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THE INFLUENCE OF ENVIRONMENTAL KNOWLEDGE AND ENVIRONMENTAL MOTIVATION ON GREEN CONSUMPTION BEHAVIOR: EVIDENCE FROM URBAN MOBILITY CONSUMPTION

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Abstract

The influence of environmental knowledge and environmental motivation on green consumption behavior in urban mobility needs to be given full attention because of the challenges of carbon emission reduction worldwide, the mission for green consumption behaviors in urban mobility, and the gap between environmental knowledge and environmental motivation and green consumption behavior. This research aimed to review the influence of environmental knowledge and environmental motivation on green consumption behavior in urban mobility, and to explore their influencing factors. MOA model was used to construct the model in this research, and a quantitative research was used based on a questionnaire survey. Questionnaires were randomly distributed to urban citizens in 9 national central cities in China. A total of 624 city citizens participated in this research, and 603 recovered questionnaires were valid. An AMOS-based confirmatory factor analysis (CFA) was conducted to test the reliability and validity of the observed variables and the latent variables. This research demonstrated that environmental knowledge and environmental motivation play a positive influence on green consumption behavior in urban mobility. Following the analysis, a green consumption behavior model was successfully constructed. The model could be applied in the new energy vehicle (NEV) industry in urban mobility and offer policy recommendations to urban policy makers and green consumption industries as the theoretical basis.

Keywords: Environmental knowledge; Environmental motivation; Green consumption behavior in urban mobility; MOA model; Confirmatory factor analysis (CFA).

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Introduction

The exponential rise of energy consumption in mobility, among other socioeconomic activities since 1950s, has led to proportionately exponential man-made influence on the Earth Systems (Dillman, Czepkiewicz, Heinonen, & Davíðsdóttir, 2021). It has been declared that unsustainable patterns of energy consumption are the primary cause of environmental deterioration(Destek & Sinha, 2020). Urgent action must be taken to combat climate change and its influences worldwide. Changing the consumption patterns of unsustainable non-renewable energy has become the common goal of all humanity (Martins, Felgueiras, & Smitková, 2018). Along with the World Climate Conference in Copenhagen, and Paris Agreement, countries around the world reached a basic consensus on climate change. Countries and different industrial sectors around the world continue to promote low-carbon and net-zero transition in order to cut carbon emissions produced by human activities. Low-carbon, net-zero transition and climate change mitigation are being carried out on both the supply and demand side(Scott, Smith, Lowe, & Carreras, 2022). Currently, most researches on climate change mitigation tends to focus on supply-side technological solutions (Creutzig et al., 2018). However, supply side technologies are controversial and most of them are speculative, and some of them would require massive global-scale change in land use (Creutzig, 2016). A better understanding of demand side solutions could fill the gap. As the main solutions for demand side, systemic infrastructural and behavioral change would likely become a necessary component of a transition to a low-carbon society (Creutzig et al., 2016).

As the heart of the supply chain and the cornerstone of any country's economy, transportation is one of the largest contributors to environmental deterioration (Fan, Perry, Klemeš, & Lee, 2018). The economic development promotes industrialization and urbanization (Q. Wang & Su, 2019), and the increasing urban mobility lead to energy consumption and carbon dioxide emissions (Toledo & Rovere, 2018). According to the International Road Alliance (IRF), energy consumption on transportation is expected to increase by 21% -25% by 2050 compared to 2016. Furthermore, road traffic in cities and towns often entails additional social costs, such as congestion, pollution, noise and accidents, which will increase the necessity for the transition to sustainable consumption patterns as well as sustainable consumption behavior to cut carbon emission in transportation in cities and towns. For various sustainable consumption patterns, green consumption has emerged as an efficient and sustainable consumption pattern to mitigate the environmental impact without compromising the quality or quantity of consumption (Liobikienė & Bernatonienė, 2017). With the goal of a long-term environment sustainability, green consumption was advocated as sustainable consumption behavior with a minimum influence on the availability of materials or energy from the environment, and a minimum influence on the structure and dynamics of ecosystems or biospheres (Nair & Little, 2016). Green consumption behavior is advocated as a greener alternative to commonly available options (ElHaffar, Durif, & Dubé, 2020). Advocating green consumption behavior in urban mobility is an important and necessary solution to cut carbon emissions. Environmental knowledge is frequently considered to be the key to green consumption behavior. Many studies have demonstrated that the knowledge of environmental issues plays a positive influence on citizens' "attitudes" and actual purchases of green products (Eze & Ndubisi, 2013; Taufique, Vocino, & Polonsky, 2017). Governments have promoted environmental education to communicate information to improve the attitudes toward, views of and knowledge about the environment and to cultivate skills to empower every citizen and community to take positive environmental actions (Ardoin, Bowers, & Gaillard, 2020). However, increasing the knowledge provided to citizens does not necessarily lead to changes in purchase behavior (Pedersen & Neergaard, 2006). The efforts to increase citizens' knowledge through the provision of information has little influence on behavior (Jackson, 2005), and could make more citizens confused or overwhelmed (Moisander, 2007). The influence of environmental knowledge on green consumption behavior in urban mobility is to be reviewed.

Motivation is frequently considered to motivate green consumption behavior (Peattie, 2010). Environmental motivation is considered as a high-quality motivation that is necessary to minimize environmental issues (Osbaldiston & Sheldon, 2003). As the current estimated market share for green products is less than 4% worldwide, environmental motivation is considered to promote environmental awareness to increase demand so as to motivate green consumption (Ritter, Borchardt, Vaccaro, Pereira, & Almeida, 2015). Over the past few decades, most countries have issued a series of national and local regulations and policies to promote green consumption, which is proved to be helpful in transforming awareness into action, thereby bridging the attitude-behavior gap (Fu et al., 2020). However, some evidence suggests that motivated green consumption is not always environmentally positive. Households that managed to save water increased their energy consumption (Tiefenbeck, Staake, Roth, & Sachs, 2013). Buying local food or taking trash to a recycling center is typically considered pro-environmental behavior. However, the environmental advantages of local foods are complex in practice and manufacture factors such as manufacture methods, the type of soil, energy inputs and distance to markets matter as well (Edwards et al., 2008). The energy consumed by citizens driving to the recycling center may exceed the amount of energy and materials saved. However, some behavior without motivations are low-influence consumption behavior. Choosing a vegetarian diet for religious reasons, or for personal health or financial savings, can be good for the environment, especially to climate change (Boer, Helms, & Aiking, 2006). The influence of environmental motivation on green consumption behavior in urban mobility is to be reviewed.

