

Article

# Green Travel: Exploring the Characteristics and Behavior Transformation of Urban Residents in China

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**Abstract:** Green travel can ease urban traffic problems and has aroused Chinese government interest regarding their extensive concerns. Although the Chinese government has formulated some policies to encourage residents to perform green travel behavior, non-green travel behavior is still popular. Using the Q method, this study explores the characteristics of Chinese urban residents from the perspective of green travel behavior. The results show that according to values and travel attitudes, urban residents can be divided into three groups; green, light green, and brown travelers. Green travelers care about the environment, have positive environmental attitudes, and implement green travel in their daily lives. Light green travelers require incentives and good conditions to carry out green travel. Brown travelers, however, hold egoistic values and their travel behavior, with little consideration of environment, is mainly affected by individual travel habits. Such results can help governments make suitable and effective policies and initiatives to promote behavior transformation from brown and light green into green travelers.

**Keywords:** green travel; urban residents; behavior transformation; Q method; China

## 1. Introduction

In recent years, with rapid economic development, the ever-accelerating urbanization and motorization, and the constant improvement of people's living standards in China, the number of cars across the country has been growing quickly [1] and reached 105 million cars by the end of 2013 [2]. Yet the frequent and extensive use of cars not only brings life convenience, but also results in traffic jams, air pollution, resource depletion, and ecological damage [3]. In order to alleviate these problems, green travel is imperative [4].

Facing the prominent consequences of traffic jam and air pollution resulting from urban transportation, some Chinese cities began to carry out a series of exploration activities to promote green travel. For example, in 2001, Chengdu, one of the large cities in China, initiated the first Car Free Day event. In 2006, the China Association for NGO Cooperation (CANGO) and Environmental Defense in Beijing issued a joint proposal calling for Beijing residents to select green travel for the blue skies of Beijing and their own health. In 2008, the Beijing municipal government and civil society organizations launched a number of green travel activities to support the Beijing Olympics as the Green Olympics. In 2010, on the basis of the Shanghai World Expo and Guangzhou Asian Games, the corresponding themes of green travel activities were respectively conducted such as the Green Travel Tour of the Expo and the Low Carbon of the Asian Games. In 2011, new energy vehicles were put

into use in Shenzhen for the Shenzhen University Games. In 2013, Green travel day was started in Shenyang to support the National Games of China. Thus, the concept of green travel gradually enters urban residents' vision through holding activities during large international events.

However, according to the data of the China Council for International Cooperation on Environment and Development in 2013, in most Chinese urban cities, the implementation effect of green travel is not satisfactory. Specifically, the ever-increasing proportion of motorized travel is mainly due to car travel. While the proportion of public transport grows slowly, the proportion of walking and cycling declines rapidly. For example, the proportion of cycling drops 2–5% every year on average [5]. This is because green travel-related policies and measures are so wide and untargeted that they do not effectively promote urban residents to conduct green travel. Thus, developing different policies and measures for different groups of urban green travelers is necessary. To achieve this, studying the characteristics of urban residents' green travel is important. However, the travel behavior of urban residents is a very complex process, and travelers would consider values, personal norms, economic conditions, traffic conditions, as well as their own travel purposes when they choose travel modes [6]. Furthermore, most research on urban residents' green travel mainly focuses on travel mode choice [7] and its influence factors from the perspective of psychology and sociology [7]. Few studies are concerned about the characteristics and differences of different groups of urban residents' travel behavior. However, only when understanding the characteristics and differences of urban residents can effective and targeted policies and measures be made to promote them to choose green travel. Therefore, the aim of this study is to categorize urban residents into different social groups based on their values, attitudes, and behavior characteristics on green travel, to analyze the features, similarities, and differences of different groups, and then to propose suggestions for the transformation of non-green travelers into green travelers.

## 2. Literature Review

### 2.1. Green Travel

Green travel, which comes from the concept of green transport, aims to guide residents to choose travel modes that are energy-efficient, reduce pollution, and beneficial to residents' health, including taking a bus, taking the subway, ridesharing, walking, riding a bicycle, etc. [8]. With rapid economic development and the expansion of urbanization, car pollution can result in serious consequences without proper management. To overcome such difficulties, some researchers have paid attention to green travel. The majority of the research focuses on green travel behavior. Some studies indicate that socio-demographic characteristics are important contributors that affect green travel behavior. For example, Golob and Hensher [9] found that green travel behavior varied according to demographic characteristics, such as female travelers under 30 years old and over 50 years old, highly educated, with low car ownership, and with high incomes were more inclined to participate in green travel behavior. Plaut [10] indicated that age was considered a prominent influencing factor of green travel behavior. Valkila and Saari [11] used a case study to determine whether there are differences in energy attitudes and energy behavior between residents from different urban densities of residential districts and found that there was a gap between residents' attitudes and behavior. Mathew and Eric [12] found that green ideology was associated with green travel behavior, and residents with green values were more likely to support environmentally friendly travel. Chen and Guo [13], by applying the structure equation model, established the concept model of psychological factors on green travel and developed measurement instruments of the factors based on a large-scale sample survey. The result indicated that both the intention and the perceived behavioral control had a direct effect on conducting green travel. So due to the environmental and social benefits of green travel, many researchers have studied it, yet still more research is needed.

## 2.2. Travel Behavior

Many studies about green travel have explored the travel behavior of urban residents. Peattie [14] considered that according to different travel purposes, travel behavior can be divided into the following two categories. One is the daily traffic behavior, including work, shopping, and leisure. Another is tourist traffic behavior. This study mainly focuses on the daily traffic behavior of urban residents. Grdzelishvili and Sathre [15] conducted a study among car drivers and public transport users in order to find the reasons why private car usage is increasing dramatically. They found that time, comfort, and safety are important factors that cause residents to select private automobiles rather than public transport. Differences in accessibility [16] and residential dissonance [17] also influenced resident travel behavior. Susilo et al. [18] found that residents' car availability decreased walking, cycling, and public transport trips. Gatersleben and Uzzell [19] viewed resistance including past habits, past behavior, and psychological reaction as a barrier that impeded residents' travel behavior change towards sustainable behavior. Structural equation modeling was used by Silva et al. [20] to reveal the connection between land use patterns and travel behavior. Notably, car ownership, commuting distance, and the amount of mobility by mode (car, transit, and non-motorized modes) were included in travel behavior variables. They found that land use variables clearly influence travel behavior. Drivers' travel behavior change was affected by changes in company car taxation [21]. From these, it can be seen that the travel behavior of urban residents is affected by many factors, such as time, comfort, safety, availability, past habits, and past behavior.

