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Received: November 13, 2024; Accepted: February 25, 2025

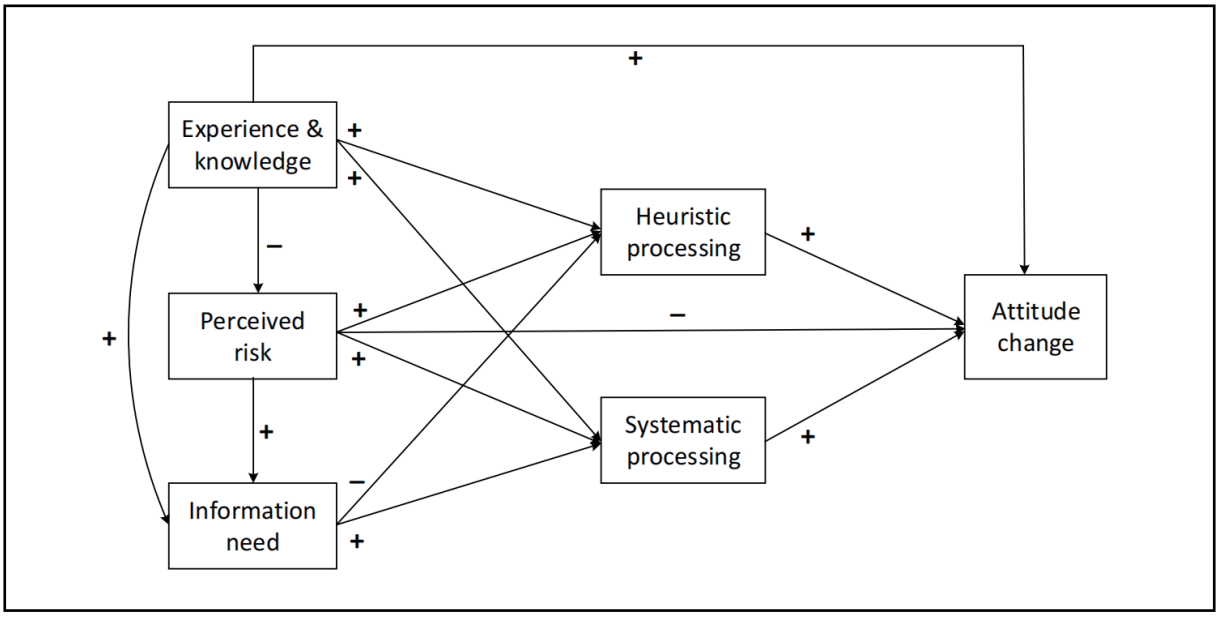
An empirical study of user's online electric vehicle car-hailing behavior based on the HSM model in the context of coordinated carbon and electricity markets

Yuan Zhang[1], Jun Li[2], Linlin Fan[3,4] ✉, and Ao Zhang[2]

[1]*Xuancheng Power Supply Company, State Grid Anhui Electric Power Co., Ltd., Xuancheng 242000, China;*
[2]*School of Economics, Hefei University of Technology, Hefei 230601, China;*
[3]*School of Economics and Management, Hunan Open University, Changsha 410004, China;*
[4]*School of Educational Science, Hunan Normal University, Changsha 410081, China*

✉Correspondence: Linlin Fan, E-mail: fanlinlin@hnou.edu.cn

Graphical abstract



Theoretical framework.

Public summary

- Theoretical contribution: The study applies the heuristic-systematic model (HSM) to understand how individuals process crisis-related information in the context of online electric vehicle (EV) car-hailing.
- Impact of experience and knowledge: High levels of experience and knowledge enhance information needs and promote both heuristic and systematic information processing, which positively impacts attitude change.
- Role of risk perception: Risk perception increases information needs and promotes systematic processing but negatively influences attitude change toward online EV car-hailing services.
- Practical implications for policy makers: Results suggest that well-structured crisis communication can effectively shape consumer attitudes by addressing perceived risks and providing comprehensive information.

Citation: Zhang Y, Li J, Fan L L, et al. An empirical study of user's online electric vehicle car-hailing behavior based on the HSM model in the context of coordinated carbon and electricity markets. *JUSTC*, **2025**, 55(11): 1102. CSTR: 32290.14.JUSTC-2024-0146. DOI: 10.52396/JUSTC-2024-0146

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[3]*School of Economics and Management, Hunan Open University, Changsha 410004, China;*
[4]*School of Educational Science, Hunan Normal University, Changsha 410081, China*

✉Correspondence: Linlin Fan, E-mail: fanlinlin@hnou.edu.cn

Cite This: *JUSTC*, **2025**, 55(11): 1102 (12pp)

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Abstract: The transportation sector's reliance on petroleum fuels exacerbates environmental issues, emphasizing the need for sustainable development. Online electric vehicle (EV) car-hailing services present a key opportunity for EV adoption. This study develops a model based on heuristic and systematic information processing, examining the impacts of factors such as perceived risk, information need, and experience and knowledge on users' utilization of online electric vehicle car-hailing services. The results indicate that users' experience and knowledge increase their information need and promote both heuristic and systematic processing, leading to positive attitude change, although they don't significantly affect perceived risk. Perceived risk increases information need and supports supports systematic processing but negatively impacts attitude change. Greater information enhances systematic processing and attitude change. Perceived risk and information need do not affect attitude change via heuristic processing. Finally, the paper concludes with implications and directions for future research.

Keywords: online electric vehicle car-hailing service; car-hailing crisis; perceived risk; attitude change; heuristic and systematic information processing

CLC number: F270.7; F273.7; F063.2 **Document code:** A

1 Introduction

Over the past decade, air pollution, greenhouse gas (GHG) emissions, energy crises, and climate change have become major global challenges. These pressing environmental issues necessitate the exploration of new pathways for sustainable development. The transportation sector is one of the primary sources of carbon emissions, posing significant threats to human health and exacerbating environmental pollution. Furthermore, the sector's heavy reliance on petroleum fuels has led to an unsustainable energy consumption pattern, worsening the global energy crisis. In response to climate change, the decarbonization of transportation has emerged as a critical global objective. It is estimated that the transportation sector accounts for nearly one-fifth of global energy consumption①. More concerning is the increasing pressure for emission reduction as private car usage continues to rise. In particular, in daily commuting, private vehicles, which are predominantly powered by conventional fossil fuels, significantly contribute to environmental degradation and carbon emissions. Therefore, reducing private car usage and promoting emerging transportation models have become essential strategies to achieve emission reduction targets in the transportation sector.