Through the reviews of relevant research on green consumption by scholars from different countries, it is identified that the development of citizens' green consumption behavior is a relatively complex process driven by multi-dimensional factors, including cognitive factors, psychological factors, situational factors, demographic factors, etc. Most of the current literatures focus on the green gap caused by one or two cognitive factors, psychological factors, situational factors and demographic factors. However, under the real-world background, green consumption is an ethical process of decision making in which citizens perform socially responsible activities (Gilal et al., 2020). The green gap in citizens is caused by many factors, and the influence of each factor on the green gap should be integrated. This research explored the influencing factors are to be explored when studying the influences of environmental knowledge and environmental motivation on green consumption behavior in urban mobility.

2. Literature Review

Green Consumption Behavior in Urban Mobility

The public option of mobility behavior is influenced by a variety of complex factors, such as efficiency, economy, safety, comfort (Yang, Liu, Liu, & Bi, 2018). The expansion of urban space scale, the improvement of citizens' income and traffic policies that only increase the supply of road resources to solve the problem of road congestion will encourage citizens to choose the mobility mode based on their respective motorized transportation (mainly private cars), and cut the carbon emissions resulted from citizens' mobility (Zhang, Tao, & Yang, 2013). Brand et al. analyzed the mobility activities of 3,474 adults in the past week and found that mobility by car accounted for 90% of the carbon dioxide emissions among all mobility activities (Brand, Goodman, Rutter, Song, & Ogilvie, 2013). According to Wang and Liu's research on carbon dioxide emissions resulted from daily mobility in Beijing, the carbon dioxide emissions resulted from private cars accounted for the highest share among all mobility, and carbon emissions increased from 51% in 2000 to 82% in 2011 (Wang & Liu, 2014). If carbon emissions from transportation are to peak by 2030 and reach net-zero by 2050, the private car sector will be the key to the transformation of urban mobility.

New energy vehicle is considered as a transformation toward low carbon and net-zero transition to reduce the negative influence on urban mobility (Dlugosch, Brandt, & Neumann, 2022). Due to the significant role played by urban transportation in climate change, the electrification of road traffic is necessary, and the replacement of internal combustion vehicles with new energy vehicles like electric vehicles seems to be a promising step toward envisaging urban sustainability (Kumar & Alok, 2020). According to General Office of the State Council, pure electric vehicles will become the mainstream and public sector vehicles will be fully electrified, and fuel cell vehicles will be commercialized. New energy vehicles will be more widely used in various fields in urban mobility. In this research, new energy vehicles refer to vehicles driven entirely or mainly by new energy or using new power systems, including pure electric vehicles, fuel cell vehicles, plug-in hybrid electric vehicles, etc. (MIIT, 2017). In order to further explore the green consumption behavior in urban mobility, and improve the effectiveness of the solutions, this research only focused on green purchase behavior, the core component of green consumption behavior. This research only focused on the new energy vehicle purchase behavior of the green consumption behavior in urban mobility.

Environmental Knowledge

Environmental knowledge can be defined as citizens' awareness of environmental status, climate change and the influence of manufacturing and consumption on the environment and other related issues (Pagiaslis & Krontalis, 2014). In urban mobility, green consumption behavior is a greener and more sustainable consumption alternative to the commonly available options. Meanwhile, the profit and side profit associated with behavioral choices will influence the possible actions taken at purchase decision making. In this research, environmental knowledge was defined as the collection of information and facts that urban citizens use to guide behavioral decisions when purchasing new energy vehicles.

The environmental knowledge in green consumption behavior is mainly reflected on product knowledge. While scholars have different views on the composition of environmental knowledge, it is consisted of pro-environmental behavior, various phases of citizen behavior such as the search for information (Brucks, 1985), learning (Daugherty, Li, & Biocca, 2008), attitude development (Aertsens, Mondelaers, Verbeke, Buysse, & Van, 2011), consumption behavior (Aertsens et al., 2011), all under the influence of product knowledge (Han, 2019) and play a significant influence on citizen behavior. Many researchers have made a clear distinction between the two types of product knowledge, objective knowledge and subjective knowledge (Flynn & Goldsmith, 1999). Scholars emphasized that objective knowledge is of limited correlation to pro-environmental behavior, and subjective knowledge is more applicable to the researches on pro-environmental behavior (Han, 2019). In addition, a citizen's objective knowledge does not reflect how much actual knowledge he has, nor does it reflect whether he is aware how much knowledge he has (Han, 2019). Therefore, in this research, environmental knowledge focused on subjective product knowledge.

Various researches have focused the influence of environmental knowledge on green consumption behavior in urban mobility. Zhu Wei et al. added environmental knowledge variables into the study of factors influencing urban citizens' choices of mobility mode, and proved that environmental knowledge can influence their choices of mobility mode (Zhu, Guo, He, Ran, & Liu, 2010). Simsekoglu et al. found that the lack of knowledge about e-bikes could be a potential barrier to the use of e-bikes by Norwegian citizens (Simsekoglu & Klöckner, 2019). The research by Barth et al. (Barth, Jugert, & Fritsche, 2016) indicated that the knowledge of electric vehicles can significantly increase the acceptance of electric vehicles, and the lack of knowledge can be a barrier to their use. Therefore, this research presented the hypothesis as follows.

H1: Environmental knowledge positively influences green consumption behavior in urban mobility.

Environmental Motivation

Environmental motivation can promote citizens' environmental behavior (Esteve, Urbig, Van Witteloostuijn, & Boyne, 2016), so as to help improve ecological and environmental governance and promote harmony between the humanity and nature (Wang, He, & Zhang, 2021). Environmental motivation can be considered as the driving force for green consumption behavior. Citizens make purchase decisions under the combined influence of intrinsic motivation and extrinsic motivation (Yang & Long, 2016). Only a few previous researches paid attention to the multiple green consumption motives. Although a few literatures have analyzed the influence of intrinsic motivation and extrinsic motivation on green consumption behavior, the relevant researches are still fragmented, and their division of multiple motivations is not reasonable, having ignored the development and influence of egoistic and altruistic appeals to multiple motivations. In this research, goal-framing theory was used to analyze the multi-motivations of green consumption behavior in urban mobility. Goal-framing theory was used to integrate and systematically study the motivational factors of citizens' pro-environment behavior, so as to more accurately explain and predict the development of pro-environment behavior (Yang & Zhang, 2020). According to goal-framing theory, goal is the key factor to behavior guidance (Steg, Bolderdijk, Keizer, & Perlaviciute, 2014). Human behavior is mostly influenced by multiple goals, and each goal framework corresponds to a kind of behavioral motive (Tang, Chen, & Yuan, 2020). Lindenberg and Steg further divided sub-goals into three dimensions of gain goal framework, hedonic goal framework and normative goal framework (Tang et al., 2020). In this research, environmental motivation was divided into hedonic motive, hedonic motive and normative motive.