## 2.3. Travel Mode Choice

In order to further study urban residents' green travel, there are some studies which focus on the influence factors of urban residents' travel mode choice. The survey conducted by Limtanakool et al. [22] indicated that socioeconomic characteristics of urban travelers, travel time considerations, and land use attributes influence travel mode choice, and their roles vary along with the travel purpose which is business, commuting, or leisure. The study by Wu and Yang [23] indicated that commuting distance significantly affects commuters' travel pattern choice and different types of residents have distinct reactions to distance when choosing the mode of transport. Zhao et al. [24] found that residents' attitudes towards service quality travel have an important influence on travel choice intention. Buys and Miller [25] demonstrated that utilitarian and psycho-social elements such as travel purpose and time-efficiency were strongly related to urban residents' travel mode choice. Parking charges [26], activity participation [27], and multiple identities [28] also had an effect on residents' travel mode. Paulssen et al. [29] suggested that personal values and individual attitudes impact travel mode choices. Notably, Cairns et al. [30] found that establishing sustainable travel patterns needs not only individual values and behavior changes, but also the change of social practices, cultures, and institutions.

## 2.4. Population Characteristics

The studies on urban residents' green travel are not limited to travel behavior and travel mode choice. A few studies have investigated the population characteristics of urban residents' green travel from different aspects. For example, from the perspective of gender, Scheiner and Holz-Rau [31] argued that gender differences exist in travel pattern choice. Dickinson et al. [32] indicated that compared with men, women commute shorter distances and cycle less. Hsu and Saphores [33] found that mothers are more inclined to chauffeur children to school than fathers, so interventions that encourage children to walk and bike to school should focus on the concerns and traffic characteristics of the mothers.

As for age, Mackett [34] found that the policy of concessionary bus travel for older people can improve older people's access to public transport services. From the point of socio-economic conditions, land use, and urban structures, Figueroa et al. [35] studied older and younger adults' travel mode. The results showed that for the older and younger adults, there are prominent differences between

their travel modes and spatial structural conditions, such as regional accessibility and density. There are also some studies about the characteristics of employees' green travel. Coleman [36] suggested the small business employers play a role in decreasing car-based employee travel. Lo et al. [37] suggested that social norms affect employees' work-related travel behavior. Marcus et al. [38] found that four mechanisms, namely regulation, information and exhortation, fiscal reform, and subsidies in commercial sector organizations, contribute to changing their employees' travel behavior. Due to the differences in attitude and personal income, organizational measures did not have similar effects on employee behavior [37].

In addition, Guella et al. [39] used a social practice theory framework to explore commuters' travel behavior through their commuting experiences and decisions. They found that choice and decisions are affected by commuters' reasoning, ambitions, and identities. The study of Cheng et al. [40] examined the travel characteristics and trip chain characteristics of urban low-income residents, and found that they have lower mobility than the non-low-income residents. Furthermore, Susilo et al. [41] argued that for certain traveler groups, such as women, young and low-income or unemployed travelers, there are distinctive determinants of satisfaction with trip stages for various travel modes.

### 3. Method and Data

In order to explore the different characteristics of different Chinese urban residents from the perspective of green travel behavior, it is required that residents with similar characteristics be categorized into one group. Thus the Q method, a method used to group people by their subjectivity [42], is applied in this study.

#### 3.1. Q Method

The Q method was invented by British physicist/psychologist William Stevenson in a letter to <Nature> in 1935 and provided a foundation for the systematic study of subjectivity, a person's viewpoint, opinion, beliefs, attitude, and so on [42]. The Q method treats respondents as the variable and the statement of a theme as the sample, and takes the respondents' standpoint and understanding as being central to its investigative procedure.

#### 3.2. Definition of the Concourse and Development of the Q Sample

In the Q method, the flow of communicability surrounding any topic in the ordinary conversation, commentary, and discourse of everyday life is referred to as a *concourse*, which contains words, pieces of art, collections of paintings, musical selections, photographs, etc. [43]. In order to ensure that the *concourse* covers as many views about green travel as possible, the *concourse* is obtained through a number of ways, such as journal articles, academic papers, research reports, newspaper articles, expert interviews, participant observations, and policy documents. The *concourse* involves the topics of environmental attitudes, personal values, the impact of individual travel behavior on the environment, travel mode choice, public transport, transport policies and measures, and so on. Then, the *concourse* of this study, including 100 statements, is obtained.

The Q sample (Q set) is a subset of statements, which is drawn from the *concourse*, and it is presented to the subjects [43]. The selection of statements from the *concourse* to form the Q set is of crucial importance [44]. First, 50 representative statements were selected through a Delphi procedure, which contains a group of experts, namely two university professors working in the environmental fields, two researchers from environmental research institutes, and one government officer from the environmental department. Second, in order to make the Q set comprehensive and applicable, 50 representative statements were put into preliminary investigation performed at Dalian University of Technology. Specifically, 15 master students and 10 doctoral students, who are in environmental majors, were invited to finish the original Q set. According to their advice, several statements they thought were important were added and they adjusted those they thought were unreasonable. Meanwhile,

a few statements were rephrased and refined so as to make them brief, clear, and understandable to participants. Finally, a set of 40 Q statements was gained in the final Q sample for this research.

### 3.3. Selection of the P Set and Q Sorting

A Q study does not require numerous participants (P sets), and a P set is not selected randomly [45]. P sets should have different and well-formed opinions to cover a wide variety of views, and represent the breadth of opinions in a target population under study [46]. Thus, in this study, P sets are chosen from engineers, public officials, researchers, company employees, and college students in two urban cities in China, Dalian and Yantai, because these two cities are both medium-sized coastal cities with ever-increasing family cars and are now also facing the severe transportation problem of traffic jams [7].

