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Exploring Multiple Motivations on Urban Residents' Travel Mode Choices: An Empirical Study from Jiangsu Province in China

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Abstract: People's actions are always accompanied with multiple motives. How to estimate the role of the pro-environment motivation under the interference of other motivations will help us to better interpret human environmental behaviors. On the basis of classical motivation theories and travel mode choice research backgrounds, the concepts of pro-environmental and self-interested motivation were defined. Then based on survey data on 1244 urban residents in the Jiangsu Province in China, the multinomial logistic regression model was constructed to examine the effects of multiple motivations, government measures, and demographic characteristics on residents' travel mode choice behaviors. The result indicates that compared to car use, pro-environmental motivation certainly has a significant and positive role in promoting green travel mode choices (walking, bicycling, and using public transport), but this unstable green behavior is always dominated by self-interested motivations rather than the pro-environmental motivation. In addition, the effects of gender, age, income, vehicle ownership, travel distance, and government instruments show significant differences among travel mode choices. The findings suggest that pro-environmental motivation needs to be stressed and highlighted to ensure sustainable urban transportation. However, policies aimed to only increase the public awareness of environment protection are not enough; tailored policy interventions should be targeted to specific groups having different main motivations.

Keywords: urban residents; travel mode choice; motivation; sustainable urban transportation

1. Introduction

With the rapid development of the traffic industry all over the world, energy consumption and greenhouse gas emissions from the transport sector account for about 1/3 and 1/4 of global energy consumption and greenhouse gas emissions, respectively [1]. Energy saving and emissions reduction in the transport sector not only involves energy and environmental issues, but also concerns global climate change [2]. Without certain actions to construct sustainable urban transportation, it is impossible to achieve the target of controlling the global temperature rise to 2, or even 1.5 degrees Celsius [3]. Sustainable urban transportation systems should represent the transition from a car-oriented development mode to a transit-oriented development mode.

It is reported that the total energy consumption of China's transport sectors increased by 309% from 1990 to 2006, which had an annual growth rate of 9.2% [4]. The transport energy consumption of urban areas is larger than that of rural areas, which is about 10%–15% of the total energy consumption [5]. Due to the rapid growth of the ownership of private cars in cities, traffic congestion not only seriously affects residents' normal lives, but also exacerbates urban air pollution caused by the rapid increase in greenhouse gas emissions [6]. China's CO_2 emissions in the urban transportation

sector increased by about 9.7 times at an average annual growth rate of 7.4% from 1980 to 2012 [7]. The improvements in fuel economy will be more than offset by the rapid increase of the vehicle population [8]. Some researchers hold the view that if no control measures are imposed on the use of vehicles, especially private cars, in China, it will be difficult to support large energy consumption and gas pollution after the following decades [4].

With the development of people's quality of life, strengthening demand-side management of energy consumption will become a major issue in developing countries, especially in China [9,10]. This revolutionary objective must be implemented at the provincial and city level [11]. Ensuring sustainable transportation requires not only technical innovation, but also changing the public's active and sustainable travel behaviors from cars to walking, bicycles, and public transport (PT), and this change should be encouraged by the pro-environmental motivation rather than just mandatory legal constraints. Many studies have shown that attitudes about environmental protection encourage people's tendencies towards green travel, but cannot completely bring about green travel actions, which results in the "attitude-behavior" gap or the "motivation-behavior" gap [12,13]. People's actions are always powered by multiple motives and are not just limited to the pro-environment motive. In order to better interpret human environmental behaviors, it is necessary to distinguish the role of the pro-environment motivation from that of other motivations. Therefore, it is important to explore the influencing mechanism of travel mode choice from the perspective of multiple motivations for guiding residents' green modal split shifts in order to ensure sustainable urban transportation.

Under these circumstances, this paper tends to define two specific motivations of travel mode choice behavior, i.e., pro-environmental motivation and self-interested motivations, and explores the dimensionality of the pro-environmental motivation and its related influencing factors. Then, after the attempt at quantifying the pro-environmental motivation, a model with multiple motivations was constructed and multinomial logistic regression was used to discuss the effects of different motivations on urban residents' travel mode choice. Finally, some control variables including gender, age, income, car ownership, and travel distance were specifically discussed.

This paper also seeks to investigate the relationship between residents' travel mode choice with government instruments (i.e., advertising, infrastructure, and policy). People with different travel behaviors may have different attitudes toward policies. A targeted and group-specific strategy of travel behavior is likely to be more effective than a "one-size-fits-all" approach. Thus, the relationship between government instruments and travel mode choices is examined.

2. Literature Review

2.1. Motivation

Motivation is a theoretical construct used to explain behavior. It represents the reasons for people's actions, desires, and needs. Since the beginning of the 1930s, researchers have tried to discuss the innate character and the process of motivation from pluralistic perspectives, including the three most representative perspectives: biological, behavioral, and cognitive.

In the biological perspective, motivation was the instinct or drive, and the related motivation theories included instinct theory, drive theory, and arousal theory. These theories mainly reflected people's early physiological driving force, insisting that drive, arousal, and habit are necessary conditions of all actions, among which drive formed the basis of behavior, arousal promoted behavior occurrence, and habit ensured behavior continuity [14]. This perspective of motivation highlighted physiological needs for human behavior, but was too mechanical and simple because it denied human consciousness and the purpose of human behavior.