Green consumption is of certain positive externality, and citizens are often faced with a dilemma between their own interests and the interests of environmental protection. As a result, there are market failures in the construction of green consumption modes. The development and issuance of green consumption policies provide specific requirements and guidance for promoting green manufacture in enterprises, improving the market mechanism, improving the awareness of green consumption and encouraging citizens to consume green products, which is an effective and important way to put the concept of green consumption into practice (Zhang, Wang, & Bo, 2012). For individual citizens with rational choices, their daily behavior is a demonstration of "rational economic man". They follow the principle of profit maximization, namely, they pursue their own interests, generate resources and expect to obtain personal profit at the minimum cost or improve resource utilization. At present, the government's policies mainly include financial subsidies, tax incentives, right-of-way priority, infrastructure construction, etc., which not only reduce the cost of car purchase for citizens, but also are more economical than traditional fuel vehicles in terms of warranty policy, maintenance cost, unit price of energy consumption, insurance, vehicle and ship tax, etc.

The economic subsidy policies, purchase tax exemption and a bunch of preferential policies for the new energy vehicle industry is of a long-term positive synergistic correlation with the market share of new energy vehicles. The purchase restriction policies of motor vehicles promote the promotion of new energy vehicles (Ma & Fan, 2018), and policies such as power charge promises provide a basic guarantee for the development of the new energy vehicle industry as well. These policies directly reflect the hedonic motive of citizens. Thus, the utilitarian motive can be considered as the concern with efficiency and achieving a specific goal (O'Brien, 2010), and it's the result of a citizen's rational choice. Driven by hedonic motives, citizens tend to make rational decisions, and the purpose of behavior is to pursue behavioral profit and achieve the purpose of purchase.

Hedonic motive refers to the fun or pleasure that one feels when using a technology or product (Venkatesh, Thong, & Xu, 2012). People who think that using technology or products will make them feel happy will like it more and tend to ignore rational factors. Psychological drives, such as feelings of satisfaction, pride, emotions, and other subjective feelings, are factors that contribute to such motives (Lestari & Tiarawati, 2020). Under the hedonic goal motive, citizens focus on the pleasure experience and positive emotions or emotions obtained in the process and the result of such behavior, while the purpose of behavior is to pursue positive subjective feelings and avoid harmful feelings. The higher a citizen's hedonic motive is, the higher the positive evaluation of technology or product use is.

Green consumption is an ethical process of decision making in which citizens perform socially responsible activities (Gilal et al., 2020). Webb et al. believed that socially responsible consumption is socially oriented rather than self-centered (Webb, Mohr, & Harris, 2008). The green purchase behavior of citizens is not always driven by utilitarian motives and hedonic motives. It follows social norms and needs in priority, that is, normative motive is equally important. The normative goal framework reflects a citizen's environmental ethics and environmental responsibility perception (Tang et al., 2020). Therefore, this research presented the hypotheses as follows.

H2: Environmental motivation positively influences green consumption behavior in urban mobility.

H2a: Gain motive positively influences green consumption behavior in urban mobility.

H2b: Hedonic motive positively influences green consumption behavior in urban mobility.

H2c: Normative motive positively influences green consumption behavior in urban mobility.

Green Consumption Intention in Urban Mobility

The global economy should adopt more sustainable and environmental consumption and manufacturing systems (Cohen & Muñoz, 2016), which depends upon citizens' willingness to engage in "greener" consumption behavior (Peattie, 2010). The TPB model demonstrates that human intention is guided by the three predictors of the attitude toward behavior, the subjective norm, and the perceived behavioral control. Intentions are indications of how hard people are willing to try, or how much effort they are planning to make in order to make the behavior (Ajzen, 1991). In this research, green consumption intention referred to urban citizens' intention of purchasing new energy vehicles.

The promoting effect of environmental knowledge on green consumption intention has been widely recognized by scholars. Mi studied urban citizens' low-carbon energy consumption behavior, and the empirical results showed that systematic knowledge and action knowledge play a significantly positive influence on citizens' willingness to low-carbon behavior (Mi, 2011). Through the research on citizens' consumption attitude and purchase behavior toward new energy vehicles, it is identified that although people have a high evaluation of the overall attitude toward new energy vehicles, they have a low behavioral intention in the actual purchase of new energy vehicles due to the lack of relevant knowledge about new energy vehicle technology, the influence of road traffic on the environment and the cost and expenses of it (Lane & Potter, 2007).

At the same time, the influence of environmental motivation on green consumption intention has been widely recognized by scholars. Fan et al. explored the key of garbage sorting behavior in Shanghai and Singapore, and the results showed that both general and specific environmental motivations play a significant influence on behavioral intention (Fan, Yang, & Shen, 2019). Through the study of environmental motivation and hedonic motive on the purchase intention of green products, Choi et al. believed that motivation plays a significant influence on the purchase intention of green products (Choi & Johnson, 2019). Rezvani et al. studied the influence of citizen motivation on sustainable consumption and believed that the acquisition utilitarian motive, hedonic motive and normative motive can all positively influence the purchase intention of new energy vehicles (Rezvani, Jansson, & Bengtsson, 2018). Therefore, this research presented the hypotheses as follows.

H3: Environmental knowledge positively influences green consumption intention in urban mobility.

H4: Environmental motivation positively influences green consumption intention in urban mobility.

H4a: Gain motive positively influences green consumption intention in urban mobility.

H4b: Hedonic motive positively influences green consumption intention in urban mobility.

H4c: Normative motive positively influences green consumption intention in urban mobility.

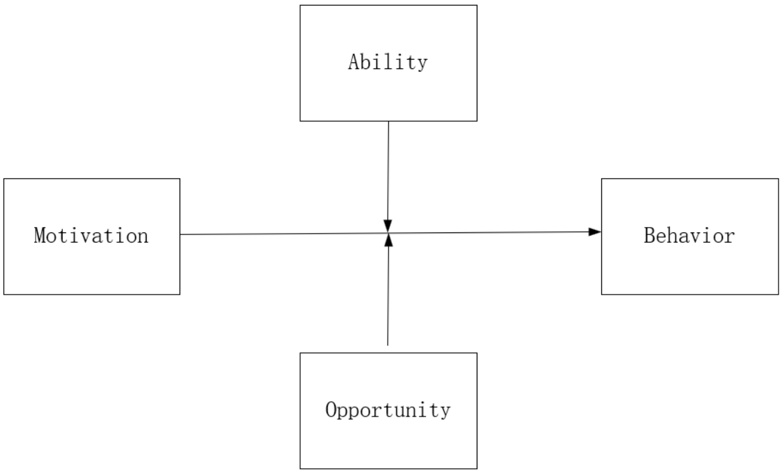
Behavioral willingness is the most direct antecedent variable of real-world behavior, and other subjective psychological factors indirectly influence actual behavior through behavioral willingness. This conclusion has been verified by many scholars. (Qu, 2011), (Mi, 2011) and (Yue, Long, & Chen, 2013) researched and studied the specific environmental behavior. They all concluded that behavioral intention plays a direct and positive influence on actual behavior. Therefore, this research presented the hypothesis as follows.