After selecting the P set, the second step of a Q study is Q sorting. However, the general Q sorting procedure based on face-to-face interviews is complex, time-consuming, and unfamiliar to the public. At the same time, Van Tubergen and Olins [47] believed that Q studies may be carried out by mail, and their research revealed that the results of Q sort self-administration are highly identical with in-person interviews. Reber et al. [48] found that the reliability or validity of computer-based Q sorts of administration have no apparent difference with the reliability or validity of interview-based Q sorts of administration. Consequently, this Q study is conducted online based on WebQ. According to the reference [49], the statements of the Q set need to be classified into three parts, “agree”, “disagree”, and “neutral”. Then, based on the degree of “agree” and “disagree”, these three parts are further detailed into nine or eleven levels from strongly agree to strongly disagree, with equal positive and negative levels, such as 5 positive and 5 negative, or 4 positive and 4 negative. The respondents in this study are instructed to rank 40 statements along a continuum from “most strongly agree” (+4) on one end to “most strongly disagree” (−4) on the other end. The distribution is similar to a normal distribution, but is actually not a normal distribution. Hence it is called a quasi normal distribution. The quasi-normal distribution in this study is shown in Figure 1. From November 2013 to January 2014, 60 questionnaires were sent to participants, and 53 questionnaires were collected. P sets should not more than 50 [43]. Thus, 50 effective P sets (50 Q sorts) were selected for this study.

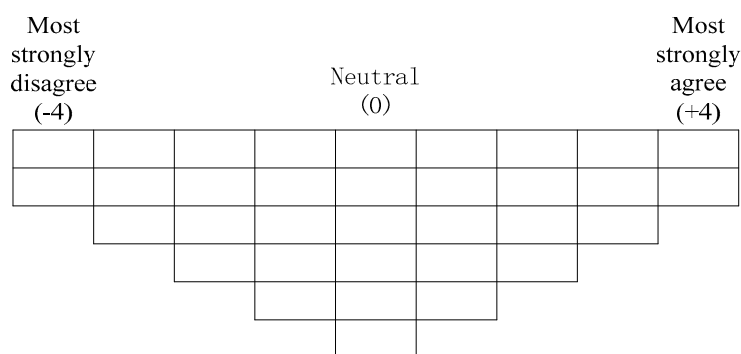


Figure 1. Distribution structure chart.

### 3.4. Data Analysis

The software used for analyzing data is PCQ for Windows Academic Edition. First, a correlation relationship analysis is performed to calculate the correlation matrix of 50 Q sorts, which represents the degree of similarity or dissimilarity in perspectives between the individual Q sorters. The correlation matrix is simply a necessary way station and a condition through which the data must pass on the way to revealing their factor structure [43]. The correlation matrix is subject to factor analysis, which identifies the number of natural types of Q sorts [42]. In the factor analysis, Principal Components Analysis (PCA) is adopted to extract the factors of this study and varimax rotation is used to rotate the factors. According to the principles of eigenvalues greater than one [50] and the variance contribution rate above 10% [51], three factors were selected for further analysis.

In order to identify which factor of Q sorts belongs to the same group, factor loading is calculated by the Q method. A factor loading needs to be determined for each Q sort so as to express the extent to which Q sort is associated with each other [52]. The factor loading evaluated by the standard of “factor loading value over  $3/\sqrt{n}$  (n is the number of Q statements) is taken as the criteria to determine that only those with factor loading value in some factor over  $3/\sqrt{n}$  can be categorized into this factor” [53]. In this study, n is 40, so factors with loadings above  $0.474(3/\sqrt{40} = 0.474)$  are significant. Thus, according to the standard of the absolute value of factor loading in excess of 0.474, 42 Q sorts are classified into these three factors. The Q sorts and their factor loadings are shown in Table 1. Factor 1 includes 11 Q sorts, factor 2 includes thirteen Q sorts and factor 3 includes eighteen Q sorts. In this study, the research of Straughan and Roberts [54] were referred to, which used the different shades of green to represent different categories of consumers’ green consumption behavior, to rename the three factors as the green traveler group, light green traveler group, and brown traveler group.

**Table 1.** Factor loading table.

P Set	Factor Loadings				P Set	Factor Loadings		
	1	2	3			1	2	3
p1	0.5534X	0.2817	0.2863		p34	0.2501	0.6025X	0.4663
p3	−0.6117X	0.1968	0.2341		p44	−0.1910	0.5244X	0.1621
p7	0.7351X	0.3521	0.0149		p47	−0.2552	0.4745X	−0.0582
p23	0.4964X	0.1069	0.1224		p2	0.4520	0.2969	0.5756X
p25	0.7521X	0.0987	0.1452		p4	0.1843	0.4629	0.6380X
p26	0.7829X	0.1433	0.2148		p6	−0.2110	−0.1021	0.5976X
p27	0.6238X	0.0483	0.4520		p10	0.4071	0.1478	0.7253X
p31	0.5023X	0.1319	0.1102		p11	0.2335	−0.0125	0.5665X
p32	0.7470X	−0.1209	0.2692		p13	0.2084	0.2982	0.5178X
p35	0.5485X	0.4284	0.0884		p14	0.0237	0.2351	0.4820X
p37	0.6589X	0.2318	0.0034		p18	0.4146	0.1920	0.5371X
p5	0.2445	0.6371X	0.0515		p24	0.1564	0.1353	0.5620X
p9	−0.0929	0.4744X	0.2463		p28	0.1810	0.0976	0.4894X
p15	−0.2210	0.5722X	0.3608		p33	−0.1847	−0.2491	0.4757X
p16	0.0837	0.4946X	0.3875		p34	0.4531	0.4437	0.5106X
p19	0.2802	0.6966X	−0.0334		p38	0.2977	−0.1365	0.6051X
p20	0.0949	0.6926X	0.1058		p40	0.3564	0.2876	0.5997X
p21	0.0661	0.5119X	0.2727		p41	0.3507	0.3266	0.6829X
p29	0.2185	0.7621X	−0.0510		p48	−0.2809	−0.0777	0.6003X
p30	0.2136	0.5293X	−0.0847		p49	−0.0590	0.1104	0.4799X
p36	0.2216	0.6235X	0.3734		p50	0.2920	0.1650	0.5313X