In the perspective of behaviorism, motivation was the external reinforcement (e.g., return or reward as the stimulus) of some behavior, and the related motivation theory was the reinforcement theory. The view from this perspective paid too much emphasis on the external causes of behaviors, thereby ignoring the essence of human initiatives and endeavors [15].

The cognitive perspective of motivation, with full attention on the coordinating and controlling function of human cognitive beliefs on behaviors, became the most influential research method of mainstream psychology. It emphasized the cognitive process of goal-setting, planning, and decision-making for the formation of motivation. In the expectancy value theory, the expectancy (expectations of successfully achieving a behavioral outcome) and the value (evaluation of gains or losses for performing the task) are believed to lead to people's motivation for pursuing the behavior [16]. The more possibilities there are and the greater the perceived values of actions are, the greater the intensity of the motivation. The self-efficacy theory proposed that values incorporated not only people's perceived values of the action, but also the internal control beliefs of their abilities to complete a certain behavior [17]. Although the expectancy value theory focused on the valuation of behaviors, it could not determine people's cognitive process without the role of goal-setting, because human's behaviors are continuous efforts towards the goals [18]. Self-determination theory emphasized the free choice of human behavior on the basis of fully understanding the internal needs and external environmental information, and the external motivation could be internalized as promoted by the internal motivation [19].

Although many researchers have put forward many typical motivation theories, there was no consensus on the process of motivations because the research was conducted in different fields. Motivation can be defined as a person's direction towards behavior, or what causes a person to want to repeat a behavior. A motive is what prompts the person to act in a certain way, or at least develop an inclination for a specific behavior. In short, motivation is the internal power that causes, maintains, and promotes individual activities toward a goal. Motivation should be caused by a specific need, based on the whole process of cognition, and to achieve a special psychological status. Motivation should comprise the beginning, intensity, direction, and persistence of the certain behavior.

2.2. Travel Mode Choice and Multiple Motivations

Since the 1970s, the motivation of environmental behavior, such as travel mode choice behavior, has become a hot topic around the world. Pro-environmental motivation is a special motivation often formed on the condition of external stimulations of environmental deterioration and of improvements of acquired cognition. Pro-environmental motivation relies more on people's initiatives that can encourage individuals to reduce or even abandon other needs that are damaging the environment. Thus, pro-environmental motivation is conductive to the implementation of pro-environmental behaviors. Pro-environmental motivation cannot be directly measured, but can be interpreted by its process of beginning, intensity, direction, and persistence.

The existing literature on travel mode choice has discussed some psychological variables that are partly helpful for understanding the process of beginning, intensity, direction, and persistence of pro-environmental motivation. As for the motivation beginning, researchers considered that green travel behavior must be initiated on the basis of need, concern, and a personal norm of environment protection. Individuals should not only realize the need to protect the environment and the bad consequence of their car usage, but also have a self-expectation derived from values or principles that they have the obligation or responsibility to implement pro-environment behaviors [20,21]. The theory of planned behavior was often introduced to discuss the intensity and direction of motivation, in which perceived behavioral control and intention were important influencing factors that explain environmental behaviors. Perceived behavioral control, similar to self-efficacy, reflects an individual's strong control belief in conquering difficulties and in performing a certain action, whereas intention is the direct factor influencing environmental behaviors [22,23]. A motive is always accompanied by a goal, so intention alone cannot fully reflect the motivation direction without the introduction of the goal [24,25]. As for the motivation persistence, the existence of habits for routine behavior has considerable effects on travel mode choice. Although there has not been a unified interpretation of habits, one of the most widely recognized ways to understand habits is as a non-moral motive. This non-moral motive would save cognitive resources in that individuals might desire not to think

about every detail of their travel mode choice every day and reduce the amount of information taken into account [26,27]. When people repeatedly use green transportation, this driving force gradually becomes unconscious, and ensures the motivation persistence [28].

Motivations rarely are totally single and homogeneous. More often than not, they are diverse and mixed [29]. Individuals always have one main motive and several background motives. The main motive dominates behaviors, whereas the background motives, usually incompatible with the main motive, seemed to somewhat affect behaviors [29,30]. Pro-environmental behavior is a continuum that embodies not only the altruistic influence to the environment by motivation, but also the self-interest of personal benefit such as money and reward. For example, people using green transportation rarely act completely altruistically even if their main motive is green and their green action is more than likely restrained by egotistical motives. Some researchers find that people are more likely to perform low-constraint pro-environmental behaviors (i.e., cheap or easy behaviors) than high-constraint behaviors (i.e., expensive or highly inconvenient behaviors) [31]. Furthermore, effects and emotions did have a significant influence on residents' travel mode, especially car use. Individuals with strong habits of car use like to treat driving a car as a pleasure or a comfortable feeling, and hence were not willing to choose public transport with its associated bias towards more negative emotions [32,33].