H5: Green consumption intention positively influences green consumption behavior in urban mobility.

MOA Model

The green gap is caused by cognitive factors, psychological factors, situational factors or social demographic factors, etc. A study on the combination of several factors is suggested. MOA model provides a complete analytical framework to explain the driving force of citizen'' information behavior from the three aspects of the subjective possibility of behavior occurrence, the objective possibility and the possibility of subjective cognition to objective cognition (Chen, 2013). The model has been successively applied and adapted in public governance, marketing, social capital, human resource management, knowledge management and other fields since its construction. These creative efforts have enriched the research content of MOA model. The stability of the model and its predictability of behavior are further verified as well. This research explored the factors influencing environmental knowledge and environmental motivation on green consumption behavior in urban mobility with an MOA model.

MacInnis and Jaworski believed that information is composed of the three parts of premise, processing and consequence, and the response of citizens to information communication is triggered by the three premises of individual needs or motives, and opportunities and abilities (MacInnis & Jaworski, 1989). Motivation is "goal-oriented motive". Whether and to what extent a motive can lead to the occurrence of behavior depends on the participation of ability and opportunity. According to the research on marketing, people with high competence are more likely to respond to external and intrinsic incentives than those with low competence, and the lack of access to incentives will hinder the occurrence of such behavior. Opportunity is listed as an important factor in the model, the lack of opportunity will prevent the occurrence of information receiving behavior, and emotional factors and time constraints are the main potential factors influencing information processing behavior in an opportunity. They have demonstrated theoretically and empirically that ability and opportunity act as moderators of specific behavior triggered by motivation, thus constructing a MOA framework to explain the motivation that triggers specific behavior of citizens (Figure 1).



Source: made by the author

Figure 1 MOA Model

Recently, MOA framework has also been applied to study green consumption behavior. By studying the influencing factors of green consumption behavior and willingness, motivation, opportunity and ability are processed operationally and converted into various management elements that can be measured. The aim is to improve citizens' pro-environment behavior through effective management of behavior and willingness. When assessing employees' environmental knowledge, ability to practice environmental behavior, motivation and self-cognition of opportunity, Julie et al.

found that ability, motivation and opportunity of environmental protection are positively correlated to green behavior (Rayner & Morgan, 2018). Li et al. used an MOA model to explore farmers' willingness to apply green fertilization technologies, such as formula fertilization technology and water-fertilizer integration technology, and their motives. The results showed that adoption motivation, adoption opportunity, technical operation ability and anti-risk ability play significant positive and direct influences on adoption intention (Li, Zeng, Mei, Li, & Li, 2019). Da et al. studied the energy-saving behavior of citizens in office buildings through an MOA model and found that opportunity plays the strongest influence on energy-saving behavior, followed by motivation and ability (Li, Xu, Chen, & Menassa, 2019).

Motivation is the internal driving force that motivates and maintains an organization's action, and guides the action to a certain goal or psychological tendency. It is the internal reason that determines a citizen’s behavior. Since environmental knowledge and environmental motivation are supposed with positively influence on green consumption intention, environmental knowledge and environmental motivation were used as motivation factors in this research.

Opportunity is an exogenous factor that inhibits or promotes individual actions. It is a collection of external environmental factors that are correlated with behavior but not controlled by the behavior’s subject. New energy vehicles are a kind of automobile product using new technology. Compared with traditional fuel vehicles, new energy vehicles are a new product in citizens' cognition. Perceived risk is one of the important characteristics of new energy vehicles (Yin, Zhang, Liao, & Ge, 2019). Compared with traditional fuel vehicles, new energy vehicles have such core issues of a short battery life, a low vehicle warranty and a short driving range (Wang & Yin, 2021). Therefore, perceived risk will be considered as an opportunity factor. The research presented the hypotheses as follows.

H6: Perceived risk negatively moderates the correlation between environmental knowledge and green consumption intention in urban mobility.

H7: Perceived risk negatively moderates the correlation between environmental motivation and green consumption intention in urban mobility.

H7a: Perceived risk negatively moderates the correlation between hedonic motive and green consumption intention in urban mobility.

H7b: Perceived risk negatively moderates the correlation between hedonic motive and green consumption intention in urban mobility.

H7c: Perceived risk negatively moderates the correlation between normative motive and green consumption intention in urban mobility

Ability is a psychological characteristic that directly influences a citizen's activity efficiency and makes his activity tasks complete smoothly. The ability in an MOA model refers to the inherent possibility of a subject to engage in object activities in a certain social relationship (Chen, 2013). In the process of driving behavior, motivational factors will be influenced by the abilities and characteristics of the citizens. As a typical pro-environmental behavior, green consumption behavior in urban mobility is closely correlated to citizens' environmental ability. Therefore, this research took environmental behavioral ability into consideration as the ability factor when studying the influences of environmental knowledge and environmental motivation on green consumption behavior in urban motility.

Tu and Yang believed that citizens' individual behavioral ability to purchase electric vehicles can be called self-control ability, including the self-efficacy, facilitating conditions and perceived behavioral control (Tu & Yang, 2019). However, Ajzen stated in 2002 that perceived behavioral control and self-efficacy are quite similar, and both focus on the perceived ability when a citizen makes a behavior (Ajzen, 2002). Therefore, perceived behavioral control and facilitating conditions of environmental behavioral ability were taken into consideration in this research. For facilitating conditions, Pieters proposed that capability factors can be divided into the two indicators of habit and task knowledge (Verhallen & Pieters, 1984). In the process of green consumption, citizens often have varying degrees of acceptance. According to the trait theory, individual behavioral intention will be influenced by individual traits, and citizen innovativeness plays a positive moderating role between the innovative characteristics of new energy vehicles and citizens' willingness to apply them (Xie & An, 2020). At the same time, citizens' consumption habits developed by long-term life accumulation will also play a significant influence on green consumption behavior. He et al. found through their research on the purchase behavior of new energy vehicles that habit is an important internal situational factor to explain the deviation of green intention behavior (He et al., 2021). Therefore, this research argued that environmental behavioral ability includes perceived behavioral control, citizen innovativeness and habit. This research presented the hypotheses as follows.

H8: Environmental behavioral ability positively moderates the correlation between environmental knowledge and green consumption intention in urban mobility.

H8a: Perceived behavioral control positively moderates the correlation between environmental knowledge and green consumption intention in urban mobility.

H8b: Citizen innovativeness positively moderates the correlation between environmental knowledge and green consumption intention in urban mobility.

H8c: Habit positively moderates the correlation between environmental knowledge and green consumption intention in urban mobility.

H9: Environmental behavioral ability positively moderates the correlation between environmental motivation and green consumption intention in urban mobility.

H9a: Perceived behavioral control positively moderates the correlation between environmental motivation and green consumption intention in urban mobility.