Before describing and interpreting the three factors, factor scores and difference scores must be calculated. A statement’s factor score, quite similar to the beta coefficient in regression analysis, reflects the degree that the statement contributes to the factor [7] and the difference score is the magnitude of the difference between factor scores of a statement on any two factors that is required for it to be statistically significant [55]. According to their factor scores, 40 Q statements can be placed in the original quasi-normal distribution, forming a composite Q sort for any one of the three factors. Generally, when a statement ranks at any extreme end of a composite sort, it is called a characterizing statement, which is used to reveal a first description of the composite point of view represented by that factor [55]. The difference score is based on the standard error (SE) for a factor score and the multiplier of a statistical significance level. The multiplier is 3.29 when the statistical significance level is at  $p < 0.001$ . The SE is calculated by the expression  $1/\sqrt{n}$ , where n equals the number of items (Q statements) [56]. The standard error of the difference (SED) is calculated by the expression SE, so the difference score for this study is 0.73 ( $3.29 \times SED = 3.29 \times 1/\sqrt{n}$ ) [44]. When a statement’s factor score between any of the identified factors does not surpass this difference score, it is called a consensus statement. A statement that is distinctive on two factors is called a distinguishing

statement. The consensus and the distinguishing statements can be used to illustrate the similarities and differences between any two factors [55].

## 4. Results

### 4.1. Demographics of the Respondents

The demographics of the respondents in this study include sex, age, education, occupation, and income.

For sex, this survey includes 33 males and 17 females, accounting for 66% and 34% of the total respondents, respectively.

For age, 22 respondents are between 20–29 years old, 12 are between 30–39 years old, 10 are between 40 ± 49 years old, and 6 are over 50 years old.

For education, 15 respondents have a Junior college degree, 17 have a Bachelor's degree, and 13 have a Master's or PhD degree.

For occupation, seven respondents are engineers, eight are government staff, two are doctors, two are lawyers, 14 are company employees, five are professionals, seven are researchers, and five are college students.

For monthly income, 31 respondents earn a monthly income of RMB ¥3000–8000 (about US \$440–1180), nine earn less than RMB ¥3000 (about US \$440), and ten earn more than RMB ¥8000 (about US \$1180) monthly.

### 4.2. Type Analysis

The characterizing statements of each group are shown in Table 2.

**Table 2.** Characterizing statements.

Factor	Item	Statement	Factor Score	Score in the Composite Sort
Factor 1 Green traveler group	1	In order to live in harmony with nature, we should choose green travel.	2.13	+4
	4	If public transport is convenient and can meet the need of my trip, I would choose it.	1.73	+4
	19	Regardless of whether others choose green travel, I will insist on green travel.	1.63	+3
	16	In order to protect environment, I select green travel.	1.45	+3
	26	Even if I have a car, I will try to take public transport to travel.	1.42	+3
	12	I do not intend to choose public transport to travel after owning a private car.	−1.11	−3
	40	I do not care about green travel.	−1.16	−3
	38	I rarely pay attention to green travel-related knowledge.	−1.17	−3
	31	I have more use of private cars due to convenience and comfort.	−1.35	−4
	7	In order to reflect my social status, I would like to choose private car travel.	−1.47	−4
Factor 2 Light green traveler group	1	In order to live in harmony with nature, we should choose green travel.	1.86	+4
	4	If public transport is convenient and can meet the need of my trip, I would choose it.	1.71	+4
	8	I worry about environmental problems brought by greenhouse gas emissions.	1.67	+3
	30	If the government has some incentives for green travel, I'll try to do it.	1.53	+3
	28	The policies about green travel made by the government affect my way to travel.	1.18	+3
	12	I do not intend to choose public transport to travel after owning a private car.	−1.28	−3
	15	I do not know what role green travel plays in environmental protection.	−1.70	−3
	11	I do not care about how I can drive a car in environmentally friendly way.	−1.90	−3
3	I do not know which mode of transportation is green.	−2.11	−4	
7	In order to reflect my social status, I would like to choose private car travel.	−2.12	−4	
Factor 3 Brown traveler group	4	If public transport is convenient and can meet the needs of my trip, I would choose it.	2.25	+4
	31	I have more use of private cars due to convenience and comfort.	1.81	+4
	1	In order to live in harmony with nature, we should choose green travel.	1.42	+3
	6	I choose a way to travel according to my habits, with little consideration of environmental factors.	1.30	+3
	17	If public transport does not involve the issue of social status, I will choose it.	0.94	+3
	37	I rarely care about greenhouse gas emissions and other environmental issues.	−1.27	−3
	15	I do not know what role green travel plays in environmental protection.	−1.59	−3
	24	My way to travel is very important for environmental protection.	−1.61	−3
	39	I do not care about the publicity associated with green travel.	−1.65	−4
	38	I rarely pay attention to green travel.	−1.83	−4

According to Table 2, in the green traveler group (Group 1), items 1, 4, 19, 16, and 26 have the highest positive factor scores, and items 12, 40, 38, 31, and 7 have the highest negative factor scores. Hence, these items are the characterizing statements of Group 1. Item 12 (I do not intend to choose public transport to travel after owning a private car) and item 26 (Even if I have a car, I will try to take public transport to travel) express the same meaning from negative and positive perspectives, and

they obtain the negative (−3) and positive (+3) scores, which indicates that the Q sample used in this study is credible.

From those characterizing statements, we find that Group 1 chooses green travel in order to live in harmony with nature and protect the environment. Their behavior is not affected by others. Even if they own a car, they still try to use public transport to travel. They are particularly against driving their cars to travel for the sake of showing individual's social status or for individual's convenience and comfort. At the same time, they are concerned about green travel-related information and knowledge. In short, they care about the environment, have rich green travel knowledge, oppose non-green travel behavior, and hold a positive environmental attitude on green travel. Just like what Paulssen et al. [57] found, personal values and individual attitudes have a great impact on travel mode choices. So people in this group conduct green travel due to their positive environmental values and attitudes. The greatest feature of Group 1 is that they have a comprehensive and profound understanding on green travel, and they insist on green travel actively and firmly in their daily lives.

