

Article

Do Personal Norms Predict Citizens' Acceptance of Green Transport Policies in China

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Received: 19 May 2020; Accepted: 19 June 2020; Published: 23 June 2020



Abstract: In order to solve the environmental problems caused by the increasing private car use in China, such as transport energy consumption, traffic congestion, and air pollution, many policy measures including car purchase taxes, restrictions on car use in the city center, and incentives to promote electric vehicles have been developed. By taking Hangzhou, a low-carbon metropolitan city in China, as an illustrative example, green transport policies have been proactively implemented in order to turn the metropolitan city into an ecologically livable city. However, citizens' acceptance of comprehensive green transport policies has seldom been studied and explored, which is actually quite valuable information for implementing and assessing the effectiveness of green transport policies. This study presents a new integrated framework by extending the value belief norm (VBN) theory in order to explore the internal factors for predicting citizens' acceptance of comprehensive green transport policies and other pro-environmental behaviors in the transport field. A survey on car use reduction was conducted among citizens in Hangzhou and a quantitative analysis was performed using a structural equation model (SEM) method. Results show that personal norms can successfully predict citizens' acceptance of pull policies for reducing car use, while is less capable of predicting that of push ones. The theoretical implications of different pro-environmental behaviors are explained. This analysis may inspire policy makers to implement appropriate policies to encourage the public to use low-carbon transport in daily life.

Keywords: pull policies; push policies; personal norms; structural equation model; value belief norm theory

1. Introduction

Due to the rapid development of Chinese economy and urbanization, China's urban development is facing some environmental challenges in the transport field. According to a report released by the Chinese government on 12 January 2019, car ownership in China reached 240 million in 2018, a growth of 10.51% from 2017 [1]. By taking Hangzhou, a low-carbon metropolitan city in China as an illustrative example, private car ownership in it had soared to 2.08 million in 2018 [2] from 0.72 million in 2009 [3]. In order to solve the environmental problems caused by the increasing private car use in China, such as transport energy consumption, traffic congestion, and air pollution, many policies have been developed by local governments, including car purchase taxes, restrictions on car use in the city center, and incentives to promote electric vehicles. Although these policies are well-intentioned, it is unclear to what extent citizens in China, in particular Hangzhou, support these green transport policies.

In recent years, environmental problems caused by private car use have attracted the attention of both the government and researchers. Alternative fuel vehicles, such as electric vehicles, are regarded

as an important means to improve transport and address environmental problems [4,5]. It has been found, in our previous work, that monetary incentive policies are helpful to encourage the public to purchase electric vehicles [6]. Similarly, Brand et al. [7] conducted a scenario study to assess car pricing and taxation instruments, and suggested car purchase feebate policies are effective in accelerating the uptake of low-carbon technology and reducing life cycle greenhouse gas emissions. It was also confirmed that parking policy is a necessary measure to control urban road demand, and that a customized parking charge policy could address the phenomenon of parking difficulty in cities [8,9]. Pu et al. [10] reported that the restrictions on car licenses in Hangzhou would restrict the vehicles with certain license numbers from entering the downtown area during peak hours, and therefore effectively reduce the car emissions in the restriction area. Undoubtedly, most of the previous studies have shown that green transport policies are theoretically effective in alleviating traffic problems. But the real situation is that, when facing car license restrictions, citizens may purchase cars with licenses from neighboring cities and towns, but use the cars mainly in the metropolitan city. For example, in Hangzhou, despite the initial effectiveness of the license restriction policy on car use, congestion, pollution, and other environmental problems have re-emerged over time. Therefore, it is difficult for an isolated transport policy to achieve a lasting and effective change in reality.

However, studies concerning multifaceted transport policies are relatively rare and the public acceptance of these policies has seldom been analyzed. To fill this research gap, this study focuses on citizens' acceptance of comprehensive green transport policies instead of a single isolated policy, and aims to explore internal factors for predicting citizens' pro-environmental behaviors, such as the public acceptance of different green transport policies and behavioral intentions in the transport field.

On the other hand, the value belief norm (VBN) theory has been tested and widely used to predict the public's pro-environmental behaviors and behavioral intentions [11–13], but it has seldom been applied to test the public acceptance of multiple green transport policies. This study attempts to extend VBN theory by integrating twelve green transport policies as well as the intention to reduce car use in a comprehensive framework. In addition, twelve green transport policies were divided into two separate groups (i.e., pull policies and push policies) according to their coerciveness. A taxonomy study was conducted by comparing different green transport policies, and it was found that personal norms can successfully predict citizens' acceptance of pull policies for reducing car use, while is less capable of predicting that of push ones.