In the study reported here, on the basis of classic motivation theories and travel mode choice literature, we divided motivations into pro-environmental motivation and self-interested motivation. Self-interested motivation includes comfort, convenience, safety, health, and economy in the context of daily travel mode choice. As for the pro-environmental motivation, we defined a more comprehensive concept comprising not only the attitude and intention, but also its complete process of beginning, intensity, direction, and persistence.

2.3. Control Variables

Demographic variables are proven to, in some degree, exert influence on people's travel mode choice. The most discussed variables include gender, age, income, vehicle ownership, etc. According to the study of Prillwitz & Barr (2011) [34], female travelers, young and middle-aged travelers, travelers with few private cars, as well as those with high incomes were more willing to travel in environmentally friendly ways. In contrast, Plaut's study (2005) [35] showed that the younger, higher-income urban residents were more likely to travel by motorized vehicles. Curtis et al. (1984) [36] and Sardianou (2005) [37] suggested that there was no significant correlation between educational background and pro-environmental behavior. As the travel distance increases (especially when more than 15 km), Yang (2013) [38] found that residents became increasingly reliant on cars. Besides, researchers paid more attention to the impact of government measures on people's travel behavior. According to the study of Yang and Long (2016) [39], road infrastructure construction can influence residents' travel modes. If a city constructs more bike paths and fast bus lanes, then non-car use will increase. The study of Geng et al. (2016) [12] indicated that publicizing green information can prolong the time people travel by walking, cycling, and public transport, and there were differences between different groups when they reacted to this kind of information. In addition, it has been proven that financial subsidies [40] and administrative restriction policies [41] have direct influences on people's travel mode choices.

In summary, we can see that the control variables chosen by scholars are not the same. Because this study focuses on individual's behavioral motivation, all the controlled variables are not included. The control variables in this study include age, gender, income, vehicle ownership, travel distance, and policy measures, which consist of infrastructure, advertising, and policy.

3. Research Methodology

3.1. Data Collection

Through existing literature and interviews with experts, an initial research questionnaire was developed. The draft questionnaire was modified and finalized through pre-research and related

validity and reliability analyses using statistical software. Jiangsu Province, with more than 7 trillion GDP (ranking 2nd in China) and more than 10 million private cars (ranking 3rd in China) at the end of 2015, was selected as the study location. The province has high energy consumption among the Chinese provinces and is making important contributions to China's energy conservation and carbon emissions reduction targets [42]. The finalized questionnaire was distributed to 1500 urban residents in typical cities in the Jiangsu province using stratified random sampling. Xuzhou (northern city), Nanjing (middle city), and Suzhou city (southern city), ranked 6th, 2nd, and 1st of private car ownerships in Jiangsu province, respectively, were selected as the typical cities in our field investigation. The data collection continued from August 2015 to December 2015, and 1244 effective questionnaires were collected.

3.2. Measures

The travel mode measuring item referenced Klöckner and Friedrichsmeier (2011) [43], which asked, "What is the main travel mode (walking/bicycle (electric or non-powered)/public transport/car (private car or taxi)) that you use for everyday trips?" Independent variables included four parts, the first of which measured the process of pro-environmental motivation, and contained four dimensions and 22 items informed by related literature (see Table 1). Likert's five-step scale ranging from 1 (strongly disagree) to 5 (strongly agree) were given as possible responses, where 5 represented the most favorable response. The second part of the independent variables measured self-interested motivation. From the pre-survey, we found that individuals tended to have multiple motives and often expressed a preference for all the motives, without a distinction between main motive and background motive. Therefore, to better distinguish people's dominating preference on motivations, respondents were asked to sort the six kinds of motives (comfort, convenience, safety, economy, health, and environment protection), and assign them from 6 to 1 according to the sorting order. The third part measured government instruments, which included road infrastructure (e.g., the highways and mass transit systems in my city are perfect), advertising (e.g., in recent years, much advertising about green travel is promoted through mass media) and policy (e.g., the local government is still lacking effective restriction on car use). Responses followed Likert's five-step scale as in the first part. The last part of the independent variables dealt with demographic variables, vehicle ownership, and travel distance. Table 1 lists the referenced scales of the pro-environmental motivation. Table 2 summarizes descriptive statistics in terms of age, sex, household income, vehicle ownership, travel distance, and travel mode choice. The SPSS 20.0 (IBM Corporation: Armonk, NY, USA) software was used for all statistical analyses.

Table 1. The referenced scales of the beginning, intensity, direction, and persistence of pro-environmental motivation.

Variables	References	Items
Beginning	Friedrichsmeier et al. (2013) [28]; Klöckner and Friedrichsmeier (2011) [43]; Hunecke et al. (2001) [44]; Bamberg and Schmidt (2003) [45]	9
Intensity	Klöckner and Matthies (2003) [26]; Verplanken and Orbell (2003) [46]	3
Direction	Gwyther and Holland (2015) [25]; Bamberg et al. (2007) [47]	5
Persistence	Friedrichsmeier et al. (2013) [28]; Verplanken and Orbell (2003) [46]	5

Table 2. The sample structure of the research questionnaire.