Due to increasing concerns about environmental issues and the growing consumer demand for eco-friendly products and services, firms have started offering various green products and services, among which electric vehicles (EVs) have gained significant attention as potential solutions. By utilizing renewable energy sources for power generation, EVs can significantly reduce the negative environmental impacts of the transportation sector. Despite the advantages of EVs, such as advanced technology, environmental benefits, lower operating costs, and government subsidies, their adoption rate in the global new car market remains relatively low. For instance, in October 2024, sales of new energy vehicles accounted for 46.8% of total monthly automobile sales, while the cumulative proportion from January to October was 39.6%②. This indicates that despite the global growth of new energy vehicles, they have not yet reached mainstream status. Therefore, increasing the usage of EVs could be a decisive factor in achieving global carbon demand emission reduction targets. The introduction of online electric vehicle car-hailing services presents a significant opportunity to promote the widespread adoption and usage of EVs, contributing to the

① www.theecoexperts.co.uk/news/top-7-most-polluting-industries.
② www.yoojia.com/article/9372029955829984416.html.

CSTR: 32290.14.JUSTC-2024-0146
DOI: 10.52396/JUSTC-2024-0146
JUSTC, **2025**, 55(11): 1102

achievement of this goal.

In reality, in the context of the integrated development of the carbon and electric markets, understanding user behavior in online ride-hailing services is of paramount importance. As green and low-carbon policies gain traction, electric ride-hailing vehicles are increasingly becoming a dominant mode of transportation. User behavior not only directly influences carbon emissions but also plays a pivotal role in the widespread adoption and progression of electric ride-hailing services. A comprehensive analysis of user preferences, decision-making processes, and behavioral patterns can offer valuable insights for policymakers, thereby facilitating the promotion of sustainable mobility. Additionally, examining users' sensitivity to factors such as carbon emissions and environmental consciousness when selecting ride-hailing options can contribute to optimizing the synergy between the carbon and electric markets, fostering a mutually beneficial outcome for both green transportation and energy transition goals.

Currently, the rapid growth of online electric vehicle car-hailing services in China has resulted in significant changes in the transportation landscape. In addition, with the increasing development of car-sharing and Internet technologies, online electric vehicle car-hailing services have gained great popularity worldwide. To hire a car, a passenger sends a request specifying his/her desired pickup address and destination to an online car-hailing app, which then supplies the order to some drivers near the pickup location. Compared with traditional transportation, online electric vehicle car-hailing services provide a convenient and flexible method of transportation for individual users[1]. Furthermore, by incentivizing private vehicle owners to supply electric vehicle car-hailing services, service providers help improve the utilization rate of electric vehicles, which further leads to decreases in traffic, fuel consumption, and carbon dioxide emissions[2]. According to statistics, there were approximately 511 million online electric vehicle car-hailing service users in China in 2025①. As shown in Fig. 1, according to the *China Ride-Hailing Industry Market Survey and Investment Prospects Research Report*②, the market size of the ride-hailing sector in China was estimated to be approximately 360.6 billion CNY in 2023, with projections indicating expansion to 386.4 billion CNY by the end of 2024. *DiDi's Green Development and Climate Resilience—DiDi Climate Action Report 2025*③ further reveals that by the end of 2024, around 68% of ride-hailing service mileage in China was powered by electric vehicles. China's large population and support from the Central Government provide great potential for the development of online electric vehicle car-hailing services[3].

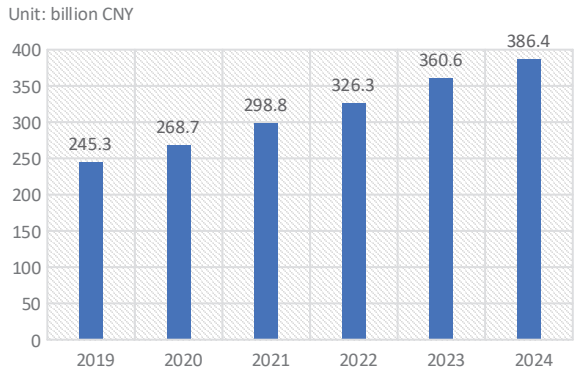

Fig. 1. The marketing volume of online car-hailing services in China. Source: Compiled by the China Business Industry Research Institute.

However, the online car-hailing crisis has provoked drastic public concern about the risks of online electric vehicle car-hailing in China. On May 5, 2018, an airline stewardess was raped and subsequently murdered when using an online electric vehicle car-hailing service supplied by DiDi hitch ride. Three months later, on August 24, 2018, another girl was raped and killed by an online electric vehicle car-hailing driver from DiDi in Wenzhou. On August 25, 2018, the Zhejiang Road Transportation Authority arranged an urgent talk with DiDi, and DiDi was asked to suspend the hitch ride service in Zhejiang due to significant potential safety hazards. Safety lapses occurring one after another led to great pressure being put on DiDi, urging the supplier to take practical measures to release the growing public anger. Two days later, DiDi officially announced the suspension of its hitch ride service until passenger safety could be guaranteed.

In previous studies, such incidents have been referred to as matters of "perceived personal safety", wherein the perceived sense of being unsafe or being victimized was to be the concern of the consumers while using such services[4]. As a consequence of these crises, personal security concerns have the potential to discourage individuals from using such services. In addition, with the development of personal safety awareness, individuals consider potential personal safety to be a very important factor when deciding to use an online electric vehicle car-hailing service. In general, when such an online electric vehicle car-hailing crisis occurs, extensive news coverage could lead individuals to overestimate the potential risk. Perceived risk might stimulate an individual's response to a crisis. On the one hand, the availability of extensive risk information, especially from reliable sources such as experts or authorities, could fortify individuals' perceived risk and affect consumers' attitudes. On the other hand, information insufficiency can spur individuals to desire more statistics and scientific information for further systematic analysis, thereby influencing individuals' attitudes.

Many previous studies have employed the heuristic–systematic model (HSM) to describe these information processing models[5–7]. According to the HSM model, people process information via heuristic and/or systematic strategies[8]. Some researchers have previously applied the HSM to investigate people's reactions to risk-related information[9–11]. However, few articles have focused on the HSM for the persuasion of individuals' attitudes toward online electric vehicle car-hailing services in China. Thus, this paper investigates people's response to a crisis via the HSM model. Furthermore, many scholars have discussed the risk information process combined with some supplementary motivations to better explain the path[12,13]. As a result, by integrating the

① https://baijiahao.baidu.com/s?id=1846126089543220116&wfr=spider&for=pc.