H9b: Citizen innovativeness positively moderates the correlation between environmental motivation and green consumption intention in urban mobility.

H9c: Habit positively moderates the correlation between environmental motivation and green consumption intention in urban mobility.

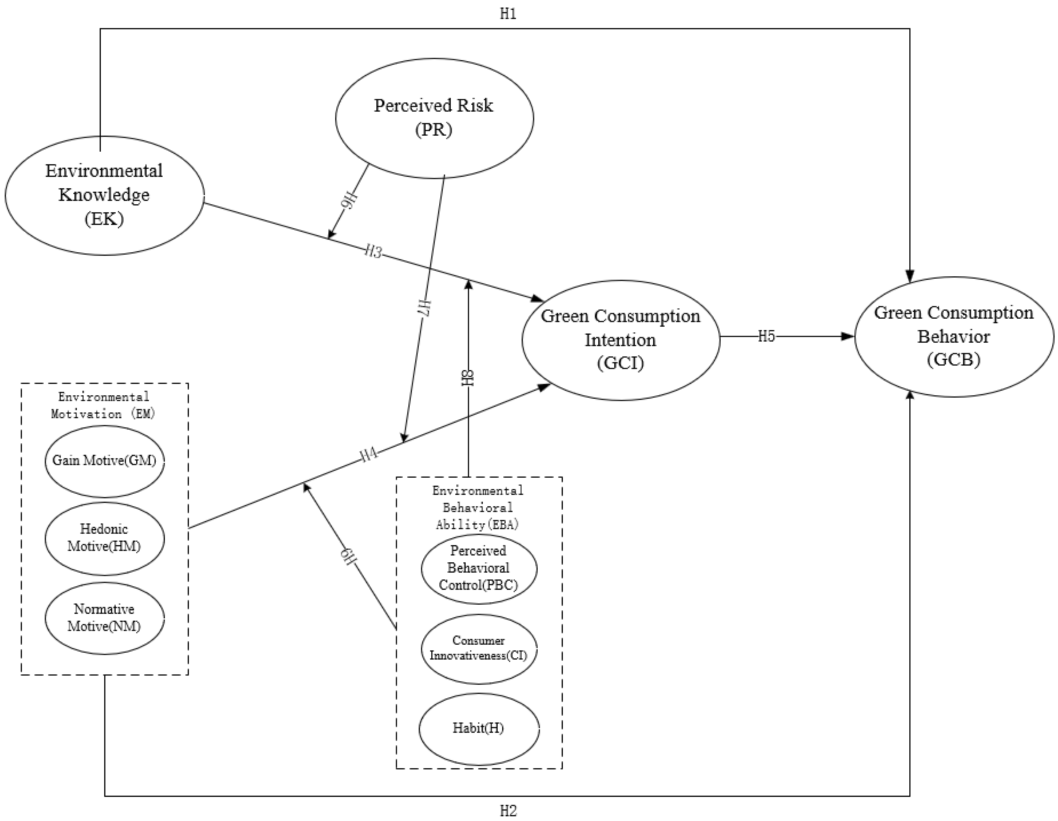


Figure 2 Conceptual framework

3. Research Methods

3.1 Samples

This research selected nine national central cities in China, namely Beijing, Shanghai, Guangzhou, Chongqing, Chengdu, Wuhan, Tianjin, Zhengzhou and Xi'an, with a population of 170.437 million. This research used stratified sampling and convenient sampling. Yamane (Yamane, 1973) suggested a widely used equation to determine the sample size in a structural equation modeling, depending on the population size and the allowable error.

$$n = \frac{N}{1 + Ne^2}$$

In this equation, N is the total population, n is the number of samples, and e is the acceptable error. In this research, the population size was 170.437 million, and the allowable error 5%, therefore the appropriate sample size for random sampling was 400. Meanwhile, in order to cut carbon emissions, the questionnaires used in this research were distributed online, and the many of them were not recovered in the end. In general, analysis and reporting should be carried out, and a questionnaire with a recovery rate greater than 70% is considered good (Babbie, 2020). In order to make up for the unrecovered and incomplete questionnaires, over 570 questionnaires were distributed, which was enough and met the minimum sample size for a structural equation modeling.

The population was divided by administrative jurisdiction to determine the sample size from each city. During the sampling, respondents were independently selected from each city according to the population share of each city in the total population, and then respondents from each city were combined together as the total sample. Key respondents were selected from each city, and the unit of analysis in this research was each respondent. Since the total population of China's national central cities has exceeded 170.437 million, it was difficult to conduct a large-scale random sampling. Testing the entire population with a large population is practically impossible as they are not easy to reach, and the additional inputs are not necessary for the principal research, therefore, convenience sampling method can be used if the population is eligible and the researcher is proximate to the sample to the greatest extent (Etikan, Musa, & Alkassim, 2016). The purpose of this research was to encourage green consumption and promote carbon emission reduction. Respondents completing the questionnaire online would effectively cut the paper usage in this research and cut carbon emissions, which was the practice of green consumption behavior. Therefore, according to the principle of convenient sampling, internet-based questionnaire could be used as an effective method to collect data of green consumption behavior in urban mobility in this research, and WJX (a platform providing functions equivalent to Amazon Mechanical Turk) was used for random sampling options.

A qualitative pre-test is a key phase of the development, adaptation, or translation of any questionnaire or psychometric instrument (Perneger, Courvoisier, Hudelson, & Ageron, 2015). In order to detect misunderstandings, ambiguities, or other situations respondents may encounter with instrument items, a default sample size of 30 respondents is recommended for a pre-test (Perneger et al., 2015). For the pre-test of this research, 120 valid questionnaires were recovered, and the initial sample size was adjusted according to the standard of a recovery rate greater than 70%. At least 170 citizens interested were selected to participate in this survey. According to the results and feedback, the expression and language accuracy of questionnaire items were verified again and modified accordingly, and the initial scale tested. The pre-test was done and the formal questionnaire survey was distributed online on WJX. The pre-test survey was conducted from the end of July to August 2022. 170 questionnaires were distributed and 131 recovered. The formal questionnaire survey was conducted from September to October 2022. A total of 656 questionnaires were distributed and 624 collected. After screening, a total of 603 valid questionnaires were selected, with an effective recovery of 91.9%.

Among the 603 respondents, 44.6% were male and 55.3% were female, showing an even gender distribution. From the perspective of age, 92% of the respondents were aged between 18 and 40 years. Urban citizens in this range were exactly the main car purchase population at present, therefore it can be seen that sample selection was representative.