Variables	Frequency		Percentage %
Gender	Male	658	52.9
	Female	586	47.1
Age (years)	18–25	202	16.24
	26–30	302	24.28
	31–40	316	25.4
	41–50	288	23.15
	>51	136	10.93
Bicycle ownership	Yes	716	57.6
	No	528	42.4
Car ownership	Yes	458	36.82
	No	786	63.18
Main travel mode	Walking	124	9.97
	Bicycle	402	32.32
	PT	376	30.23
	Car	342	27.48
Monthly household income (Yuan)	<2000	211	16.96
	2000–4000	284	22.83
	4000–6000	279	22.43
	6000–8000	261	20.98
	8000–10,000	141	11.33
	10,000–30,000	52	4.18
	>30,000	16	1.29
Travel distance	<1 km	134	10.77
	1–3 km	216	17.36
	3–5 km	260	20.9
	5–10 km	300	24.12
	10–15 km	142	11.41
	15–20 km	94	7.56
	>20 km	98	7.88
Total		1244	100.00

PT: public transport.

3.3. Multinomial Logistic Regression

Because travel model choices, i.e., the dependent variables, have many levels with no orders, the multinomial logistic regression was used in our study as the simplest and the most popular discrete choice model. According to the literature [48], the principle and process of this model are as follows.

Assume that an individual m is associated to every travel mode of the choice set. Level $i(i \in (1,2,\ldots,m))$ and Level $j(j \in (1,2,\ldots i-1.i+1,\ldots,m))$ are two levels, such that level i is the reference level, and j is the selected level. $\pi_j = P(y = j/x)$ is the conditional probability that an individual chooses alternative j. The multinomial logistic regression model is defined by Equation (1):

$$ln\left[\frac{\pi_j}{\pi_i}\right] = ln\left[\frac{P\left(y=\frac{j}{x}\right)}{P\left(y=\frac{i}{x}\right)}\right] = \alpha_j + \beta_{j1}x_1 + \beta_{j2}x_2 + \cdots + \beta_{jn}x_k = \alpha_j + \sum_{k=1}^{n}\beta_{jk}x_k, \quad j \in (1,2,\ldots i-1.i+1,\ldots,m) \tag{1}$$

where x_k is the independent variable; k is the number of independent variables; α_j is the estimated intercept; and β_{jk} is the estimated coefficient.

$ln\left[\frac{P(y=j/x)}{P(y=i/x)}\right]$ is the odds ratio (OR) of level j versus level i. Normally the first or last level is selected as the reference level, i.e., $i = m$ or $i = 1$. The condition has to meet the requirement expressed as Equation (2):

$$\sum_{j\in(1,2,\ldots i-1.i+1,\ldots,n)} \pi_j + \pi_i = 1 \tag{2}$$

The likelihood function for samples, each with m alternatives, is defined as Equation (3):

$$L(\beta) = \prod_{k=1}^{n}\prod_{j=1}^{m}\left[\pi_j(x_k)^{y_{jk}}\right] \tag{3}$$

where L is the likelihood that the model assigns to the vector of available alternatives, and y is chosen as an indicator (= 1 if j is chosen, and 0, otherwise).

The likelihood function is transformed to a log-likelihood function and is given as Equation (4).

$$LL(\beta) = Log(L(\beta)) = \sum_{j=1}^{m}\sum_{k=1}^{n} y_{jk} ln\left[\pi_j(x_k)\right] \tag{4}$$

The estimated values β of the parameters are obtained by maximizing the first derivative of the log-likelihood function and equating it to zero. The validity of the model is tested by the correlation coefficient (R^2) and the Likelihood Ratio Test (LRTS), especially the latter. The LRTS value can be obtained using Equation (5):

$$LRTS_i(\beta_j) = -2\left[LL_i(\beta_j) - LL_i(\beta_i)\right] \tag{5}$$

where $LRTS_i(\beta_j)$ represents the likelihood ratio test values, i.e., fitting information, which restricts the parameters estimated from variable x_j to be used to predict the model; $LL_i(\beta_j)$ is the log-likelihood ratio value when variable x_j is restricted; $LL_i(\beta_i)$ is the log-likelihood ratio value when the variable x_j is unrestricted.

The LRTS tests, i.e., the goodness-of-fit tests, are distributed as a Chi-square function with k degrees of freedom, where k is the number of independent variables. If the LRTS value is less than the critical Chi-square value at 95% confidence level, the null hypothesis that variable x_j is unnecessarily introduced cannot be rejected; otherwise, it is rejected.

4. Results

4.1. Factor Analysis of Pro-Environmental Motivation

To explore the dimensionality of the pro-environmental motivation, factor analysis was used. The basic purpose of factor analysis is to use a few factors to describe the connections between many elements, i.e., to classify some closely related items; each type of variable becomes a factor, which can reflect the majority of the original information. In the factor analysis, as long as the eigenvalue of a factor is greater than 1, this factor is analyzable [49]. When it is necessary to search for potential factors among many variables, factor analysis uses rotation techniques to explain the factors by the variance contribution rate, which is advantageous in its explanation. The Kaiser-Meyer-Olkin value is 0.811 and the significance level of the Bartlett spherical test is 0.000, which is fit for factor analysis. Table 3 shows the exploratory factor analysis of pro-environmental motivation items and their Cronbach's Alpha (α) values. Table 4 lists the six factors and their variance contributions after exploratory factor analysis.