The remainder of this paper is arranged into four sections. Section 2 surveys the literature and illustrates the proposed conceptual framework and hypotheses. Section 3 demonstrates the main methodology. Section 4 presents the data analysis. Section 5 interprets the analysis and provides a conclusion and future research suggestions.

2. Literature Review and Hypotheses Development

2.1. Green Transport Policies

Green transport policy measures should be acceptable to the public in order to reduce the private car use [14], and the public acceptance of green transport policies is a crucial factor for decision makers to implement green transport policies [15]. Public support and attitudes toward different transport policies have been investigated in the literature. Sugiarto et al. [16] conducted a survey to test whether Jakarta residents support the urban congestion charge policy and found that the "awareness of city's environment" and "awareness of car problem in society" were two important reasons for supporting this green transport policy. Similar results were discovered in the implementation of alternative fuel vehicle incentive policies in Colombia [17] and green transport taxes in California, USA [18]. Domenico et al. [19] investigated some soft mobility interventions in Italy, which were combination of clean vehicles, shared mobility, and green public transport, and found that such measures could play a significant role in addressing traffic problems. In contrast, transport policies such as high parking fees, high toll charges, and high fuel taxes were sometimes not tolerated by citizens in Norway [8].

The effects of different transport policies implemented in different regions have also been evaluated by Nocera and Cavallaro [20] and Letnik et al. [21]. Researches from different countries and regions have shown that the public acceptance of different green transport policies varies. Therefore, there is a need to explore the public acceptance of various policies in the same region to better understand the differences in multiple green transport policies.

On the other hand, Keizer et al. [22] proposed that green transport policies could be divided into two groups (i.e., pull and push) according to their coerciveness. Pull policy measures in the transport field, with relatively low coerciveness, often refer to policies that make green transport means more attractive or increase public's benefits from eco-friendly behavior [14,23]. Examples include providing subsidies to encourage citizens to use public transport, promoting alternative energy vehicles with incentives, and organizing campaigns for green transport. Push policy measures often refer to financial instruments and regulations that add costs and limit one's freedom to use private cars [8,24]. Examples include excising a consumption tax on petrol, charging high parking fees, and restricting car use in the city's downtown area. The public acceptance of push policies has been found to be fairly low and may be influenced by social factors [8]. Compared with push policy measures, pull policy measures are usually more acceptable, because they add benefits and less costs to the public [25].

Therefore, twelve green transport policies were divided into two separate groups (i.e., pull policies and push policies) as two separate contrastive constructs based on their coerciveness, and a taxonomy study was conducted to explore the internal factors for predicting citizens' acceptance of different green transport policies in this study.

2.2. Value Belief Norm Theory

In order to explore citizens' attitudes toward green transport policies, this study employed the value belief norm (VBN) theory, which has been widely used to explain individuals' pro-environmental intentions and behaviors. The VBN theory was first presented by Stern [11], which extended Schwartz's norm activation model (NAM) [26]. There are three variables in the NAM, including the awareness of consequences (AC), ascription of responsibility (AR), and personal norms (PN). Specifically, AC indicates the level of an individual's feelings of undesirable consequences concerning others. AR means to what extent a person can take action or inaction to prevent adverse situations. PN refers to feelings of personal obligation. The NAM theory argues that AC triggers AR, which then activates PN in a causal chain. Building upon NAM, the VBN theory introduces value variables to study the motivation progress of behavior in the environmentalism context. Values are in the initial stage as guiding principles, leading to beliefs. Beliefs mainly contain AC and AR from NAM. Therefore, the VBN theory is also a causal chain that starts from values to beliefs, and then to personal norms. In addition, recent studies show that there are two possible paths after the awareness of consequences. Specifically, Fornara et al. [13] tested the value belief norm (VBN) theory to explore homeowners' intention to use renewable household devices and found that the link between the awareness of consequences (AC) and ascription of responsibility (AR) was weak, whereas a direct link between AC and personal norms (PN) emerged. Besides, Shin et al. [27] argued that personal norms (PN) was activated by the awareness of consequences (AC) and ascription of responsibility (AR) in choosing organic food at restaurants. Likewise, Gkargkavouzi et al. [28] studied the determinants of environmental behavior in a private-sphere context and found results similar as Shin et al. [27]. Thus, based on these recent studies [13,27,28], this study employed two possible paths after the awareness of consequences (AC). One path is that the awareness of consequences (AC) is expected to positively affect the ascription of responsibility (AR). The other possible path is that the awareness of consequences (AC) is directly linked to the individual personal norms (PN).