In the light green traveler group (Group 2), items 1, 4, 8, 30, 28, 12, 15, 11, 3, and 7 are the characterizing statements. Group 2 strongly agrees with the statement that "In order to live in harmony with nature, we should choose green travel.", while they disagree with the opinion that driving a private car to travel is a reflection of social status. Meanwhile, they have some knowledge of green travel, for example, the importance of green travel for environmental conservation, green travel methods, green drivers, and so on. Even though they have a car, they will actively choose public transport to travel. In a word, they are worried about environmental issues and have positive environmental attitudes. However, froms item 4, 30, and 28, it is clear that the convenience of public transport, government incentives, and relevant policies will affect the travel behavior of Group 2. Actually many researchers such as Susilo et al. [18] and Shiftan et al. [21] indicated that the travel behavior of urban residents is affected by factors of time, comfort, safety, availability, and past habits or past behaviors, and these factors impede residents' travel behavior change towards green behaviors. So on the one hand, Group 2 accepts the concept of green travel, and on the other hand, their travel behavior is susceptible to external factors. Therefore, for Group 2, the appropriate incentives and the improvement of conditions will promote them to transform thier behavior from light green to green travel.

For the brown traveler group (Group 3), the characterizing statements are items 4, 31, 1, 6, 17, 37, 15, 24, 39, and 38. Group 3 recognizes that they should choose green travel so as to protect the environment, and travel mode choice has nothing to do with the symbol of status. At the same time, they express their concerns about green travel and have some knowledge of green travel. However, from items 4, 31, and 6, it can be found that although the convenience of public transport will make Group 3 choose public transport, they usually select their travel mode on the basis of their personal habits and they use private cars more generally for convenience and comfort. In fact, comfort and convenience are very important factors that affect residents to select private automobiles rather than public transport [15,20]. Moreover, they do not believe that personal travel mode choice plays an important role in environmental protection. In brief, the travel behavior of Group 3 is subject to individual needs and habits rather than environmental conservation.

#### 4.3. Consistency Analysis

The consensus statements of the three groups are shown in Table 3.



**Table 3.** Consensus statements.

Item	Statement	Factor Score in Every Factor		
		1	2	3
1	In order to live in harmony with nature, we should choose green travel	2.13	1.86	1.42
4	IF public transport is convenient and can meet the need of my trip, I would choose it	1.73	1.71	2.25
7	In order to reflect my social status, I would like to choose private car travel	−1.47	−2.12	−1.48
40	I do not care about travel	−0.81	−0.17	−0.30

According to Table 3, the difference of the factor scores of items 1, 4, 7, and 40 in any two factors is below 0.73, indicating that they are the consensus statements of the three groups. First, all three groups know about the necessity to select green travel and the positive role that green travel plays in environmental protection, which shows that for most residents, the concept of green travel has been basically established. Second, they all agree that if the public transport is convenient, they will choose public transport to travel. Thus, it can be concluded that travel convenience is an important factor for residents when selecting their travel patterns. Finally, most urban travelers rationally hold a negative attitude regarding the view that driving private cars to travel can reflect personal wealth and status.

#### 4.4. Difference Analysis

The distinguishing statements of any two groups are shown in Table 4.

**Table 4.** Distinguishing statements.

Group	Item	Statement	Factor Score		Difference
			Factor 1	Factor 2	
Group 1 and Group 2	19	Regardless of whether others choose green travel, I will insist on green travel.	1.63	−0.75	2.38
	14	I will take the initiative to learn about green travel-related laws, regulations, and policies made by the government.	1.18	−1.01	2.19
	5	I'm usually concerned about green travel-related knowledge.	1.27	−0.89	2.16
	23	I know about relevant policies made by the government to promote green travel.	0.61	−0.91	1.52
	33	Whether I choose green travel will be affected by the behaviors of people around me.	−0.74	0.44	1.18
	34	My personal way to travel has little impact on the environment.	−0.89	0.42	−1.31
	28	The policies about green travel made by the government affect my way to travel.	−0.42	1.18	−1.60
	30	If the government has some incentives for green travel, I'll try to do it.	−0.81	1.53	−2.34
Group	Item	Statement	Factor Score		Difference
			Factor 3	Factor 1	
Group 3 and Group 1	31	I have more use of private cars due to convenience and comfort.	1.81	−1.35	3.16
	6	I choose a way to travel according to my habits, with little consideration of environmental factors.	1.30	−0.49	1.79
	12	I do not intend to choose public transport to travel after owning a private car.	0.59	−1.11	1.70
	36	The implementation of the policy of car restrictions brings my life a lot of inconvenience.	0.49	−1.02	1.51
	35	I will actively respond to the green travel-related publicity organized by the government and other organizations, such as public service ads, etc.	0.03	0.90	−0.87
	5	I'm usually concerned about green travel-related knowledge.	0.31	1.27	−0.96
	26	Even if I have a car, I will try to take public transport to travel	−0.54	1.42	−1.96
	19	Regardless of whether others choose green travel, I will insist on green travel.	−0.57	1.63	−2.20

Table 4. Cont.

Group	Item	Statement	Factor Score		Difference
			Factor 3	Factor 2	
Group 3 and Group 2	31	I have more use of private cars due to convenience and comfort.	1.81	−0.42	2.23
	12	I do not intend to choose public transport to travel after owning a private car.	0.59	−1.28	1.87
	14	I will take the initiative to learn about green travel-related laws, regulations, and policies made by the government.	0.50	−1.01	1.51
	6	I choose a way to travel according to my habits, with little consideration of environmental factors.	1.30	−0.20	1.50
	30	If the government has some incentives for green travel, I'll try to do it.	0.54	1.53	−0.99
	33	Whether I choose green travel will be affected by the behaviors of people around me.	−1.10	0.44	−1.54
	38	I rarely pay attention to green travel.	−1.83	−0.01	−1.82
	39	I do not care about the publicity associated with green travel.	−1.65	0.39	−2.04

The differences between Group 1 and Group 2 are mainly reflected in the following four aspects. First, from item 19 and item 33, it can be found that the travel behavior of Group 2 is easily influenced by others, while Group 1 has a firm attitude about green travel in that they are not affected by others. Second, item 28 and item 30 express that government policies and incentives have more positive and greater impacts on Group 2 than Group 1. Thus, Group 2 is sensitive to others' travel behavior transformation and environmental policies. Third, according to item 5, item 14, and item 23, compared with Group 2, Group 1 holds a more positive attitude about green travel and is more willing to learn about green travel-related knowledge, regulations, and policies. Finally, Group 1 believes that personal travel mode has an effect on the environment. This belief will promote Group 1 to choose green travel mode and also to affect the travel mode choice of others around.