Table 3. Exploratory factor analysis of pro-environmental motivation items.

Items	*F*1	*F*2	*F*3	*F*4	*F*5	*F*6	Cronbach α
It is urgent to do something about the pollution caused by using the car.	0.784	−0.050	0.116	0.175	0.112	0.132	0.808
I am worried about the destruction of the environment caused by cars.	0.779	0.030	0.128	0.084	0.034	0.076	
Car use is one of the main environmental problems.	0.745	−0.002	0.085	0.011	−0.054	0.007	
When I use the car, exhaust gases have a negative effect on the global climate.	0.742	0.040	0.118	0.074	0.045	0.116	
I think that my use of PT contributes to the protection of the environment.	0.688	−0.012	0.332	0.001	0.098	0.101	
I am aware that my car use will contribute to the smog and haze.	0.677	0.028	0.247	−0.053	−0.064	0.183	
Taking PT for everyday trips is something that is part of my routine.	−0.077	0.839	−0.039	0.019	0.044	−0.051	0.766
Taking PT for everyday trips does not require any active thought.	−0.062	0.824	−0.049	0.045	0.126	−0.051	
Taking PT for everyday trips is something that I do automatically.	−0.004	0.760	0.017	−0.003	−0.046	0.053	
Taking PT for everyday trips is something that I do without thinking about it.	0.023	0.715	0.033	0.025	−0.075	0.037	
Taking PT for everyday trips is something that gives me a strange feeling when I don't do it.	0.066	0.680	0.009	0.018	−0.014	0.002	
Because of my own values, I feel a responsibility to use PT for everyday trips.	0.274	0.037	0.848	0.092	0.082	0.076	0.843
Regardless of what others do, I feel an obligation to use PT for everyday trips.	0.259	0.001	0.820	0.093	0.083	0.144	
The aspect of environmental protection in travel mode choice is solidly anchored in my values.	0.268	−0.044	0.814	0.007	−0.035	0.028	
My everyday use of PT is for the purpose of protecting the environment.	0.055	−0.012	−0.019	0.889	−0.062	0.014	0.702
When I'm making an everyday trip, I always plan to protect the environment.	0.080	0.061	0.096	0.847	−0.108	0.020	
Though using PT, I am not considering the plan of protecting the environment. (reversed)	0.082	0.024	0.089	0.753	0.110	0.247	
My autonomy to use PT for everyday trips is large even in challenging circumstances.	0.064	−0.024	0.061	−0.036	0.821	0.066	0.829
Once I choose PT for everyday trips, it would be easy for me to stick to it even in bad weather.	0.035	−0.040	0.042	−0.034	0.813	0.086	
I can conquer adverse conditions that are not conducive to my use of PT for everyday trips.	0.045	−0.034	0.039	−0.032	0.797	0.072	
I plan to protect the environment by using PT for everyday trips.	0.197	−0.028	0.099	0.137	0.145	0.876	0.737
My intention to protect the environment by using PT for everyday trips is very strong.	0.284	0.137	0.134	0.133	0.030	0.834	

Note: *F*1 means Factor 1, *F*2 means Factor 2, . . . , *F*6 means Factor 6.

According to the coefficients in the rotation matrix (Table 3), six factors can be extracted from the environmental motivation, and all the variables within the dotted line are well loaded on the factors (factor loadings > 0.5), thus the factor analysis is effective. According to the variance contribution rate (Table 4), the total variance contribution rate of these six factors is 69.77%, which means that the six factors explain 69.77% of the variance of the 22 measured items, thus the explanatory ability is good. Therefore, based on the existing literature, we might name these six factors: cognition, habits, personal norms, goals, perceived behavioral control (PBC), and intentions. According to Table 4, the contribution rate of the cognitive factor is the highest (17.21%) and the contribution rate of the intention factor is the lowest (7.93%). We represent the weight of each factor by using the variance

contribution rate of each factor divided by the total variance contribution rate (69.77%) of all six factors. The scores of the six factors were weighted and summed using Equation (6) to calculate the comprehensive value for the pro-environmental motivation (F).

$$F = F_1 \times 0.247 + F_2 \times 0.208 + F_3 \times 0.16 + F_4 \times 0.149 + F_5 \times 0.123 + F_6 \times 0.114 \quad (6)$$

The weights (0.247, 0.208, 0.16, 0.149, 0.123, and 0.114 for F_1–F_6, respectively) were calculated using the variance contribution of each factor divided by the cumulative variance contribution of all factors (Table 4). The F_j values were calculated using Equation (7):

$$F_j = \sum_{\substack{1 \le i \le 22 \\ 1 \le j \le 6}} x_i \cdot f_{ij} \quad (7)$$

where F_j is the score of each factor, x_i is the original value of items from the questionnaire, and f_{ij} is the score coefficients of the rotated component matrix.

Table 4. Variance contribution of pro-environmental motivation items after exploratory factor analysis.