② https://www.askci.com/news/chanye/20240727/14211427220612746-4737533.shtml.

③ https://img-ys011.didistatic.com/static/didiglobal_gift/2025greenreport.pdf.

CSTR: 32290.14.JUSTC-2024-0146
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JUSTC, **2025**, 55(11): 1102

additional roles of perceived risk, information need, and experience and knowledge, this study examines how risk information affects people's attitudes toward online electric vehicle car-hailing services via the HSM model.

The purpose of this study is to systematically investigate individuals' crisis responses to safety issues related to online electric vehicle car-hailing from the perspective of existing information. Our research focuses on how information processing strategies affect individuals' reactions. To address these issues, a hypothetical model based on the HSM combined with perception risk, information need, and experience and knowledge is constructed. Some theoretical implications of this research are worth discussing. First, this research extends the application range of the HSM to the crisis of car-sharing. The results confirmed that the HSM model was genuinely effective in predicting people's attitude change during a car-sharing crisis. Second, this research integrated three motivated factors, perceived risk, experience and knowledge, and information need, into the HSM model and constructed new hypothetical models that improve the explanatory power of the HSM model. Furthermore, this study confirmed that both heuristic and systematic processing can work concurrently to affect people's attitude change, enriching the current research on information processing strategies based on the HSM. In addition, we confirmed that perceived risk is associated with information need, which subsequently influences people's reactions through systematic processing. Thus, our study also extends the research range of the RISP. In general, this study enriches current crisis management research on car-sharing and extends new views into people's reactions to a car-sharing crisis.

Moreover, our findings will broaden the application range of multi-motive HSM by providing insights into risk information, facilitating a better understanding of individuals' psychological decision-making processes during a transportation safety crisis. The results can help policymakers and managers shape individuals' responses through crisis communication.

The remainder of this paper is organized as follows. In Section 2, we introduce the theoretical framework and propose a conceptual model of the perceived risk of online crises and attitude change toward online electric vehicle car-hailing services on the basis of information processes. Next, Section 3 presents the research methodology. In Section 4, we report the main research results and key findings. Finally, we provide a detailed discussion of the implications and limitations of this study, as well as directions for future research.

2 Theoretical framework and research hypotheses

The HSM was proposed by Shelly in 1980 and attempts to explain how people receive and process persuasive information[5]. It is a widely recognized communication model that investigates information processing as an antecedent factor to attitude change. The model assumes that people's attitudes are formed and changed as more information is gained and processed[10]. In the model, individuals can process messages in two ways: heuristically or systematically. Heuristic processing occurs when individuals make judgments on the basis of simple decision rules; however systematic processing occurs when individuals make decisions by carefully investigating arguments and comparing them to existing information[5]. The choice of a dual information processing model depends on people's motivations and abilities[12]. When the dominant factor is economic concern, people will likely employ a more heuristic strategy to formulate judgments; when the dominant factor is reliability concern, people will probably adopt more systematic processing to modify judgments[5]. Both heuristic and systematic processes can occur concurrently, and they can also take place independently of each other[14].

Some scholars have previously applied the HSM to explore how people respond to risk information. For instance, Kim and Paek[12] assessed the value of HSM to interpret people's attitude change toward risk-related information about genetically modified food. Xie et al.[9] used the HSM to predict people's processing strategies on health risk information. Ryu and Kim[15] investigated how individuals' judgment was influenced by accidents caused by the Fukushima nuclear disaster using the HSM. As such, the HSM is well suited for application in risk communication research, as it can effectively link factors such as where individuals obtain risk information, how they deal with it, and how the way individuals process information affects their subsequent attitude change. Thus, our study applies the HSM in the online electric vehicle car-hailing crisis situation and focuses on individuals' attitudes toward safety crises, especially owing to risk information about personal safety hazards.

However, the HSM does not discuss motivations and abilities in detail, which may influence information processing[12]. According to Zeng et al.[16], perceived risk is a significant predictor of how people's information processing is affected; it also has an important effect on information need and attitude change (protective response)[13]. Moreover, some scholars have mentioned that knowledge and experience play a significant role in processing information and making judgments in the field of consumer research about risk information[13,17]. In addition, during the online electric vehicle car-hailing crisis, people may need more information about potential personal safety hazards and the progress of the crisis to help evaluate the risk. Therefore, in this research, we integrate perceived risk, experience and knowledge, and information need into the HSM. In the following subsections, we elaborate each part of the model in detail.

2.1 Perceived risk

Perceived risk has been a focus of interest for researchers for decades, and it has received substantial attention in understanding and explaining information processing[18,19]. According to Lindell and Perry[13], perceived risk is a central determinant of people's behavioral reactions to risk events and an important factor affecting information search and protective behavioral response. Yang et al.[20] mentioned that people's perceived hazards may lead them to perceive the information they possess as insufficient for making judgments, which makes them search for additional information. In this research, when people perceive potential safety hazards from online electric vehicle car-hailing services, on the one hand,

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JUSTC, **2025**, 55(11): 1102

they can process risk information on the basis of their current knowledge or receive suggestions from authorities or experts. We regard this route as heuristic processing. On the other hand, when people perceive greater risk, they prefer to process the information in a more scientific or statistical way, indicating systematic processing. Moreover, some studies have discussed the relationships between perceived risk and attitude change in risk situations. For instance, according to Anderson et al.[21], an individual's perceived risk is regarded as a significant factor in predicting people's behavioral responses to natural hazards. Gupta et al.[17] mentioned that people are more likely to take protective actions to avoid risk when they perceive a greater risk of food crises. Therefore, in our study, we investigate whether perceived risk has a significant effect on information need and information processing (heuristic and/or systematic) and whether it has a direct negative influence on people's attitudes toward online electric vehicle car-hailing services.