The differences between Group 1 and Group 3 are shown in three aspects. First, the different scores on items 31, 6, 12, 26, and 19 indicate that Group 1 and Group 3 hold diametrically opposite attitudes on travel mode choice. Group 3 selects a travel mode on account of personal comfort and habits, and they seldom take environmental factors into consideration. Whereas Group 1 is a firm practitioner of green travel, and their green travel behavior is not affected by owning a private car or others' travel behavior. Second, according to item 35, Group 1 responds to green travel-related publicity more actively than Group 3. Finally, item 36 expresses that Group 3 thinks that green travel policies, such as car restrictions, bring inconvenience to their lives, while Group 1 does not think so.

The differences between Group 2 and Group 3 are as follows. Group 2 has more environmental and friendly travel motivations and behaviors. In addition, compared with Group 2, the travel patterns of Group 3 are usually not affected by others' behavior, incentives, and other external factors. Thus, although Group 3 expresses concerns for green travel, they do not put it into practice.

In a word, all three groups have a good understanding on green travel-related knowledge and the positive role of green travel regarding environmental aspects. However, compared with the other two groups, the essential difference of Group 3 is that they do not put green travel into practice, and individualistic value is obvious in their travel mode selection. Meanwhile, the distinct feature of Group 2 is that their travel behavior is susceptible to external factors such as incentives and policies.

## 5. Discussion

Based on the analysis, urban residents can be classified into the three groups, green, light green, and brown travelers, and different groups of travelers hold different values and attitudes about green travel. Their specific travel behavior is also affected by different factors. Group 1 understands green travel comprehensively and profoundly, and they insist on green travel actively and firmly in their daily lives, due to the positive environmental values and attitudes [29]. Therefore, making suitable policies and measures to the targeted groups will effectively prompt all residents to perform green travel. For brown travelers, personal habits have hindered the implementation of green travel, so personal habit changes will guide this group to conduct green travel. Similarly, although light green travelers hold favorable environmental values and attitudes, the implementation of specific green

travel actions are usually susceptible to interpersonal and environmental factors. Based on the research by Susilo et al. [18] and Shiftan et al. [21], factors like time, comfort, safety, or availability could be obstacles that impede them from adopting green travel behavior. Consequently, for this group of residents, social condition improvement is of great importance. As for the green travelers, they have a good environmental attitude and stable green travel behavior. Hence, in this study, we mainly discuss how to make brown and light green travelers transform into green travelers.

The results shows that brown travelers usually have egoistic values. Their travel behavior is subject to personal habits, and environmental factors are rarely considered in their behavior decision-making process. Once their travel habits are formed, it is hard to change their behavior through external factors. Brown travelers view travel convenience and comfort as important factors in travel mode choice. Based on the transtheoretical model of behavior change, ten processes consisting of five stages are needed to form a new behavior by getting rid of an old one; they are consciousness raising, self-liberation, social liberation, self-reevaluation, environmental reevaluation, counterconditioning, stimulus control, reinforcement management, dramatic relief, and helping relationships [57]. Considering the characteristics of brown travelers, low environmental consciousness, and being seriously affected by external conditions, this study mainly focuses on the following three stages in order to convince brown travelers to transform to green travelers.

The first stage is enhancing their environmental values. To achieve this, travelers need to understand environmental information to improve environmental awareness. Governments can carry out green travel-related propaganda and practices in schools, enterprises, and communities. Governments can also release green travel reports regularly to the public, to increase public participation. After environmental values and the sense of responsibility are improved, travelers begin to try new travel modes and make green travel choices in practice. Therefore in stage two, travelers require a lot of travel information to help them make optimal judgments about green travel mode choices. Therefore, governments can provide the public with the information they need, such as the roadmaps for walking and cycling or the timetables of public transport. The third stage is strengthening green travel behavior. Green travel behavior calls for continual consolidation to ultimately form a green travel habit. In this process, governments can establish green travel behavior incentive mechanisms in the whole society to reward travelers who actively participate in green travel activities. The rewards can be a water bottle or a backpack for walking or cycling, and so on.

As is mentioned above, a primary feature of light green travelers is that their travel behavior is susceptible to physical and socio-cultural environmental factors. Remarkably, physical environmental factors mean the convenience and comfort of public transport at the infrastructure level. In the meantime, socio-cultural environmental factors point to the green travel-related laws, regulations, and incentives made by governments. More importantly, good physical and socio-cultural environments will encourage light green travelers to perform green travel. Therefore, the behavior transformation of light green travelers largely depends on the improvement of the physical and socio-cultural environment.

In terms of improving the physical environment, governments should take concrete measures to perfect transportation infrastructure, for instance by optimizing bus lines, recovering urban slow travel systems, and encouraging companies to increase the number of shuttle buss. Governments also need to consider how to make the public transport service system better, specifically regarding the aspects of providing accurate information on public transport travel, improving public transport comfort, and implementing integrated public transport systems. As for improving the socio-cultural environment, governments may establish a special fund for public transport development to support urban public transport construction.

## 6. Conclusions and Implications

Combined with the status quo of green travel in China, this paper uses the Q method to study the green travel behavior of urban residents. Based on the group classifications, it summarize the

attitudes, behaviors, and characteristics of different groups of travelers, analyzes the consistency and differences among those groups, and discusses the behavior transformation of non-green into green travelers. The main conclusions of this study are as follows. First, based on different values and travel attitudes regarding green travel, three groups of travelers are classified, namely green travelers, light green travelers, and brown travelers. Green travelers are concerned about environmental issues, have positive environmental attitudes and values, and have rich green travel knowledge. Most importantly, they put green travel into practice in their daily lives actively and firmly. Brown travelers, however, hold egoistic values and their green travel behavior, with little consideration of the environment, is mainly affected by individual travel habits. Thus, promoting brown travelers to transform into green travelers requires changing their egoistic values and overcoming their inherent bad travel habits. Third, light green travelers have certain knowledge on green travel and have good environmental attitudes, but their travel behavior is substantially affected by external factors such as the convenience of public transport and government incentives. Therefore, to promote light green travelers to transform into green travelers requires providing them with good environmental conditions and some incentives.