Factor	Initial Eigenvalue			Eigenvalue after Rotation			Weight
	Total	VC (%)	CVC (%)	Total	VC (%)	CVC (%)	VC/CVC
Cognition	5.216	24.838	24.838	3.615	17.214	17.214	0.247
Habit	3.074	14.637	39.474	3.044	14.495	31.708	0.208
Personal norm	2.083	9.917	49.392	2.340	11.144	42.852	0.160
Goal	1.809	8.616	58.007	2.180	10.380	53.233	0.149
PBC	1.377	6.557	64.565	1.808	8.608	61.840	0.123
Intention	1.093	5.206	69.770	1.665	7.930	69.770	0.114

Note: VC means variance contribution, CVC means cumulative variance contribution.

4.2. Multinomial Logistic Regression of Pro-Environmental Motivation and Control Variables

Table 5 summarizes the significant effects of pro-environmental motivation, government instruments, travel distance, gender, age, income, and vehicle ownership on travel mode choice. The values of government instruments (advertising, policy, and infrastructure) were selected as the mean of related items. Model_1 only considered the pro-environmental motivation, while Model_2 introduced the control variables into the logistic regression model.

Compared to car use, pro-environmental motivation, as a sole variable, shows a positive and very significant effect on residents' green travel modes, such as walking, bicycling, or using public transport (PT). From the goodness-of-fit test, the LRTS value is 32.11 (= 3243.62 − 3211.51), with a significance level less than 0.001 and low R^2, showing a valid model but with low fitting ability. This result confirms that pro-environmental motivation will promote green travel modes (Model_1 in Table 5).

After the variables of government instruments, travel distance, gender, age, family income, and vehicle ownership are introduced, the positive effect of pro-environmental motivation on green travel modes is still significant (according to both the Wald and Chi-square tests), with a stronger effect on PT than on bicycling and walking (Model_2 in Table 5).

Gender and age have significant effects on travel mode choice. Compared to car use, women are more likely to use PT ($p < 0.05$) and a bicycle ($p < 0.1$) than men, while elderly people only prefer to walk ($p < 0.1$). Vehicle ownership has large absolute Wald and LRTS values for explaining a certain travel mode ($p < 0.01$). Family income is valid according to the Chi-square test and a significant effect is embodied in the lower family incomes of bicycle users compared to the incomes of car users ($p < 0.1$).

Travel distance has a large impact on travel mode choice, especially on walking and bicycling rather than on PT ($p < 0.01$). Therefore, travel distance is an important variable that constrains walking and cycling. As for government instruments, compared to car use, advertising and policy have

significant influence on walking. Residents that prefer to walk have a higher satisfaction towards advertising ($p < 0.01$) and policy ($p < 0.05$) than people who prefer other travel modes. Infrastructure appears to be significantly different between PT and car users, indicating PT users' higher satisfaction with infrastructure than car users ($p < 0.1$).

After the inclusion of control variables, the model had a valid and higher fitting ability; for example, with all variables included, the model had an LRTS value of 727.41 (= 3243.62 − 2513.88), which was higher than the critical Chi-square value at 99% confidence level. In addition, before the other motivations were introduced, pro-environmental motivation had a significant and positive impact on green travel modes, regardless of the control variables (Model_1 and Model_2).

Table 5. Estimation results of pro-environmental motivation and control variables.

Variable	Mode	Model_1		Model_2		
		Estimated Coefficient	Wald	Estimated Coefficient	Wald	LRTS (β)
Constant	Walking	−0.95	8.6 ***	−1.58	3.75 *	-
	Bicycle	0.25	7.73 ***	1.06	3.16 *	
	PT	0.15	3.56 *	-	-	
Pro-envi. motivation	Walking	0.69	7.55 ***	0.65	4.49 **	10.95 **
	Bicycle	0.76	18.5 ***	0.46	4.09 **	
	PT	0.96	27.76 ***	0.74	10.5 ***	
Distance [a]	Walking			−0.51	33.26 ***	46.12 ***
	Bicycle			−0.20	11.12 ***	
Gender [a]	Bicycle			−0.45	3.23 *	11.87 ***
	PT			−0.58	5.8 **	
Age [a]	Walking			−0.15	2.94 *	10.25 **
Household income [a]	Bicycle			−0.02	4.76 **	7.39 *
Ownership (bicycle) [a]	Bicycle			2.51	72.2 ***	165.01 ***
Ownership (car) [a]	Walking			−3.54	114.08 ***	344.31 ***
	Bicycle			−3.41	164.78 ***	
	PT			−3.4	169.63 ***	
Advertising	Walking			0.43	8.3 ***	12.89 ***
Policy	Walking			−0.41	9.32 ***	10.03 **
Infrastructure	PT			0.14	2.8 *	9.06 **
−2LL(0)		3397.84		3397.84		
−2LL(c)		3243.62		3259.29		
−2LL(β)		3211.51		2513.88		
Cox & Snell R Square		0.03		0.45		
Nagelkerke R Square		0.03		0.49		
McFadden R Square		0.01		0.23		

Reference category: car use. [a] Reference category is the last category (e.g., for "gender" it is "female"; for "vehicle ownership" it is "with no vehicle"). Only variables with significant differences are listed considering the limited table size. −2LL(0) shows the total information. −2LL(c) and −2LL(β) separately indicate the fitting information after the intercept and all independent variables are added, respectively. The significance of differences on variables is tested by Wald tests. The goodness-of-fit test, i.e., LRTS tests, used Chi-square tests. Similarly, hereinafter *** means $p < 0.01$, ** means $p < 0.05$, and * means $p < 0.1$.