Plenty of empirical works have shown that the VBN theory could successfully predict pro-environmental intentions and behaviors in different fields. For example, Fornara et al. [13] adopted the VBN theory to explore homeowners' intention to use renewable household devices and suggested that moral norms were an important behavioral intention predictor. Youn et al. [29] examined traditional

restaurant diners' intentions through the VBN theory and found that traditional culture values had a strong influence on customers' intention to dine in traditional restaurants. The VBN theory has also been used to predict recycling behaviors [30] and transport behavioral intentions [8,31,32]. However, most previous work has focused mainly on behavioral intention variables, seldom exploring variables associated with the public acceptance of policies.

Therefore, the psychological factors from the VBN theory, including biospheric values (BV), awareness of consequences (AC), ascription of responsibility (AR), personal norms (PN), pull policies (PL), push policies (PS), as well as the intention to reduce car use (IN), will be analyzed in this study to predict citizens' acceptance of different green transport policies.

2.3. Framework and Hypotheses

As shown in the literature, pull and push green transport policies have been widely adopted by governments to improve traffic conditions and solve environmental problems in the world [14,22–25]. Researchers have engaged in conducting studies to evaluate the effectiveness and public acceptance of policies in the transport field. Some scholars evaluated and examined isolated transport policies instead of from a comprehensive perspective [4,5,9]. Some explored the different public acceptance of green transport policies in different countries and regions at different times [20,21]. In order to better understand the public acceptance of green transport policies, this study focuses on multiple transport policy scenarios and tries to evaluate the different green transport policies in the same region. This study extends the VBN theory by focusing on specific transport beliefs and integrating twelve green transport policies to predict citizens' acceptance of policies in the transport field. The VBN theory was extended by integrating pull and push transport policies into a comprehensive framework, as shown in Figure 1. Based on the literature review, the following hypotheses are presented.

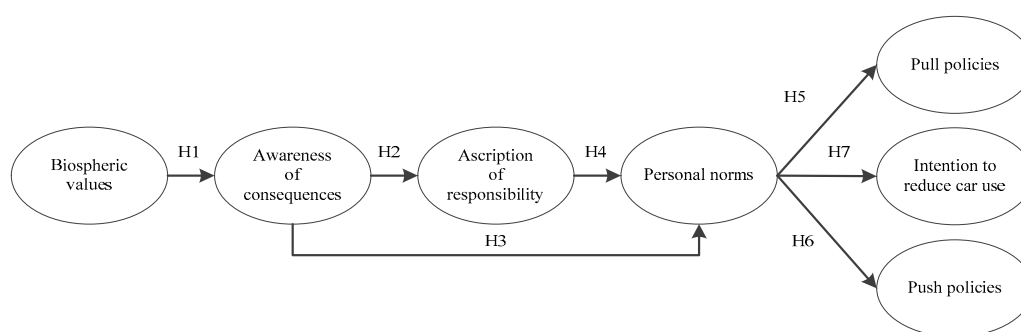


Figure 1. Modeling framework (Extended from Stern [11]).

Hypothesis 1 (H1). According to the VBN theory, an individual's biospheric values concerning environmental protection positively affect the awareness of consequences.

Recent studies show two possible paths after the awareness of consequences, through hypotheses H2 and H3 [8,31,32].

Hypothesis 2 (H2). One path is that the awareness of consequences is expected to positively affect the ascription of responsibility.

Hypothesis 3 (H3). The other possible path is that the awareness of consequences is directly linked to individual personal norms with positive effect.

Hypothesis 4 (H4). According to the VBN theory, personal norms are positively triggered by one's ascription of responsibility.

The VBN theory can be enhanced with three independent policy variables, including: citizens' acceptance of pull policies, citizens' acceptance of push policies, and the intention to reduce car use through hypotheses H5, H6, and H7, respectively.