By applying the Q method, this study groups Chinese urban residents into three different groups, green, light green, and brown travelers, based on their subjectivity regarding green travel. The results show the implication of green travel and suggest how to foster green travel behavior. However, limitations of this study still exist. The characteristics of each group are identified and the implications are also provided in order to encourage each group to perform green travel behavior. Although this study tries to survey diverse respondents with different identities, still many other identities such as doctors and lawyers are not included in this study. Therefore in future research, more respondents need to be surveyed to more precisely reflect urban residents and their traits. Furthermore, the factors affecting light green and brown travelers need to be identified, and methods of encouraging light green and brown travelers to transform into green travelers merits further study.

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## References

1. Fu, L.; Yang, S.; Zhao, Y.; Chen, H. Urban Transportation Sustainable Development Strategies Based on the Conception of Green Traffic. *China Popul. Resour. Environ.* **2011**, *21*, 367–370. (In Chinese)
2. Dong, G.; Ding, H.; Hu, D. Chinese car carbon emissions estimates. *Sci. Technol. Vis.* **2014**, *15*, 48–49. (In Chinese)
3. Zhang, D.; Yang, X. Influences of Social Norm on Urban Travel Modal Choice Behavior. *J. Transp. Syst. Eng. Inf. Technol.* **2014**, *14*, 16–21. (In Chinese)
4. Yang, B.; Feng, X.; Zou, J. The Analysis on Current Situation and Countermeasures of Chinese green travel. *Environ. Prot.* **2013**, *41*, 39–40. (In Chinese)
5. Yi, T. China is not a big cycling country. *Gd. Gard. Sci.* **2014**, *24*, 8–9.
6. Lu, Y. Research on Psychological Behaviour of the Inhabitants on a Journey of Wuhu City. *Hum. Geogr.* **1996**, *11*, 44–48. (In Chinese)
7. Wang, Y. Study on Features of Urban Residents' Green Travel and Countermeasures of Behavior Change. Master's Thesis, Dalian University of Technology, Dalian, China, 2014.
8. Yang, R.; Long, R.; Bai, Y.; Li, L. The influence of household heterogeneity factors on the green travel behavior of urban residents in the East China region. *Sustainability* **2017**, *9*, 237. [[CrossRef](#)]
9. Golob, T.F.; Hensher, D.A. Greenhouse gas emissions and Australian commuters' attitudes and behavior concerning abatement policies and personal involvement. *Transp. Res. Part D* **1998**, *3*, 1–18. [[CrossRef](#)]
10. Plaut, P.O. Non-motorized commuting in the US. *Transp. Res. Part D* **2005**, *10*, 347–356. [[CrossRef](#)]
11. Valkila, N.; Saari, A. Attitude-behaviour gap in energy issues: Case study of three different Finnish residential areas. *Energy Sustain. Dev.* **2013**, *17*, 24–34. [[CrossRef](#)]

12. Kahn, M.E.; Morris, E.A. Walking the walk: The association between community environmentalism and green travel behavior. *J. Am. Plan. Assoc.* **2008**, *75*, 389–405. [[CrossRef](#)]
13. Chen, K.; Li, H.J.; Guo, F. An analysis on psychological factors of consumers' green commuting. *East China Econ. Manag.* **2014**, *6*, 129–134.
14. Peattie, K. Green consumption: Behavior and norms. *Annu. Rev. Environ. Resour.* **2010**, *35*, 195–228. [[CrossRef](#)]
15. Grdzlishvili, I.; Sathre, R. Understanding the urban travel attitudes and behavior of Tbilisi residents. *Transp. Policy* **2011**, *18*, 38–45. [[CrossRef](#)]
16. Srinivasan, S.; Rogers, P. Travel behavior of low-income residents: Studying two contrasting locations in the city of Chennai, India. *J. Transp. Geogr.* **2005**, *13*, 265–274. [[CrossRef](#)]
17. Vos, J.D.; Derudder, B.; Acker, V.V.; Witlox, F. Reducing car use: Changing attitudes or relocating? The influence of residential dissonance on travel behavior. *J. Transp. Geogr.* **2012**, *22*, 1–9. [[CrossRef](#)]
18. Susilo, Y.O.; Williams, K.; Lindsay, M.; Dair, C. The influence of individuals' environmental attitudes and urban design features on their travel patterns in sustainable neighborhoods in the UK. *Transp. Res. Part D* **2012**, *17*, 190–200. [[CrossRef](#)]
19. Gatersleben, B.; Uzzell, D. Self-identity threat and resistance to change: Evidence from regular travel behavior. *J. Environ. Psychol.* **2012**, *32*, 318–326.
20. Silva, J.A.; Morency, C.; Goulias, K.G. Using structural equations modeling to unravel the influence of land use patterns on travel behavior of workers in Montreal. *Transp. Res. Part A* **2012**, *46*, 1252–1264.
21. Shiftan, Y.; Albert, G.; Keinan, T. The impact of company-car taxation policy on travel behavior. *Transp. Policy* **2012**, *19*, 139–146. [[CrossRef](#)]
22. Limtanakool, N.; Dijst, M.; Schwanen, T. The influence of socioeconomic characteristics, land use and travel time considerations on mode choice for medium- and longer-distance trips. *J. Transp. Geogr.* **2006**, *14*, 327–341. [[CrossRef](#)]
23. Wu, J.; Yang, M. Modeling commuters' travel behavior by Bayesian networks. *Procedia Soc. Behav. Sci.* **2013**, *96*, 512–521. [[CrossRef](#)]
24. Zhao, L.; Wang, W.; Hu, X.; Ji, Y. The importance of residents' attitude towards service quality in travel choice of public transit. *Procedia Soc. Behav. Sci.* **2013**, *96*, 218–230. [[CrossRef](#)]
25. Buys, L.; Miller, E. Conceptualising convenience: Transportation practices and perceptions of inner-urban high density residents in Brisbane, Australia. *Transp. Policy* **2011**, *18*, 289–297. [[CrossRef](#)]
26. Bao, D.; Deng, W.; Gu, S. Impact of Parking Rates on Resident Travel Behavior. *J. Transp. Syst. Eng. Inf. Technol.* **2010**, *10*, 80–85. [[CrossRef](#)]
27. Pitombo, C.S.; Kawamoto, E.; Sousa, A.J. An exploratory analysis of relationships between socioeconomic, land use, activity participation variables and travel patterns. *Transp. Policy* **2011**, *18*, 347–357. [[CrossRef](#)]
28. Murtagh, N.; Gatersleben, B.; Uzzell, D. Multiple identities and travel mode choice for regular journeys. *Transp. Res. Part F* **2012**, *15*, 514–524. [[CrossRef](#)]
29. Paulssen, M.; Temme, D.; Vij, A.; Walker, J.L. Values, attitudes and travel behavior: A hierarchical latent variable mixed logit model of travel mode choice. *Transportation* **2014**, *41*, 873–888. [[CrossRef](#)]
30. Cairns, S.; Harmera, C.; Hopkina, J.; Skipponc, S. Sociological perspectives on travel and mobilities: A review. *Transp. Res. Part A* **2014**, *63*, 107–117. [[CrossRef](#)]
31. Scheiner, J.; Holz-Rau, C. Gendered travel mode choice: A focus on car deficient households. *J. Transp. Geogr.* **2012**, *24*, 250–261. [[CrossRef](#)]
32. Dickinson, J.E.; Kingham, S.; Copse, S.; Hougie, D.J.P. Employer travel plans, cycling and gender: Will travel plan measures improve the outlook for cycling to work in the UK? *Transp. Res. Part D* **2003**, *8*, 53–67. [[CrossRef](#)]
33. Hsu, H.; Saphores, J. Impacts of parental gender and attitudes on children's school travel mode and parental chauffeuring behavior: Results for California based on the 2009 National Household Travel Survey. *Transportation* **2014**, *41*, 543–565. [[CrossRef](#)]
34. Mackett, R. Has the policy of concessionary bus travel for older people in Britain been successful? *Case Stud. Transp. Policy* **2014**, *2*, 81–88. [[CrossRef](#)]
35. Figueroa, M.J.; Nielsen, T.A.S.; Siren, A. Comparing urban form correlations of the travel patterns of older and younger adults. *Transp. Policy* **2014**, *35*, 10–20. [[CrossRef](#)]