4.3. Multinomial Logistic Regression of Multiple Motivations

Table 6 (Model_3) summarizes the effects of multiple motivations on different travel modes. The measurements of multiple travel motives were performed according to the sorting item. If the pro-environmental and self-interested motives are added to the logistic model at the same time, there will be serious multi-collinearity. Hence, to avoid data redundancy, each motivation is evaluated

respectively. Because the data of the sorting item itself can well distinguish residents' preference for multiple motivations, separate regression analysis of such variables can reflect the complex relationship between multivariate motivations and travel modes.

It has been found in Model_3 in Table 5 that pro-environmental motivation is conducive to an individual's non-car use travel behavior. However, as shown in Table 6, it is not always the main motivation when confronted with other motivations. Moreover, residents who walk, use a bicycle, or use PT are more likely to be powered by other motives rather than just the pro-environmental motive; the effect of pro-environmental motivation is evaluated significantly negative ($p < 0.05$), or otherwise non-significantly positive ($p > 0.1$).

Compared to car users, PT users are more concerned with travel convenience ($p < 0.01$) and health ($p < 0.05$). Environmental protection is their least important motive ($p < 0.01$). Bicycle users give the most weight to economic concerns ($p < 0.05$) rather than comfortable consideration ($p < 0.1$). Residents that walk have high concerns about health ($p < 0.05$), but do not care about environment protection ($p < 0.01$). In general, more often than not, car users are concerned with safety and travel comfort, while non-car users take care with regards to economy and health. Therefore, although individuals often have pro-environmental motivation, their green travel mode choices are always strongly powered by other self-interested motivations, such as convenience, health, or economy.

Table 6. Estimation results of multiple motivations.

Mode	Multiple Motivations	Model_3		
		Constant	**Estimated Coefficient**	**Wald**
Walking	Comfort	−0.93 ***	−0.02	0.08
	Convenience	−0.91 ***	−0.02	0.07
	Safety	−0.87 **	−0.03	0.08
	Economy	−1.05 ***	0.02	0.08
	Health	−1.56 ***	0.22	9.52 ***
	Pro-environment	−0.46 **	−0.19	6.34 **
Bicycle	Comfort	0.46 ***	−0.07	3.22 *
	Convenience	0.20	0.01	0.01
	Safety	0.65 **	−0.03	2.33
	Economy	−0.14	0.12	4.69 **
	Health	0.01	0.09	2.68
	Pro-environment	0.25	0.01	0.04
PT	Comfort	0.189	−0.02	0.21
	Convenience	−0.53 **	0.15	8.61 ***
	Safety	0.58 *	−0.09	0.12
	Economy	0.03	0.03	0.35
	Health	−0.15	0.11	4.31 **
	Pro-environment	0.71 ***	−0.21	14.99 ***

Reference category: car use. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

5. Discussion

From our analysis above, we can conclude that residents' green travel mode choices are not always strongly powered by pro-environmental motivation. More often than not, they are triggered by self-interested motivations. When confronted with other motives, the pro-environment concern seems to be somewhat ignored. Self-interested motivations not only significantly affect green mode choice, but also interfere with or even block the activation process of pro-environmental motivation. Schwartz and Howard (1984) [20] proposed that personal norm played a significant role in the motivation stage for environmental behaviors, while cognition and PBC were preconditions in the first attention stage before the motivation stage, but before the environmentally-friendly motivation can be actually

activated, other non-moral aspects, e.g., economical, would have to be fully evaluated [50]. Once other motives overtake the pro-environmental motive, the activation process of pro-environmental motivation would be blocked [26].

When making decisions about travel mode choices, people tend to have more motives, one of which is the main motive and the others which are background motives [29]. Motivations rarely are totally single and homogeneous. More often than not, they are diverse and mixed [29]. Furthermore, there may be a mutual promotion between different motivations (such as environmental protection and economy), but conflicts or interferences sometimes occur (such as environmental protection, comfort, and convenience). As shown in our study, when motivations promote each other, the pro-environmental motivation will bring about green travel behavior. However, when motivations interfere with each other, some people may well give up the pro-environmental motivation (background motive) to pursue their most cared preference (main motive), resulting in the "attitude-behavior gap" or "motivation-behavior gap". For example, the economic concerns (main motive) helps individual's green travel actions, but this short-term green behavior is unstable and unsustainable without the full support of the pro-environmental motivation. Once economic conditions permit, most people may buy and use cars and rapidly change to non-green travel behaviors. On the contrary, people with pro-environmental concerns as their main goals are always more willing to implement sustainable green travel behavior [12,29]. When pro-environmental motivation is promoted by self-interested motivation, it will bring about green travel behavior; however, when it is interfered by self-interested motivation, it will more than likely result in the "motivation-behavior gap" and then non-green car use. Therefore, how to highlight the absolute dominance of pro-environmental motivation, or how to strengthen the complementary role of some self-interested motivations that are conducive to green behavior (e.g., economy), or how to reduce the interfering effect of other self-interested motivations that are not conducive to green behavior (e.g., comfort or convenience), will be a critical problem with regards to policy-making to ensure sustainable transportation and pro-environmental behaviors.