Table 1 Descriptive statistics of the sample

Item	Category	Number	Percentage in total	Item	Category	Number	Percentage in total
Resident City	Beijing	77	14.6%	Gender	Male	269	44.6%
	Shanghai	88	12.8%		Female	334	55.3%
	Tianjin	49	11.0%	Driving License	Yes	556	92.2%
	Guangzhou	66	18.8%		Taking the exam now	47	7.7%
	Chongqing	114	12.3%	Age	18-30	307	50.9%
	Wuhan	44	7.3%		31-40	248	41.1%
	Zhengzhou	45	8.1%		41-50	39	6.4%
	Chengdu	74	7.4%		51-60	9	1.4%
	Xi’an	46	7.6%		61-70	0	0%

3.2 Measures

This research used a quantitative method of questionnaire as the data collection instrument. The questionnaire was divided into three parts. The first part explained the purpose of this survey and emphasized the academic nature of the data. Considering that some citizens' understanding of new energy vehicles might not be uniform, which might cause understanding deviations, so a brief introduction and description was made on the scope of the survey of new energy vehicles make. The second part was the characteristics of urban citizens. The third part was the question items corresponding to the research variables. Environmental knowledge measurement scale was borrowed from (Jing, Huang, Ran, Zhan, & Shi, 2019), Tanwir and Hamzah (Tanwir & Hamzah, 2020). Environmental motivation measurement scale was borrowed from (Tang et al., 2020), (Yang, 2021), and (Yang, Chen, & Zhang, 2020). Green consumption intention measurement scale was borrowed from (Liu, Zeng, & Wang, 2021), and (Gunawan et al., 2022). Green consumption behavior measurement scale was borrowed from (Kim, 2011), (Kim & Choi, 2005), and (Han, 2015). The items were evaluated by experts, and the total number of question items was cut to 30 following the Item Objective Congruence index (Tongprasert, Rapipong, & Buntragulpoontawee, 2014) ,which was in line with the objectives of this research.

Question items in the questionnaire were measured with a 7-point Likert scale, in which 1=strongly disagree, 4=neutral and 7=strongly agree. Respondents were required to evaluate and judge according to their own understanding and experience. A pre-test was conducted before the final questionnaire distribution, and was analyzed with Cronbach’s Alpha to ensure the reliability of each item. The value of Cronbach’s Alpha ranges from 0 to 1. The closer it is to 1, the better the internal consistency of the questionnaire is and the more reliable the data are. When the value is greater than 0.8, it indicates that the internal consistency of the questionnaire is good and the reliability is high (Henseler, Ringle, & Sinkovics, 2009).

3.3 Data Analysis

All reversed items were recorded before the analysis. An exploratory factor analysis (EFA) by SPSS software was used to identify the manageable sets of dimensions. A confirmatory factor analysis (CFA) by AMOS was used to confirm the dimensions of each variable derived from EFA.

4. Results

4.1 Exploratory Factor Analysis (EFA)

Factor analysis is usually used to study whether the scale can measure the basic structure hypothesized in the scale design. In this research, exploratory factor analysis was used to test the validity of the initial scale construction. The main function of factor analysis is to extract some common factors from all items of the scale, which are highly correlated with a group of specific variables, and these common factors represent the basic structure of the scale. The main forms of applicability test were KMO value and Bartlett's Test of Sphericity. The KMO value of each scale was greater than 0.6, and significant levels of Bartlett's Test of Sphericity are all smaller than 0.001, indicating that the scale of this research was suitable for a factor analysis (Shrestha, 2021). The exploratory factor analysis in this research was done by SPSS, and a principal component analysis was used to extract principal components from the scales of independent variables, dependent variables and intermediate variables respectively. The extraction standard was that the eigenvalue was greater than 1, and the rotation method was orthogonal rotation with maximum variance. The loading of each factor, the eigenvalues of each factor and the percentage of variance of each factor are shown in Table 2. Since the characteristic root was greater than 1, the varmax-rotation method was used to extract 30 factors. The final questionnaire contained 6 principal components (common factors). The items corresponding to the 6 common factors were consistent with the expected items, and the items corresponding to the common factors were greater than 0.5, indicating that the items were of a good explanatory ability for the public components, and the questionnaire structure was valid.

Table 2 EFA results

Variable	Item	Component (factor loading)										KMO	Bartlett's test of sphericity		
		1	2	3	4	5	6	7	8	9	10		Approx. Chi-Square	df	Sig.
EK	EK1	0.746										0.871	1762.404	10	0.000
	EK2	0.846													
	EK3	0.765													
	EK4	0.806													
	EK5	0.642													
EM	EM1		0.856									0.885	9731.980	153	0.000
	EM2		0.738												
	EM3		0.741												
	EM4		0.751												
	EM5		0.83												
	EM6		0.787												
	EM7			0.729											
	EM8			0.737											
	EM9			0.715											

	EM10	0.703											
	EM11	0.701											
	EM12	0.751											
	EM13		0.796										
	EM14		0.749										
	EM15		0.824										
	EM16		0.765										
	EM17		0.77										
	EM18		0.842										
	PR1			0.859									
	PR2			0.889									
PR	PR3			0.833						0.901	2468.393	10	0.000
	PR4			0.912									
	PR5			0.869									
	EBA1				0.881								
	EBA2				0.776								
	EBA3				0.721								
	EBA4				0.702								
	EBA5					0.797							
EBA	EBA6					0.791				0.816	3733.103	55	0.000
	EBA7					0.725							
	EBA8						0.901						
	EBA9						0.892						
	EBA10						0.849						
	EBA11						0.897						
	GCI1							0.693					
GCI	GCI2							0.752		0.682	1222.418	6	0.000
	GCI3							0.701					
	GCI4							0.718					
	GCB1								0.795				
GCB	GCB2								0.729	0.732	976.094	3	0.000
	GCB3								0.661				

4.2 Empirically Tested CFA Model (Measurement Model)

Confirmatory factor analysis (CFA) was done to verify the validity of the data collected with the hypothesized model in predicting the composition of the factors. AMOS software was used to conduct a confirmatory factor analysis, and the fit between the underlying factor structure of variables and the sample data was confirmed by structural validity, aggregate validity and discriminative validity, so as to further verify the overall authenticity of the constructed structural validity.

When testing the structural validity, this research calculated the Absolute Fit NC (CMIN/DF), the Goodness of Fit Index (GFI), Root Mean Square Error of Approximation (RMSEA), Normed Fit Index (NFI), Incremental Fix Index (IFI), Tucker-Lewis Index (TLI), Comparative Fit Index (CFI). The fitting degree of the model was verified by verifying the fitting degree of the covariance matrix implied by the model and the sample covariance matrix (Joe F. Hair, Sarstedt, Ringle, & Mena, 2012). From Table 3, it can be seen that each index model fit well. CMINN/DF was 2.965, which indicated that the fitting degree was good. Incremental Fix Index (IFI), Tucker-Lewis Index (TLI) and Comparative Fit Index (CFI) were greater than 0.90, and the model fit well overall (Joseph F. Hair, 2009).