2.2 Experience and knowledge

Many previous studies have applied product knowledge and/or experience in the area of consumer research[13,22,23]. In our study, we plan to use both experience and knowledge in the model because many people in China have used online electric vehicle car-hailing services. Experience and knowledge are significant factors influencing people's information processing regarding certain risks[24–26]. Some researchers have argued that people's prior knowledge could facilitate information processing and that consumers who possess greater knowledge are more likely to process information systematically[24, 25]. Li et al.[26] mentioned that people's experience may influence their judgment while processing information. Moreover, Hochstein et al.[27] proposed that prior product knowledge and product involvement can influence people's ability to seek information. People in high-risk situations often require a more accurate assessment of the threat and, subsequently, need more quality information[10]. That is, consumers' experience and knowledge are positively associated with information need in a crisis. Additionally, Klerck and Sweeney[28] confirmed the positive effects of product knowledge on decreasing people's perceived risk with respect to genetically modified foods. Gupta et al.[17] mentioned that people's direct or indirect experiences have been found to influence perceived risk across a variety of domains. Although many studies have discussed the effects of experience and knowledge in risky situations, to our knowledge, no research has focused on these factors in online electric vehicle car-hailing services in China. Accordingly, this study aims to address this gap.

2.3 Information need

Information insufficiency or information need is a gap between the amount of risk information people have and the amount of information they desire[29]. During online electric vehicle car-hailing safety incidents, warning information is released to the general public, which could make people feel anxious or threatened. When people perceive threats, more information about crises and progress may be needed to help assess risk. They may hope that the involved companies can supply and update risk-related information through public channels. According to Hovick et al.[29], information insufficiency could lead people to use a systematic strategy for information processing. Hoffmann and Plotkina[30] proposed that, in a risk situation, people's perceived need for additional information can motivate effortful information processing, but information insufficiency or information need is negatively related to heuristic information processing. Moreover, Yang et al.[20] argued that people's psychological need for information sufficiency could motivate the processing of risk-related information to explain patients' motivation for clinical trial enrollment. Additionally, according to Cao et al.[31], the larger the gap between what people think they know and what they think they should know, the less likely they are to process related information heuristically. Thus, in our research, we examine how information needs positively impact systematic processing but negatively impact heuristic processing in the context of online electric vehicle car-hailing services.

2.4 Heuristic and systematic processing

The HSM regards information processing as an antecedent to attitude change and considers that individuals process information through heuristic and/or systematic models[9,31]. A heuristic strategy has an economic advantage since it requires minimal cognitive effort. Heuristic information processors prefer to accept the experts' view or information endorsed by others without completely processing the semantic content of the information[5]. Compared with systematic strategies, heuristic processors judge the validity of messages on the basis of accessible context cues, which are more persuasive to them[5]. In a systematic strategy, individuals pay more attention to the content of information. That is, information characteristics may exert greater influence on persuasion than the characteristics of the source; individuals exert considerable cognitive effort in processing messages[15]. Systematic assessors attempt to understand and appraise the arguments of the information and analyze the relationship between validity and conclusion[15]. The elaboration likelihood model (ELM) assumes two different routes of information processing: central and peripheral[32]. In contrast, the HSM explains how individuals process information in both heuristic and systematic modes concurrently[12]. According to Kim and Paek[12], this simultaneous processing assumes that heuristic and systematic models can coexist and exert independent and dependent influences on attitude change. Although some studies have confirmed that people's judgments are influenced by information processing based on the HSM during crises[12,15], few studies have applied both heuristic and systematic processing to explain people's attitudes toward online electric vehicle car-hailing services in China. Therefore, this study aims to extend existing research by including both heuristic and systematic processes to better understand people's reactions to the crisis.

On the basis of the above discussion, our hypotheses are constructed as shown in Fig. 2, which indicates a more comprehensive information flow. In the model, we account for people's initial perceived risk derived from a combination of risk information and preexisting experience and knowledge, creating the need for more information to perform a better

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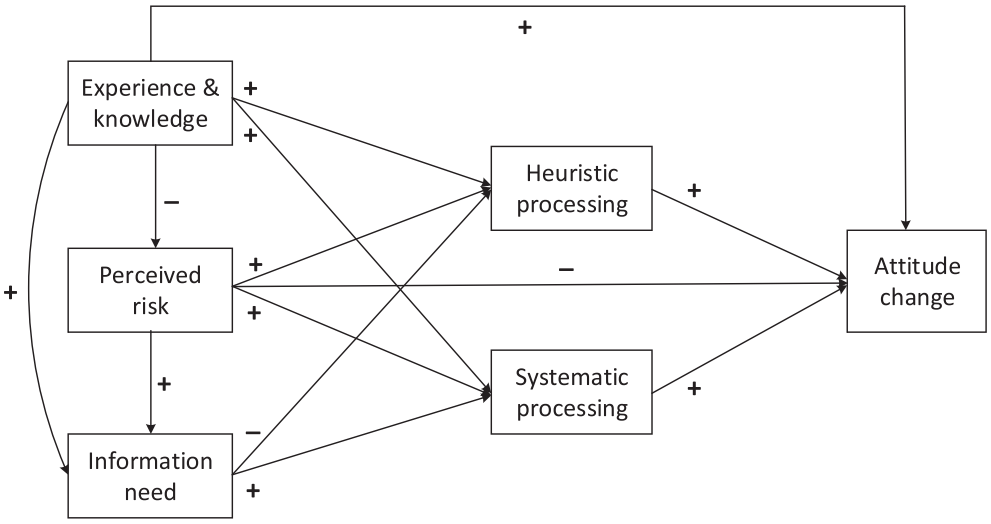

Fig. 2. Hypothesized model of people's responses to the online electric vehicle car-hailing crisis.

assessment. After that, two information processes (heuristic and systematic) are stimulated, and they subsequently affect the attitude change toward online electric vehicle car-hailing services.

3 Research method

3.1 Sample and data collection

The data for our research were collected through questionnaires completed during social network surveys with the main users of online electric vehicle car-hailing services in China. We started the survey by developing a custom-made web-based questionnaire. The questionnaire consisted of four parts, beginning with a brief introduction to thank respondents for their participation. The second part introduced the actual crisis, and in this scenario, we presented two typical severe online electric vehicle car-hailing crises that have occurred recently and attracted great attention from governments and ordinary consumers. After refreshing people's memories of the crisis, some investigative items regarding the scales of the constructs of this study were designed in the third part. Finally, the fourth part concerned individual information such as gender, age, education level, personal income, job occupation, and number of family members.

