Emergency Management Based on Attention Mechanism

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Abstract. Emergency management plays a pivotal role in today's social governance, but the existing emergency management system still suffers from ambiguous monitoring objectives and unreasonable allocation of government attention. As an important technique in the field of machine learning, attention mechanism can be a good way to fill the shortcomings of the current emergency management. This paper combines Simon's finite rationality theory, tries to introduce attention mechanism in the field of machine learning, and proposes a new model of emergency management, which provides a new way of thinking for the reform of emergency management system mechanism in China.

Keywords: emergency management · attention mechanism · finite rationality

1 The Dual Context of the Risk Society and the Digital Age

A risk society is a social form in which various risks arising in the process of social development pose a threat to human survival and development. The digital era refers to the era in which information technology and digital development have profound impacts on social economy, political culture, and lifestyle. Under the dual background of risk society and digital era, emergency management is facing new challenges and opportunities. On the one hand, the development of digital technology provides powerful support and empowerment for emergency management, such as big data, cloud computing, Internet of Things, and artificial intelligence, which can enhance the level of informationization, intelligence, precision, and collaboration of emergency management and improve the efficiency and effectiveness of emergency response. On the other hand, the development of digital technology also brings new risks and threats, such as network security, data leakage, information distortion, and technology dependence, which may affect the security, credibility, fairness, and sustainability of emergency management.

2 Finite Rationality in Emergency Management

Due to the complexity of emergency management itself, it is difficult to try to fully consider objective factors in the response process. Discussing the process design of emergency management based on complete rationality at this point would go against objective reality by being too idealistic.

2.1 Theoretical Development of Finite Rationality

Finite rationality theory is an important theory in economics and management. In his article "A behavioral model of rational choice", Simon proposed that in reality, what is pursued is often the "satisfactory solution" of limited rationality, rather than the "optimal solution" of full rationality. In Simon's view, the pursuit of the "optimal solution" is futile when dealing with complex uncertainty, while the pursuit of the "satisfactory solution" is not only consistent with the actor's cognitive and computational abilities, but also with the uncertainty of the complex situation in which he or she finds himself or herself. Schmid pointed out that the information processing capacity of the human brain is limited, so people are finite rational, while the preferences of finite rational people are endogenous, and in the case of uncertainty, incomplete information and discrete knowledge, people have to ensure certainty and improve cognitive ability through beliefs, ideologies and institutions; Hayek emphasized that everyone has a "state of ignorance beyond reason" when he made the premise of institutional evolution theory. "a state of ignorance that is less than rational", that the lack of individual rationality can be compensated to some extent by ideology and rules of behavior, and that spontaneous order is the path of institutional choice to prevent the transformation from a free society to a totalitarian society.

2.2 The Finite Rationality Dilemma in Emergency Management

The Finite rationality dilemma of emergency management has the following main aspects.

(1) Information Dilemma

The information dilemma in emergency management is an important obstacle affecting the improvement of our emergency response capability and efficiency. In major emergencies such as SARS and the new crown pneumonia epidemic, we have deeply felt the harm caused by the information dilemma. For example, in the early stage of the epidemic, the lack of timely and accurate information on the source of the virus, transmission routes, number of infected people and other key information led to lagging prevention and control measures and mistakes.

(2) Time Dilemma

Time dilemma in emergency management is a dilemma that causes decision makers and executors to have difficulty in making optimal choices and actions in the face of emergencies due to the characteristics of time constraint, unpredictability and irreversibility, thus affecting the effectiveness and efficiency of emergency response. Time dilemma will not only increase the difficulty and risk of emergency work, but also cause panic and anxiety to the public.

(3) Risk dilemma

The impact of emergencies often involves multiple fields and levels, and emergency decision makers and implementers often face multiple risks, such as life safety, property damage, social stability, and political responsibility, etc. They need to balance the interests and demands of all parties under uncertainty or bear the unpredictable consequences.

3   Optimizing Finite Rationality in Emergency Management: The Attention Mechanism

3.1   The Development of Attention Mechanism

Attention mechanism is a data processing method in machine learning, which is widely used in various types of machine learning tasks such as natural language processing (NLP), image processing (CV) and speech recognition. The attention mechanism is essentially a manifestation of the Finite rationality of the human brain, and its origin can be traced back to the 1990s. When studying human vision, scholars in the field of cognitive science discovered a special signal processing mechanism of the human brain. This mechanism makes the human brain not process and understand all information when receiving external information, such as visual information and auditory information, but only focus on some significant or interesting information, which helps filter out unimportant information, thus improving the efficiency of information processing, it was eventually named attention mechanism.

3.2   Bayesian Theorem and Bayesian Brain

Bayesian reasoning is proposed by British mathematician Bayes to describe the relationship between two conditional probabilities. The specific formula is as follows:

$$P(A|B) = \frac{P(A)P(B|A)}{P(B)}$$

P(A|B) is called a posterior probability, P(B|A) is called likelihood, P(A) is called A priori probability, P(B) is called an evidence. Bayesian theorem believes that some prior beliefs can be combined with observed data to update beliefs. This process is also called "learning". As we get more information, we constantly adjust our estimate until it is close to the real answer. On this basis, some scientists put forward the concept of Bayesian brain, that is, the working mechanism of human brain is to compare the observed facts with memory to check whether the view is correct, and then add new facts to the brain to form a new transcendental probability. In emergency management, the government plays the role of a brain. We can think that the government's reform model also follows the "Bayesian brain". For example, the government formulates emergency plans based on the summary of past emergency experience, and adjusts the plans according to the new facts after the emergency.