Table 3 Model goodness of fit

Goodness of fit	Explanation and evaluation reference	Goodness of fit standard		Fitting of model	Fitting degree
		Acceptable	Good		
Absolute Fit NC (CMIN/DF)	Generally, if the value is smaller than 3.0, it indicates that the model is of good fitness. If it is between 3.0 and 5.0, the model adaptation is acceptable; if the value is greater than 5.0, the model adaptation is unacceptable; and if the value is smaller than 1.0, it indicates that the model is over-adapted (Joseph F. Hair, 2009).	1-5.0	1-3.0	2.965	Good
Goodness of Fit Index (GFI)	If the value of the fitness index is 0.85-0.90, it is acceptable; and if the value is greater than 0.9, it is good (Joseph F. Hair, 2009).	>0.85	>0.90	0.852	Acceptable
Root Mean Square Error of Approximation (RMSEA)	The smaller the value is, the better the fitness of the model is. If RMSEA is smaller than 0.08, the model is acceptable, and the model fits well if it is smaller than 0.05 (Joseph F. Hair, 2009).	<0.08	<0.05	0.057	Acceptable
Normed Fit Index (NFI)	Comparative fitting index, it is generally required to be close to 0.90. If it is greater than 0.85, it is acceptable. The closer the values of the four indexes are to 1.0, the better the fitness of the model is. If it is greater than 0.95, the model is very good (Joseph F. Hair, 2009).	>0.85	>0.90	0.876	Acceptable
Incremental Fix Index (IFI)		>0.85	>0.90	0.914	Good
Tucker-Lewis Index (TLI)		>0.85	>0.90	0.905	Good
Comparative Fit Index (CFI)		>0.85	>0.90	0.914	Good

Referring to Figure 3, the standardized factor loading was between 0.650 and 0.935. Convergent validity analysis was measured by combining the standardized factor loading coefficient of confirmatory factor analysis, CR (composite reliability), and AVE value (average variance extracted). From the standardized factor loading coefficient, CR and AVE, most factor loading coefficients were greater than 0.7. The AVE values corresponding to all 10 factors were greater than 0.5, and the CR values were greater than 0.7, which indicated that the data of this analysis was of a good convergent validity (Bailey, 1994).

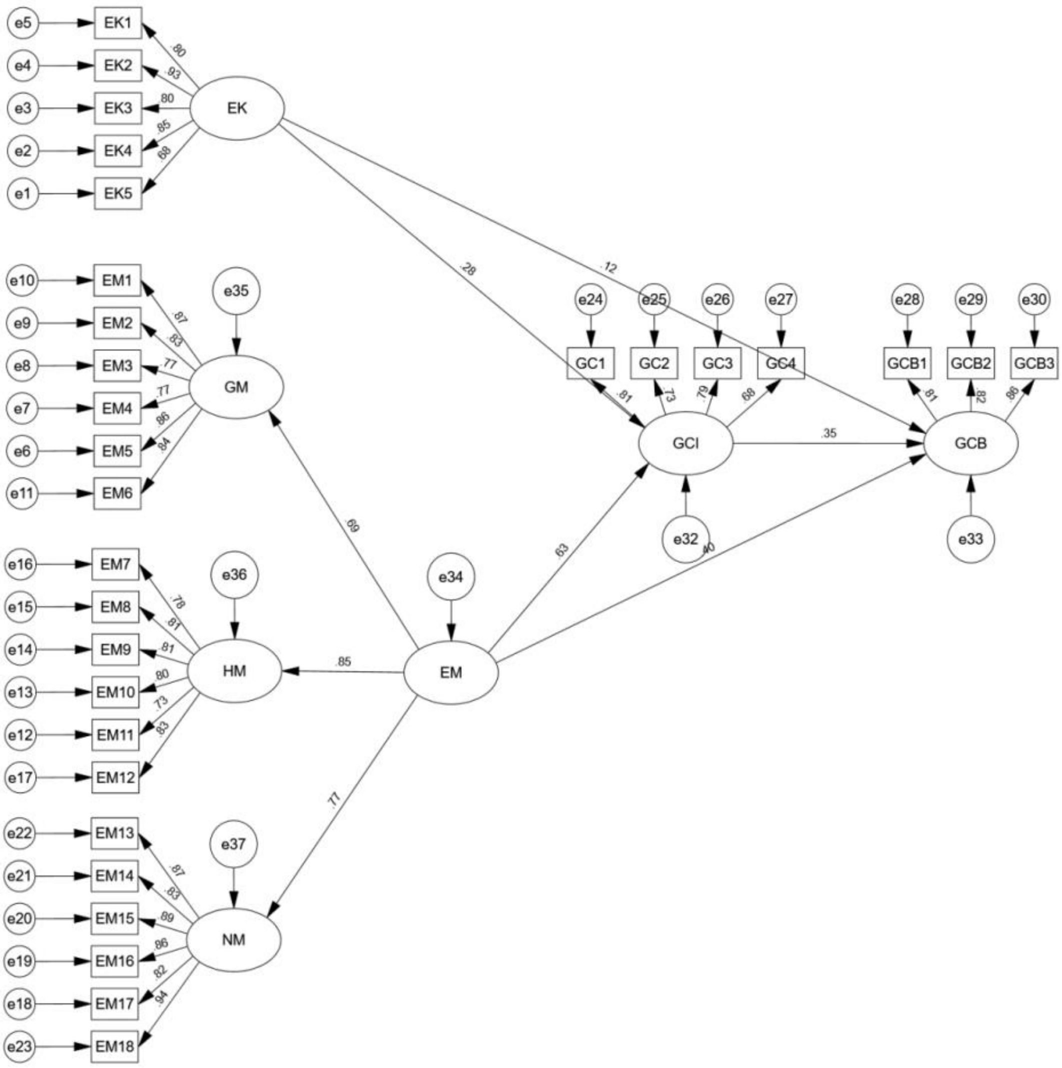


Figure 3 Final model of the green consumption behavior in urban mobility

Table 4 Summary of confirmatory factor analysis results (convergent validity)

Variable		Item	Factor loading	AVE	CR
Environmental Knowledge (EK)		EK1	0.788	0.634	0.896
		EK2	0.911		
		EK3	0.782		
		EK4	0.829		
		EK5	0.650		
Environmental Motivation (EM)	Gain Motive (GM)	EM1	0.869	0.679	0.927
		EM2	0.833		
		EM3	0.765		
		EM4	0.766		
		EM5	0.862		
		EM6	0.842		
	Hedonic Motive	EM7	0.786	0.633	0.912
		EM8	0.807		