Prior scholars have used online social networks for marketing research or data collection, especially in the field of Internet-based technology or business models[33,34]. For instance, Persia and Dauria[35] mentioned that online social networks are powerful instruments not only for communicating with friends and family members but also for connecting professional groups and are good platforms for marketing research purposes. Kaplan et al.[34] noted that mobile social networks are popular as a timely, cost-effective way to search for information and collect questionnaires. Lee et al.[33] argued that social media may provide managers with the most personal, authentic, and straightforward access to consumers. In addition, mobile social networks provide the possibility of collecting data from many different cities via convenient and economical methods. Thus, in our study, we planned to use online social networks, especially mobile Internet social platforms, to distribute and collect the questionnaires.

The data collection process was as follows. First, the targeted group of our survey was identified. Our research focused on white-collar employees and university students. Second, we discussed with the managers and student organizations to obtain support for collecting the questionnaire. To better obtain their assistance, we agreed to share the survey data with them and promised that our questionnaires were only for academic research and publication. Third, a web-based questionnaire was sent to the managers and leaders of the student organizations, who distributed the questionnaire to the participants. To ensure the quality of the survey and enhance participant engagement, we provided the participants with a random-value electronic red envelope as an incentive. Upon completing and submitting the questionnaire, the participants received a red envelope valued between 5 and 50 CNY. This approach was designed to motivate greater participation and encourage respondents to complete the survey accurately and thoughtfully, thereby improving the validity and reliability of the collected data.

The data were collected from March 10 to 30, 2019. Finally, a total of 554 valid questionnaires were collected. Table 1 shows the demographic data of the participants. The sample consisted of 257 (46.4%) females and 297 (53.6%) males. Among these respondents, 96.9% ranged from 18–50 years, while the remaining 3.1% were either under 18 or over 50. Most of the participants had a bachelor's degree or above. Approximately 37% of them had a personal yearly income over 120000 CNY (17404 USD). Most of them were working in state-owned enterprises or institutions, and the second largest source was private enterprises and students. A previously tested survey was conducted before formal questionnaire distribution. The participants who were present at the pretest were asked to complete the pretest questionnaire and clarify concepts and possible ambiguities during the survey. After the pretest, we modified and finalized the questionnaire. Although initially developed in English, the questionnaire was translated into Mandarin Chinese prior to distribution. All measurement data in this study were obtained from the finalized questionnaire.

CSTR: 32290.14.JUSTC-2024-0146
DOI: 10.52396/JUSTC-2024-0146
JUSTC, **2025**, 55(11): 1102

Table 1. Demographic profile of the respondents (n = 554).

Demographics	Frequency	Percentage
Gender		
0. Female	257	46.4%
1. Male	297	53.6%
Age		
1. Under 18	4	0.7%
2. 18–30	295	53.2%
3. 31–50	242	43.7%
4. Over 50	13	2.4%
Education level		
1. Below associate degree	24	4.3%
2. Associate degree	32	5.8%
3. Bachelor's degree	218	39.4%
4. Master's degree or Ph.D. degree	280	50.5%
Personal income (net yearly)		
1. Less than 50000 CNY (7252 USD)	166	30%
2. 50001–80000 CNY (7252–11603 USD)	74	13.3%
3. 80001–120000 CNY (11603–17404 USD)	109	19.7%
4. More than 120000 CNY (17404 USD)	205	37%
Job occupation		
1. Government departments	36	6.5%
2. State-owned enterprises or institutions	179	32.3%
3. Private enterprises	129	23.3%
4. Foreign companies	27	4.9%
5. Students	129	23.3%
6. Others	54	9.7%
Number of family members		
1. 1–2	73	13.2%
2. 3–4	364	65.7%
3. More than 5	117	21.1%
Total	554	100%

3.2 Construction of measurements

In the following sections, we describe the measurements that are applied in our research. All of the multiple items in the variables were designed using a seven-point Likert scale from 1 to 7, where 1 denotes strong disagreement and 7 denotes strong agreement. Perceived risk is a crucial construct for investigating how people comprehend risk[36]. In this study, perceived risk refers to the potential personal safety risks that users may face when using electric car-hailing services. In our survey, people were asked to indicate the likelihood and seriousness of personal risk from using a car-hailing service. The ideas of Wei et al.[37] were used to measure this construct. The evaluation includes four statements: (PR1) I worry about the danger when using an online electric vehicle car-hailing service; (PR2) I worry that I may face a life-threatening situation when using an online electric vehicle car-hailing service; (PR3) I feel concerned when thinking of these crimes related to online electric vehicle car-hailing services; (PR4) I worry about the loss of property when using an online electric vehicle car-hailing service.

Experience and knowledge measure product familiarity and prior product usage, as well as people's perceptions of their knowledge about the general products or services and actual knowledge stored in their memories[26,28]. Based on the opinions of Li et al.[26], the items used for measuring this construct were as follows: (EK1) I know online electric vehicle car-hailing services; (EK2) I have used online electric vehicle car-hailing services before; (EK3) I read online electric vehicle car-hailing service-related websites or other sources; and (EK4) I spend more time on online electric vehicle car-hailing services than others around me.

Information need refers to the amount of knowledge and information people require regarding risk on the basis of their current knowledge[29]. The respondents were asked to indicate whether the information concerning the risks of online electric vehicle car-hailing services was sufficient and whether they needed more information from suppliers to help them make judgments about the crisis. The ideas of Wei et al.[37] were adopted for evaluating this construct, which consists of three items: (IN1) I need more information about the crisis of online electric vehicle car-hailing services; (IN2) I require much information to judge the risks of online electric vehicle car-hailing services; (IN3) I need more information provided by the suppliers of online electric vehicle car-hailing services.

Previous studies mentioned that the measurement of heuristic and systematic processing is a difficult task[8]. In the heuristic strategy, people are more likely to make fast, effortless judgments on the basis of their current existing knowledge and information or opinions from experts or authorities. In our study, three items based on the perspectives of Refs. [8, 12] were employed to describe heuristic processing: (HP1) Past experiences have made it easier for me to decide how I feel about the risk of car-sharing; (HP2) regarding the car-sharing risk, I am willing to place my trust in the experts; (HP3) in the context of my existing knowledge, I can decide how concerned I am about the risk of car-sharing.

In systematic information processing, people make judgments through careful and systematic investigations, comparisons, and arguments. Based on the opinions of Refs. [12, 19], participants were asked to indicate their level of agreement through the following three aspects: (SP1) To be completely informed about the safety of car-sharing, I feel that the more viewpoints I read, the better off I will be; (SP2) I have made a strong effort to carefully examine the scientific information presented regarding car-sharing; (SP3) I think about the importance of the information.