3.3   The Integration of Attention Mechanisms and Emergency Management

The domestic research on attention mechanism is still mainly in the field of image processing, natural language processing, data prediction, etc. Some scholars in the field of public management and emergency management are also studying the allocation model of government attention, but there are not many studies that try to combine attention mechanism with emergency management, so there is still much potential to explore in this field.

According to Charles F. Hermann, emergencies often have the following characteristics: (1) emergencies change the decision priorities of managers, and the goals that are prioritized in the daily state are threatened; (2) managers need to shift their decisions to respond; and (3) emergencies attract the attention of decision makers when they occur. According to Herman's theory, we can learn that decision makers do not have to have all the relevant information when an emergency occurs, and some information will be the key to influence decision makers' behavior. Therefore, if we can combine the attention mechanism to simulate disaster scenarios and build an emergency response model based on Finite rationality, we can largely eliminate the interference and dissipate the waste of government attention caused by information redundancy.

3.4 Analysis of the Application of Attentional Mechanisms in the Field of Emergency Management

(1) Attention mechanism improves the clarity of emergency monitoring objectives

For emergency management, daily routine issues can easily become a disturbance for risk monitoring, and among the many normal information, a few abnormal states are not easy to attract attention, so the root cause of untimely emergency response often does not lie in intelligence failure, but in the fact that managers are actually in a "scattered, noisy and chaotic environment The reason is that managers are actually in a "scattered, noisy and chaotic environment" and are unable to allocate their attention effectively to pay attention to and confirm abnormal phenomena in a timely manner. In the previous emergency monitoring sessions, emergency managers always emphasized comprehensive monitoring of all risk factors, without emphasizing the priority of risk factors. However, comprehensive monitoring without prioritization is actually a kind of sloppy management, which will inevitably lead to ambiguous governance of emergency management. An important role of the attention mechanism is to shift emergency decision-making behavior from "fuzzy" management experience based on leaders to scientific and sophisticated data analysis. It can help decision makers to clarify their goals and achieve clear and effective responses by focusing on the more hazardous parts of the causal factors.

(2) Attention mechanism assists emergency departments to allocate their attention rationally

Government attention refers to the scope and depth of issues and information that the government pays attention to when dealing with public affairs, and is considered by some scholars as a kind of government resources. In the early stage of a disaster, emergency departments have to deal with the event itself, but also be disturbed by public attention and public opinion pressure, so the Finite attention resources are more obvious at this time. How to correctly allocate government attention is very important at this time. When the scale, urgency and unpredictability of the hazards generated by an emergency event exceed the regular response capacity of relevant government departments, it is difficult to fully utilize attention resources based on the experienced judgment of top managers alone. The attention model is a big data approach to allocate attention resources, which is much more rational than "human" in emergency situations. The machine will always remember that the primary goal of emergency management is to solve problems, not to

make everyone happy. Therefore, by using the attention model to assist the decision-making department, the emergency decision can be more focused on the key of the disaster.

4 A Case Study of Attentional Mechanisms Applied to Emergency Management

At present, there are relatively few cases where attention mechanisms are directly applied to emergency management, but attention thinking has been reflected in some past public emergencies. For example, back in 2009, Google launched its influenza risk monitoring system (GFT), which used high-frequency search data from search engines to monitor influenza in real time and achieved good results over a period of time. Compared to the CDC's conventional surveillance methods, GFT could detect influenza outbreaks two weeks earlier, which gave the government and the public ample time to prepare for prevention and reduced a large number of human infections and economic losses. But then, with the advent of the era of big data, massive data, real-time data, and rich and diverse unstructured data, which entered people's lives with unprecedented breadth, people's search behavior changed, and the accuracy of GFT predictions began to show large deviations, and thus began to withdraw from the historical stage. Although GFT was eventually eliminated by the times, it confirmed that in some public emergencies, we only need to focus on some important indicators to achieve better risk monitoring.

The "one map, one code, one index" invented in Zhejiang Province during the New Guinea epidemic is a successful practice of this model. According to relevant studies, the risk level of individuals infected with NCC has the highest correlation with the travel history of the risk area, in addition to the convenience of local transportation, the number of foreign population and other correlations. Based on the results of the big data assessment, Zhejiang Province launched a five-color "epidemic map" and "smart control index" by focusing on key indicators and combining visualization technology, which became an important basis for epidemic risk warning; and the health code generated by using the model to monitor health data in real time became an important basis for the emergency response process. The health codes generated by the model's real-time health data have become an important object of attention in the emergency response process, and the emergency department can simply focus on groups with abnormal health codes due to certain reasons, which greatly saves the resources of the emergency department in various aspects.

It is found that the attention mechanism has not been formally introduced into the field of emergency management, but the response of the emergency department in certain scenarios already reflects the attention idea, and due to the development of digital technology, there is already a technical basis for combining the attention mechanism with emergency management.

5 Conclusion and Outlook

The essence of digital reform is to combine various big data technologies and concepts with emergency management. This paper combines two major fields of attention mechanism and emergency management to make some throwaway discussions. The authors

argue that there is much more that can be explored in this cross-cutting area in the future. For example, how the flattened attention mechanism model can be integrated with the traditional top-down emergency management mechanism in China; how the attention mechanism model can be relocated from other fields into the emergency management field; and how the relevant legal basis should be improved after the introduction of the attention mechanism. The authors believe that there must be many valuable research questions and important challenges included in this, and we look forward to further exploration and research in our future work.

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