	(HM)	EM9	0.814		
		EM10	0.800		
		EM11	0.730		
		EM12	0.832		
	Normative Motive (NM)	EM13	0.870	0.753	0.948
		EM14	0.825		
		EM15	0.886		
		EM16	0.865		
		EM17	0.820		
		EM18	0.935		
Perceived Risk (PR)		PR1	0.836	0.740	0.934
		PR2	0.883		
		PR3	0.851		
		PR4	0.811		
		PR5	0.915		
Environmental Behavioral Ability (EBA)	Perceived Behavioral Control (PBC)	EBA1	0.911	0.608	0.860
		EBA2	0.765		
		EBA3	0.672		
		EBA4	0.751		
	Citizen Innovativeness (CI)	EBA5	0.756	0.527	0.769
		EBA6	0.770		
		EBA7	0.645		
	Habit (H)	EBA8	0.914	0.771	0.931
		EBA9	0.850		
		EBA10	0.873		
		EBA11	0.875		
Green Consumption Intention (GCI)		GC1	0.827	0.602	0.858
		GC2	0.758		
		GC3	0.808		
		GC4	0.704		
Green Consumption Behavior (GCB)		GCB1	0.837	0.713	0.882
		GCB2	0.828		
		GCB3	0.867		

The discriminant validity can be analyzed by Fornell-Larcker criterion. The logic of Fornell-Larcker is based on the idea that a construct shares more variance with its associated indicators than with any other construct. The value of AVE is the degree to which a latent construct can explain the variance of its indicators in detail. If the square root value of AVE is greater than the maximum absolute value of the dimension correlation coefficient, it indicates that the data is of a good discriminant validity (Bailey, 1994). The square root values of AVE of environmental knowledge, hedonic motive, hedonic motive, normative motive, perceived risk, green consumption intention, green consumption behavior, perceived behavioral control, citizen innovativeness and habit were 0.79, 0.82, 0.79, 0.87, 0.86, 0.77, 0.84, 0.78, 0.73 and 0.88 respectively, all greater than the maximum absolute value of the dimension correlation coefficient. It indicated that the data was of a good discriminant validity.

Table 5: Correlation coefficient and square root value of AVE

	EK	GM	HM	NM	PR	GCI	GCB	PBC	CI	H
EK	**0.79**									
GM	0.44	**0.82**								
HM	0.45	0.61	**0.79**							
NM	0.48	0.52	0.64	**0.87**						
PR	-0.34	-0.16	-0.26	-0.21	**0.86**					
GCI	0.48	0.48	0.48	0.59	-0.27	**0.77**				
GCB	0.42	0.46	0.42	0.59	-0.34	0.69	**0.84**			
PBC	0.51	0.30	0.37	0.35	-0.21	0.43	0.33	**0.78**		
CI	0.39	0.40	0.45	0.40	-0.16	0.38	0.38	0.36	**0.73**	
H	0.23	0.33	0.27	0.28	-0.17	0.41	0.41	0.19	0.19	**0.88**

Note: The bold numbers in the table are square root values of AVE.

5. Discussion and Conclusion

Figure 2 shows that there are 7 latent variables in the path analysis, among which the 3 first-order latent variables GM, HM and NM together form the second-order latent variable EM. In addition, the normalized path coefficients from GM, HM and NM to EM were 0.689, 0.852 and 0.768 respectively, indicating that EM represented the variation information of GM, HM and NM well. For EK (GCB) and EM (GCB) paths, according to the model calculation results, EK played a significant positive role in explaining GCB. The labeled path coefficient was 0.123, and the T-test statistic of the unstandardized path coefficient was 3.090, and the corresponding p value was smaller than 0.01. EM played a significant positive role in explaining GCB. The T-test statistic of standardized path coefficient was 0.398, and the T-test statistic of unstandardized path coefficient was 6.401, and the corresponding p value is smaller than 0.001. In addition, from the perspective of action strength, the standardized path coefficient of EM to GCB was 0.398, the standardized path coefficient of EK to GCB was 0.123, and the standardized path coefficient of EM to GCB is greater than that of EK to GCB. It can be considered that the positive effect of EM on GCB was stronger than EK. It can be seen that, if urban citizens have more environmental knowledge or environmental motivation, and they will make more new vehicle consumption behavior in urban mobility. For EK (GCI), EM(GCI), GCI (GCB), it can be seen from the model calculation results that EK played a significant positive role in explaining GCI. The standardized path coefficient was 0.283, and the T-test statistic of the unstandardized path coefficient was 7.162, and the corresponding p value was less than 0.001. EM played a significant positive role in explaining GCI, and the T-test statistic of standardized path coefficient was 0.625, and that of unstandardized path coefficient was 11.249, corresponding top value smaller than 0.001. From the perspective of action strength, the standardized path coefficient of EM to GCI was 0.625, the standardized path coefficient of EK to GCI was 0.283, and the standardized path coefficient of EM to GCI was greater than that of EK to GCI. It can be considered that the positive effect of EM on

GCI was stronger than EK. GCI played a significant positive role in explaining GCB. The T-test statistic of standardized path coefficient was 0.351, and that of unstandardized path coefficient was 5.768, corresponding to p value smaller than 0.001. It can be seen that, urban citizens with more environmental knowledge or environmental motivation will develop more new vehicle consumption intention in urban mobility, and urban citizens with greater new vehicle consumption intention would lead to more new vehicle consumption behavior.

This research on the consumption behavior of new energy vehicles answered to the policy to develop green consumption. It was also an exploration of the development path of the carbon emission reduction industry. The path of green consumption behavior in urban mobility is constructed based on environmental knowledge and environmental motivation variables. It had expanded the research scenes and contents of green consumption behavior and provides theoretical support for promoting urban mobility. Exploring the influencing factors of environmental knowledge and environmental motivation to green consumption behavior in urban mobility, and a model of the influence mechanism of environmental knowledge and environmental motivation on green consumption behavior was constructed based on the MOA theory. Taking the purchase behavior of new energy vehicles of urban citizens as the research object, a questionnaire survey was conducted, in which not only the direct influence of environmental knowledge and environmental motivation on green consumption behavior were taken into consideration, but also the situational variables influencing the correlation between environmental knowledge, environmental motivation and green consumption behavior were further explored. It had provided a new perspective, model, path and method for analyzing the influence mechanism of green consumption behavior, and was an important supplement to the research of green consumption behavior and urban traffic. At the same time, it also had expanded the applicable scope of MOA theory. However, this research has limitations. The scope of questionnaire survey was limited, and the regional distribution of research sample was limited, as the economic and social development, urban transportation planning, new energy vehicle policies and other aspects vary in different national central cities. Due to the limitations of sample size and distribution of sample cities, this research failed to analyze the spatial differences of green consumption behavior of citizens in different cities, as well as factors influencing the filtering and limitations in the design of the questionnaire scale. Human behavior is complicated. In a specific situation, human behavior is influenced by multiple factors, which also determines that the screening of motivating factors between environmental knowledge, environmental motivation, as consumption behavior is impossible to be exhaustive and stable. With the change of times, the fit degree of scale measurement items will be challenged to a certain extent, which also needs to be followed up by further studies.

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