To describe people's attitude change toward online electric vehicle car-hailing services, four items based on the suggestions of Refs. [12, 38, 39] were employed: (BI1) My overall opinion toward car-sharing is positive; (BI2) I recommend car-sharing to someone who seeks advice; (BI3) I encourage friends and others to use car-sharing; (BI4) I will boycott this car-sharing.

4 Data analysis and results

In this study, we evaluate our proposed model through structural equation modeling (SEM) using the software package

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AMOS 21. The SEM technique, as one of the most popular multivariate analysis tools, has often been used by previous studies in risk and transportation areas[36,40]. In accordance with the recommendation of Anderson and Gerbing[41], two steps were performed in the analysis. First, a confirmatory factor analysis (CFA) was applied to judge whether the survey data fit the intended items well. In this process, the measurement model was built, and both convergent and discriminant validity were evaluated. Second, if the measurement model fits the data well, the path coefficient and significance between the constructs would be computed to test the hypothesized relationships of the proposed model.

4.1 Measurement model analysis

The construct reliability and validity of the multi-item measurement scales were evaluated via CFA in AMOS 21. Initially, the estimated reflective loadings were examined, and in Table 2, one item of heuristic processing was deleted because the factor loading was smaller than 0.7[42]. Following the assessment of loadings, reliability and validity were evaluated. The construct reliability was applied to measure the internal consistency of each construct's indicator. In our paper, the statistics of composite reliability and average variance extracted (AVE) were used to evaluate the reliability of the constructs. As Table 2 shows, our composite reliability ranges from 0.85 to 0.978, which are higher than the threshold value of 0.8, and all the AVE scores range from 0.656 to 0.93 and are above the benchmark value of 0.50[43,44]. Moreover, to further prove the credibility, an exploratory factor analysis (EFA) was used to examine the construct reliability, and all the Cronbach's alpha coefficients ranged from 0.727 to 0.967, which are greater than the threshold of 0.7[45]. Thus, the construct reliability was quite good in our research.

Furthermore, we assessed the discriminant and convergent validity of the survey data. Discriminant validity examines whether constructs are not expected to be related and are actually unrelated. It indicates the degree to which the measurement is different from another measurement[46]. The square root of the AVE was applied to compute the discriminant validity, and the value should be higher than the correlation coefficient of each construct in the framework. For example, as shown in Table 3, the square roots of the AVEs of perceived risk and information need are 0.915 and 0.964, respectively, which are higher than the correlation coefficient, 0.429, between these two constructs. Thus, the discriminant validity between these two constructs was obvious. Moreover, according to Table 3, we can conclude that all the results support discriminant validity well because the square roots of the AVE values are greater than all the correlation coefficients between each pair of constructs. Next, the convergent validity was tested. Convergent validity is the extent to which two or more measurements of constructs that should be relevant and actually relevant[46]. If the values of the AVE are greater than 0.5, all the factor loadings are greater than 0.5, and all the composite reliabilities are greater than 0.6, then the measurement model has adequate convergent validity[47]. As shown in Table 2, all the values exceed the above threshold, and consequently, the convergent validity in this research fits well. Therefore, the empirical results indicate that the composite reliabilities, discriminant validity, and convergent validity in our paper were all acceptable, and that the measurement

Table 2. Confirmatory factor analysis results for the measurement model.

Constructs	Items	Loading	Cronbach's alpha value	Composite reliability	AVE
Experience and knowledge (EK)	EK1	0.913	0.881	0.923	0.75
	EK2	0.899			
	EK3	0.894			
	EK4	0.749			
Perceived risk (PR)	PR1	0.933	0.935	0.954	0.838
	PR2	0.945			
	PR3	0.856			
	PR4	0.925			
Information need (IN)	IN1	0.968	0.962	0.975	0.930
	IN2	0.970			
	IN3	0.955			
Heuristic processing (HP)	HP1	0.885	0.727	0.85	0.656
	HP2(delete)	0.674			
	HP3	0.855			
Systematic processing (SP)	SP1	0.965	0.967	0.978	0.938
	SP2	0.979			
	SP3	0.961			
Attitude change (AC)	AC1	0.936	0.928	0.954	0.874
	AC2	0.935			
	AC3	0.933			

Table 3. Means, standard deviation, and correlations.

Construct	M	SD	PR	IN	SP	EK	HP	BI
PR	4.853	1.468	**0.915**					
IN	5.365	1.449	0.429**	**0.964**				
SP	5.443	1.205	0.391**	0.495**	**0.969**			
EK	5.272	1.472	0.036	0.143**	0.284**	**0.866**		
HP	4.712	1.256	0.170**	0.196**	0.364**	0.424**	**0.810**	
BI	5.082	1.359	−0.028	0.117**	0.336**	0.496**	0.468**	**0.935**

1) Means are measured based on average factor scores; SD indicates standard deviation. 2) The diagonal (bold) elements are the square roots of the AVEs, and the off-diagonal elements are the correlations among the constructs. 3) $^{**}p < 0.01$.

CSTR: 32290.14.JUSTC-2024-0146
DOI: 10.52396/JUSTC-2024-0146
JUSTC, **2025**, 55(11): 1102

model fit the survey data well.

4.2 Structural model and hypothesis testing

In our research, the hypothesis model was evaluated through SEM, which can simultaneously test the paths between latent factors. The results of the structural model are summarized in Fig. 3, and all the relationships among the variables in the model were calculated. According to the results, the general performance of the model effectively supported the theoretical framework, as all but three paths reached statistical significance at the 0.001 level. Table 4 and Fig. 3 show that people with more experience and knowledge normally have a greater level of information need ($\beta = 0.135$, $p < 0.001$) and present a higher level of heuristic processing ($\beta = 0.433$, $p < 0.001$) and systematic processing ($\beta = 0.205$, $p < 0.001$). A greater level of experience and knowledge is also positively related to the behavioral intentions of online electric vehicle car-hailing services ($\beta = 0.267$, $p < 0.001$).

