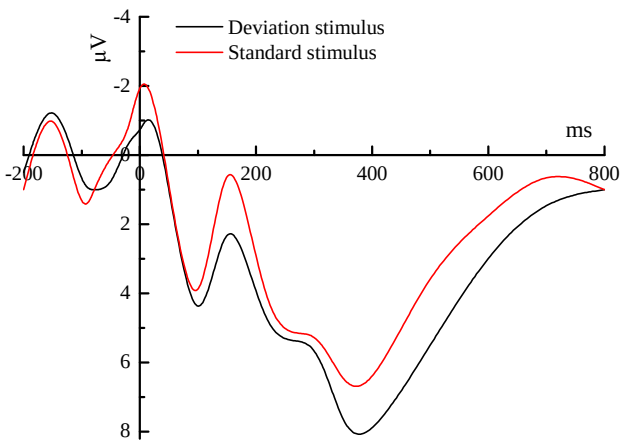

Figure 5. The original waveform diagram in the process of processing positive information

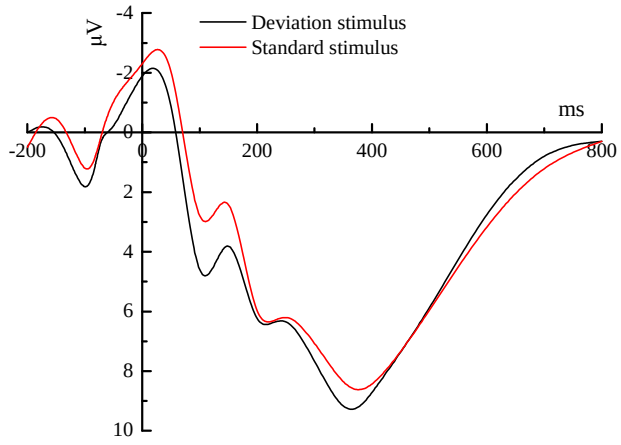

Figure 6. The original waveform diagram in the processing of negative opinion information

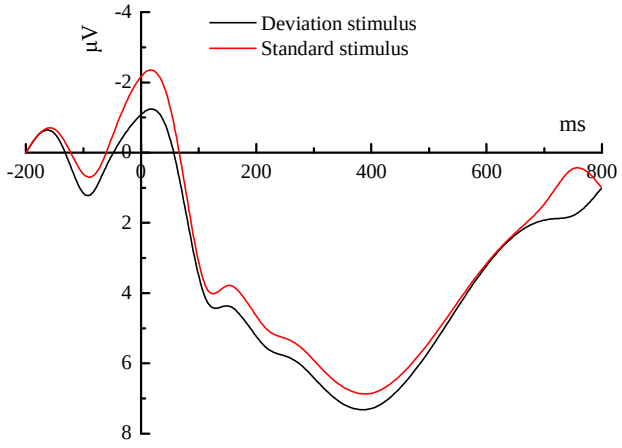

Figure 7. Original waveform diagram in the state of public opinion induced by an emergent situation

Table 7. Comparison of average area and latency of each group

Groups	Experimental treatment	Average area	Latency (ms)
Group 1 Neutral-Positive- sudden	Neutral picture	-156.47	176.55
	Positive pictures	-152.46	170.45
	Sudden situation picture	-64.07	168.87
Group 2 Neutral-negative- sudden	Neutral picture	-159.01	171.22
	Negative picture	-148.89	178.01
	Sudden situation picture	-61.27	175.48

condition (Portnova, 2017; Reddy and Suseela, 2017; Feng *et al*., 2016; Salokyová, 2016).

Conclusions

Based on the four induced conditions, including positive public opinion, neutral public opinion, negative public opinion and public opinion induced by emergent situations, this paper studies the brain evoked potential information of the subjects. The concrete experimental conclusions are as follows:

(1) People's decision-making preference is related to self-relevance. People's decision-making behavior is more adventurous under negative public opinion state, compared with the states of neutral public opinion and positive public opinion.

(2) The scores of the positive public opinion group in the positive and negative scale tests before and after the experiment show no difference; the difference in the average scores of the negative public opinion group on the positive and negative scales are exactly opposite to those of the positive public opinion group; the scores on the positive and negative scales of the group of public opinion induced by emergent situations are consistent with those of the negative public opinion group.

(3) While the neutral, positive and negative public opinions are processed, the standard stimulus and the deviant stimulus in EEG can induce the obvious negative deflection at 100-200ms, and the positive amplitude of the standard deviation is obviously higher than its negative amplitude.

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