36. Coleman, C. Green commuter plans and the small employer: An investigation into the attitudes and policy of the small employer towards staff travel and green commuter plans. *Transp. Policy* **2000**, *7*, 139–148. [CrossRef]
37. Lo, S.H.; Breukelen, G.J.P.; Gjalt-Jorn, Y.P.; Kok, G. Proenvironmental travel behavior among office workers: A qualitative study of individual and organizational determinants. *Transp. Res. Part A* **2013**, *56*, 11–22. [CrossRef]
38. Enoch, M.; Potter, S. Encouraging the commercial sector to help employees to change their travel behavior. *Transp. Policy* **2003**, *10*, 51–58. [CrossRef]
39. Guella, C.; Pantera, J.; Jonesb, N.R.; Ogilviea, D. Towards a differentiated understanding of active travel behaviour: Using social theory to explore everyday commuting. *Soc. Sci. Med.* **2012**, *75*, 233–239. [CrossRef] [PubMed]
40. Cheng, L.; Bi, X.; Chen, X.; Li, L. Travel Behavior of the Urban Low-Income in China: Case Study of Huzhou City. *Procedia Soc. Behav. Sci.* **2013**, *96*, 231–242. [CrossRef]
41. Susilo, Y.O.; Cats, O. Exploring key determinants of travel satisfaction formulti-modal trips by different traveler groups. *Transp. Res. Part A* **2014**, *67*, 366–380.
42. Brown, S.R. A primer on Q methodology. *Oper. Subj.* **1993**, *16*, 91–138.
43. Brown, S.R. A Q Methodological Tutorial.Eight Postings to QUALRS-L@UGA. A Qualitative Methods List Out of the University of Georgia (1991/1992). Available online: <http://facstaff.uww.edu/cottlec/QArchive/Primer1.html> (accessed on 6 July 2014).
44. Brown, S.R. *Political Subjectivity*; Yale University Press: New Haven, CT, USA, 1980.
45. Cross, R.M. Exploring attitudes: The case for Q methodology. *Health Educ. Res.* **2005**, *20*, 206–213. [CrossRef] [PubMed]
46. Webler, T.; Danielson, S.; Tuler, S. *Using Q method to Reveal Social Perspectives in Environmental Research*; Social and Environmental Research Institute: Greenfield, MA, USA, 2009. Available online: [www.seri-us.org/pubs/oprimer.pdf](http://www.seri-us.org/pubs/oprimer.pdf) (accessed on 12 July 2014).
47. Van Tubergen, G.N.; Olins, R.A. Mail vs. personal interview administration for Q sorts: A comparative study. *Operant Subj.* **1979**, *2*, 51–59.
48. Reber, B.H.; Kaufman, S.E.; Cropp, F. Assessing Q-Assessor: A Validation Study of ComputerBased Q Sorts versus Paper Sorts. *Operant Subj.* **2000**, *23*, 192–209.
49. Luo, W.H. The theory and application of Q methodology. *J. Study* **1985**, *37*, 45–72. (In Chinese)
50. Stephenson, W. *The Study of Behavior: Q-Technique and Its Methodology*; University of Chicago Press: Chicago, IL, USA, 1953.
51. Thomas, D.M.; Watson, R.T. Q-sorting and MIS researeh: A primer. *Communications AIS* **2002**, *8*, 141–156.
52. Van Eeten, M. *Dialogues of the Deaf: Defining New Agendas for Environmental Deadlocks*; Eburon: Delft, The Netherlands, 1998.
53. Schlinger, M.J. Cues on Q-technique. *J. Advert. Res.* **1969**, *9*, 53–60.
54. Straughan, R.D.; Roberts, J.A. Environmental segmentation alternatives: A look at green consumer behavior in the new millennium. *J. Consum. Mark.* **1999**, *16*, 558–575. [CrossRef]
55. Van Exel, J.; De Graaf, G. Q Methodology: A Sneak Preview. 2005. Available online: [www.jobvanexel.nl](http://www.jobvanexel.nl) (accessed on 18 May 2014).
56. Raje, F. Using Q methodology to develop more perceptive insights on transport and social inclusion. *Transp. Policy* **2007**, *14*, 467–477. [CrossRef]
57. Prochaska, J.O.; Diclemente, C.C. Stages and processes of self-change of smoking: Toward an integrative model of change. *J. Consult. Clin. Psychol.* **1983**, *51*, 390–395. [CrossRef] [PubMed]