Moreover, the results indicate that a perceived greater level of risk leads to a greater level of information need ($\beta = 0.433$, $p < 0.001$); moreover, it increases the level of people's systematic processing ($\beta = 0.166$, $p < 0.001$). A higher level of perceived risk is negatively related to the behavioral intentions of online electric vehicle car-hailing services ($\beta = -0.169$, $p < 0.001$). In addition, as shown in Table 4, information need is another significant factor affecting information processing and is positively related to systematic processing ($\beta = 0.322$, $p < 0.001$). In the results, three paths are not significant for the framework. Experience and knowledge fail to predict perceived risk ($\beta = 0.017$, $p = 0.713$). Perceived risk ($\beta = 0.102$, $p = 0.020$) and information need ($\beta = 0.054$, $p = 0.241$) fail to predict heuristic processing.

To predict individuals' attitude change to online electric vehicle car-hailing services, the model reveals that experience and knowledge ($\beta = 0.267$, $p < 0.001$), heuristic processing ($\beta = 0.337$, $p < 0.001$) and systematic processing ($\beta =$

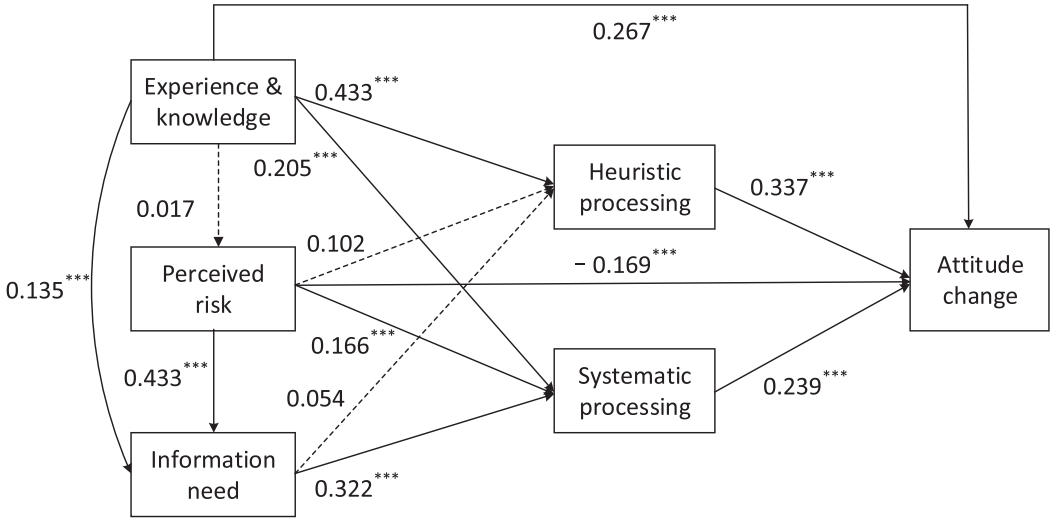

Fig. 3. Structural model test and hypotheses test results. ***$p < 0.001$.

Table 4. Path coefficients of the structural model.

Path	Path coefficient	SE	CR	p	Results
Experience and knowledge → Perceived risk	0.017	0.046	0.368	0.713	Not supported
Experience and knowledge → Information need	0.135	0.039	3.443	***	Supported
Experience and knowledge → Heuristic processing	0.433	0.043	10.167	***	Supported
Experience and knowledge → Systematic processing	0.205	0.032	6.501	***	Supported
Experience and knowledge → Attitude change	0.267	0.043	6.283	***	Supported
Perceived risk → Information need	0.433	0.039	11.221	***	Supported
Perceived risk → Heuristic processing	0.102	0.044	2.328	0.200	Not supported
Perceived risk → Systematic processing	0.166	0.034	4.891	***	Supported
Perceived risk → Attitude change	−0.169	0.036	−4.672	***	Supported
Information need → Heuristic processing	0.054	0.046	1.173	0.241	Not supported
Information need → Systematic processing	0.322	0.036	8.973	***	Supported
Heuristic processing → Attitude change	0.337	0.049	6.900	***	Supported
Systematic processing → Attitude change	0.239	0.046	5.241	***	Supported

***$p < 0.001$.

CSTR: 32290.14.JUSTC-2024-0146
DOI: 10.52396/JUSTC-2024-0146
JUSTC, **2025**, 55(11): 1102

0.239, $p < 0.001$) are positively related to the attitude change, whereas perceived risk is negatively related to the attitude change ($\beta = -0.169$, $p < 0.001$). Based on the results, we can conclude that ten of the hypotheses in our research were supported, whereas three of them were not.

In addition, the insignificant impact of perceived risk on users' heuristic information processing may be attributed to the fact that users often make quick decisions on past experiences or external cues, such as driver ratings, rather than spending time thoroughly analyzing the risks. This behavior is particularly common in situations involving incomplete information or time pressure, which leads to a diminished influence of perceived risk on heuristic decision-making. Moreover, the lack of a significant impact of users' information needs on heuristic information processing may be explained by the fact that users typically access readily available information on ride-hailing platforms, such as driver ratings and fare estimates, which are generally sufficient for their decision-making requirements. Given the direct accessibility of such information, users are inclined to rely on simplified heuristic decision-making rather than engaging in an extensive information search. As a result, the influence of information needs on heuristic processing is attenuated. Moreover, frequent users of ride-hailing services tend to establish relatively fixed decision-making patterns through accumulated experience. In this context, users' information needs may diminish as they rely on past experiences (e.g., selecting familiar drivers or routes) to make decisions without the need for elaborate analysis for each trip. This pattern leads users to favor heuristic decision-making over more comprehensive, information-intensive approaches.

In the context of ride-hailing services, users often have immediate access to information such as driver ratings and fare estimates, which typically suffices for their decision-making needs. This direct availability of information may lead users to rely on simplified heuristic decision-making processes, reducing the necessity for in-depth information gathering. Additionally, as users become more familiar with ride-hailing services, they may develop adaptive strategies to mitigate potential risks. Consequently, their information needs may diminish, as they habitually base decisions on past experiences—such as selecting familiar drivers or routes—without engaging in complex analyses for each trip. Furthermore, users' perceived risks are influenced not only by personal experiences and knowledge but also by external social factors, such as media reports and societal perceptions. In such cases, even users with extensive experience and knowledge may perceive risks differently because of these external influences, thereby attenuating the impact of their personal experiences and knowledge on perceived risk.