Individuals with different motivations always have distinct concerns and reactions toward policy interventions [51]. Geng et al. (2016) [12] carried out a controlled trial to indicate that information (advertising) has distinct impacts on travel mode choice of urban residents with different main motivations. Residents are more inclined to increase their average daily use time of green travel modes, especially the bicycle, after the information intervention and this effect is more obvious in subjects with pro-environmental motivations [12]. It has also been proven that residents, even if they do not take environmental protection as their main motivation, can still be more or less guided by diversified information [12]. Our study shows that non-car users are more satisfied with government instruments. Those people that use green travel modes tend to recognize government's efforts on infrastructure and advertising more than other people, but tend to recognize the policy less. Car users, on the contrary, are not satisfied with the road infrastructure. Due to some people's preference on economy, economic subsidies for green-travel individuals will be a necessary government measure for guiding and maintaining their sustainable green travel behavior. The highly car-addicted group is most concerned about comfort and positive emotions brought about by car use, with little care about economy. Therefore, for car users, the government should not only develop the road infrastructure, but also improve public facilities and management services so as to provide a better positive experience about using public transit.

The conclusions drawn from this study are consistent with previous studies [12,34,35], especially the analysis in relation to control variables. Therefore, the results of these variables are universal to a certain degree. Thus, local and national governments can make policies according to the heterogeneity of the population in the future. Throughout the existing literature, a large number of studies only focused on the factors such as value, attitude, and intention, that influence people's travel behavior. This study seeks out the specific content of pro-environmental motivation and understands people's travel behaviors from a deeper multi-level motivation perspective.

The methods and conclusions in this research can be partly applied to other related studies (especially on human environmental behaviors) in other cities in China and even abroad. However, as mentioned in the segmentation theory, people with the same characteristics of geographical location, demographic composition, and social culture tend to gradually form similar values, habits, or lifestyles, resulting in different societal segments. Residents from cities, regions, and countries of different economic levels, often hold diverse ideas towards using cars, and the main motivation of their behaviors are also different. In low-income areas, people are more likely to perform low-constraint pro-environmental behaviors (i.e., cheap or easy behaviors) than high-constraint behaviors (i.e., expensive or highly inconvenient behaviors) [31].Thus, they are more likely to take economy and convenience into consideration when choosing travel modes. While in high-income areas, people tend to relatively ignore the economy and convenience, but are more concerned about safety, health, and comfort [12]. Nonetheless, as the results of this study show, the impact of pro-environmental motivation on residents' green travel is significant, while the roles of other self-interested motivations for encouraging or disrupting pro-environmental motivation cannot be ignored. Therefore, how to highlight the absolute dominance of pro-environmental motivation under the interference of other motivations, will be a critical problem to be explored on the worldwide scale.

There is a general consensus that a targeted and group-specific strategy of travel behavior is likely to be more effective than a "one-size-fits-all" approach. So, discussing differences between segments and similarities within segments, and designing targeted behavioral interventions, will be a wiser strategy for sustainable transportation policies. As shown in our research, it is not enough to rely only on advertising messages about environment protection. More integrated information on sustainable travel and consumption will be a more effective measure for publicity and education [12]. In conclusion, more tailored policy interventions including environmental and health advertising, economic subsidies, public service optimization, etc., should be targeted to specific groups with different motivations and behaviors.

6. Conclusions

In this study, the concepts of pro-environmental and self-interested motivation was defined, and a multinomial logistic regression model was constructed to analyze the effects of multiple motivations and control variables on urban residents' travel mode choices. The following conclusions are drawn from our analysis.

First of all, four dimensions of the pro-environmental motivation are proposed and six influencing factors are discovered which are respectively named as cognitive, habit, personal norm, goal, PBC, and intention. These factors cover the beginning, intensity, direction, and persistence of the pro-environmental motivation.

Second, gender, age, income, vehicle ownership, travel distance, and government instruments show significant differences in their effects on different travel mode choices. Compared to car users, residents that walk, bicycle, or use PT are younger, are more likely female, have a shorter travel distance, a lower family income and proportion of car ownership, and are more satisfied with government instruments such as infrastructure, advertising, or policy.

Finally, residents with pro-environmental motivation are more willing to walk, bicycle, or use PT instead of a car. In turn, however, the use of green transportation by these residents is not always motivated by pro-environmental motivation, and they experience a strong interference from self-interested motivations such as comfort, convenience, health, or economy. People's attitudes and motivations toward environment protection need to be stressed and highlighted in guiding and dominating their pro-environmental behaviors. Only in this way can we ensure the active and sustainable behaviors to support sustainable development in transportation, economy, and society.

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