5 Conclusions

On the basis of the heuristic and systematic information processing model, this paper systematically investigates individuals' responses to the crisis of online electric vehicle car-hailing services in China. To better understand how people's attitude change are influenced by the crisis, it also includes the factors of perceived risk, experience and knowledge, and information need. Such an examination would provide further insights into the motivations and abilities of information processing in a risk situation, which is important for interpreting people's attitude change to the risk information. A custom-made web-based questionnaire was developed to collect data, and then an SEM was used to analyze the data and build the proposed model. The findings demonstrated that people's reactions are positively affected by experience and knowledge and heuristic and systematic processing directly but negatively influenced by perceived risk. Our results also revealed the relationships among motivations, abilities, and information processing. The main findings are discussed in the following sections.

Our research pioneers the examination of the influence of perceived risk on people's attitude change in online electric vehicle car-hailing services. The results confirmed that people with higher perceived risk could require more information for further evaluation. When people are faced with crises, they probably have little experience and knowledge. As a result, they experienced information insufficiency, which subsequently induced people to require more information for systematic processing. Thus, our empirical findings provide support for the model of risk of information seeking and processing[48]. Moreover, we pioneer the application of perceived risk as one of the direct antecedent factors to HSM in public service areas. In our study, we confirmed that people with greater perceived risk could process information more systematically. However, according to the results, higher perceived risk can't affect the attitude change through heuristic processing. This is not surprising because we are the first study to investigate this relationship. A possible explanation is that when people perceive a greater risk to online electric vehicle car-hailing services, some continue to believe the opinions of experts or authorities to conduct heuristic processing, whereas others disregard such sources, resulting in an unclear relationship between perceived risk and heuristic processing.

The experience and knowledge, which play key roles in predicting people's reactions to crises, also deserve special attention. Here, this variable measured people's prior experience with online electric vehicle car-hailing services and the available information about them. The results indicate that people's experience and knowledge are positively related to information need, systematic processing, and attitude change. More specifically, unlike previous studies, in our results, experience and knowledge failed to magnify perceived risk. In China, online electric vehicle car-hailing services have undergone rapid development since 2010, and many people have experienced such development. While some people have positive experiences with online electric vehicle for car-hailing services, others, especially young female users, worry about the potential danger. This may explain why more experience and knowledge do not lead to greater perceived risk in online electric vehicle car-hailing services in China.

Notably, in our study, experience and knowledge not only affect attitude change through systematic processing but also highly contribute to attitude change through heuristic processing, which has been ignored by most scholars. Clearly, if people have more experience and knowledge about online car-hailing services, they prefer to employ more economic

CSTR: 32290.14.JUSTC-2024-0146
DOI: 10.52396/JUSTC-2024-0146
JUSTC, **2025**, 55(11): 1102

processing strategies. Indeed, 80% of the participants in our survey had experience with online car-hailing services. Given the above, it is not surprising that our findings support this hypothesis, highlighting the important role of experience and knowledge in predicting people's attitude change through heuristic processing.

Information need is positively related to systematic processing; this is understandable since more information can influence people's ability to make more systematic processing. However, in our findings, the relationship between information need and heuristic processing is not clear. A possible explanation is people's different purposes for information needs: Some people might need more information to support their trust in experts or authorities, whereas others do so to support their distrust of such sources, resulting in a non-significant effect of information need on heuristic processing.

For the heuristic and systematic processing model, the results confirmed the positive relationship between these two types of information processing and positive attitude change. Specifically, for the relationship between heuristic processing and positive attitude change, only Kim and Paek[12] have previously demonstrated that people's attitude change is significantly affected by heuristic processing in the impression-motive group, in which participants were presented with the statement that most other people favor the use of genetically modified food. The present study extends this line of research to the context of online electric vehicle car-hailing services and confirmed that heuristic processing has the greatest positive impact on attitude change in this setting.

From a managerial perspective, our findings also make several contributions. Online electric vehicle car-hailing services, as a form of the sharing economy that encourages the effective use of idle personal resources, have developed very well in China. If, for some reason, online electric vehicle car-hailing services were designed to experience a negative crisis that may affect their development, quickly recovering from the negative event and maintaining high usage is one of the most important concerns for both suppliers and policymakers. The results of our study confirmed that heuristic processing has the greatest positive effect on attitude change. That is, people's attitude change is mostly based on what they perceive from the opinions of experts and authorities or what they already know. Therefore, suppliers should do more to improve people's knowledge via various channels. Moreover, the government, as the authority, should also invest more resources to improve people's positive attitudes. For instance, the government could release more authoritative information about risk, take part in risk management in online electric vehicle car-hailing services, and announce to the public that all services are under supervision. This would increase some people's confidence in online electric vehicle car-hailing services. Furthermore, suppliers and the government should release more risk-related information about car-hailing services and relevant crises, especially from official channels and in a timely manner. This information could spur more systematic processing, which would ultimately positively influence people's attitudes. Therefore, on the basis of our findings, these insights can provide references for suppliers and policymakers to enhance positive public attitudes after a crisis.

While this study presents important findings, it has several limitations. First, this study only investigated online electric vehicle car-hailing services; therefore, future studies may extend to assess people's attitude change toward other forms of car-sharing and compare the findings. Second, this study did not analyze the differences between males and females. Gustafsod[49] argued that there is a gender difference in the perception of risk. Thus, some priority should be given to gender differences in future studies. Moreover, our study highlighted only the effects of perceived risk, experience and knowledge, and information need in the HSM model. Additional factors, such as information seeking, perceived information-gathering capability, and channel beliefs, should be incorporated in future studies.

Acknowledgements

This work was supported by the National Natural Science Foundation of China (72374061), the Ministry of Education Humanities and Social Science Research Youth Project (22YJC630056), the Anhui Provincial Natural Science Foundation (2208085UD02), the Scientific Research Fund of the Hunan Provincial Education Department (23C0677), and the Changsha Municipal Planning Project of Philosophy and Social Sciences (2025CSSKKT25).

Conflict of interest

The authors declare that they have no conflict of interest.

Biographies

Yuan Zhang is an Engineer at the Xuancheng Power Supply Company, State Grid Anhui Electric Power Co., Ltd. She received her engineering degree in Electrical Engineering from Nanjing Institute of Technology in 2007. Her research mainly focuses on carbon market and electricity market.

Linlin Fan is a Lecturer at Hunan Open University, a Ph.D. candidate at the College of Educational Science, Hunan Normal University, and a visiting scholar at Hunan Normal University. Her research mainly focuses on environmental economics, as well as green consumption behavior and psychology.

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