Hypothesis 5 (H5). *Personal norms positively affect citizens' acceptance of pull policies [25].*

Hypothesis 6 (H6). *Personal norms positively affect citizens' acceptance of push policies [8].*

Hypothesis 7 (H7). *Citizens' intention to reduce car use is positively affected by personal norms [8,31,32].*

3. Methodology

3.1. Data Collection

Although many green transport policies have been developed by local governments to solve the environmental problems caused by private car use in China, it is still unclear to what extent the citizens in China, particular in Hangzhou, support these policies. Therefore, a survey concerning car use reduction was designed to explore citizens' attitudes toward different green transport policies. In December 2019, a survey on car use reduction was conducted in Hangzhou China through a well-known survey portal (<https://www.wjx.cn>), the largest online questionnaire survey platform in China. The initial questionnaire was developed by extending and adapting previous literature in English, so it was necessary to use a back-translation procedure to keep the questionnaire's consistency, avoiding the ambiguities caused by different languages. To avoid unnecessary mistakes due to unclear statements and to make the questionnaire more understandable, a pilot sample test was performed among volunteers. Minor revisions were made based on the pretest results. Then, the questionnaire was distributed online. Finally, 351 Hangzhou citizens participated in the online survey.

The sample size of 351 Hangzhou citizens was selected by following the rule of the partial least squares structural equation model (PLS-SEM) approach, which accepts a small sample size and guarantees reliable test results. According to Hair et al. [33], the minimum sample size should be 10 times the maximum number of items in a construct, therefore the required minimum sample size in this study was 60 ($10 \times 6 = 60$), considering that the policy construct contained the maximum number of items (6 items). According to Zhang et al. [34], the sufficient sample size should be about 10 times the number of all items, therefore the sufficient sample size in this study was 320 ($10 \times 32 = 320$), considering there were 32 items in total in this study. Besides, the mean sample size of PLS-SEM studies was 159, as was also reported by Hair et al. [33]. In addition, the required sample size in this study could be estimated by using the Power Analysis and Sample Size (PASS) software with certain statistic settings [35]. According to Hahn and Meeker [36], a required sample size of 123 could be calculated in PASS by setting the confidence level at 95%, the distance from mean to limits at 5, the estimated standard deviation at 28, and the population size at infinite. The confidence level could reach 99.9% with a sample size of 351 by setting, in PASS, the distance from mean to limits at 5, the estimated standard deviation at 28, and the population size at 6,353,000, i.e., the total population in Hangzhou's urban district by the end of 2018 [2]. Thus, 351 sample size in this study was small but adequate.

The original 351 respondents included 149 males (42.45%) and 202 females (57.55%). After excluding dishonest and irregular data, 315 valid samples were analyzed. The demographic features of the 315 respondents are shown in Table 1. Basically, the demographic features in Table 1 were consistent with that of Hangzhou Statistical Yearbook [2].

Table 1. Demographic features.

Participants' Characteristics	Categories	Quantity (n = 315)	Percentage (%)
Gender	Male	131	41.59
	Female	184	58.41
Age	Under 18	5	1.59
	18–29	113	35.87
	30–44	150	47.62
	45–59	38	12.06
	60 and above	9	2.86
Family size	1 people	8	2.54
	2 people	35	11.11
	3 people	103	32.70
	4 people	70	22.22
	5 people	99	31.43
Education level	Junior school or below	6	1.90
	High school	43	13.65
	College	155	49.21
	Master	99	31.43
	Doctor	12	3.81
Annual family income	Under CNY100,000	69	21.90
	CNY100,000–299,999	137	43.49
	CNY300,000–499,999	72	22.86
	CNY500,000–699,999	20	6.34
	CNY700,000 and above	17	5.40

3.2. Structural Equation Model

The Structural Equation Model (SEM) is a prevailing multivariate statistical method by integrating covariances and regressions, which can be used to analyze the relationships between multiple variables to verify the structure of the proposed model. In this study, the partial least squares (PLS) approach was used to test the proposed model. The PLS approach is an emerging branch of the SEM method, which can evaluate the measurement model and structural model in one software program [37–39]. As a multivariate statistical method, PLS-SEM has been widely used in psychology and behavior science [6,34,40]. The advantages of using PLS-SEM include the small sample size requirement, extraordinary exploration ability, and suitability for testing complex theories [33]. Therefore, this study employed the PLS-SEM approach with SmartPLS3.0 to test the proposed framework and aimed to explore internal factors for predicting citizens' acceptance of different green transport policies.

3.3. Measurement Model Design

The measurement model contains items and constructs which consist of the main part of the questionnaire, whereas the structural model (inner model) estimates hypothesized paths between constructs. From a mathematical point of view, the measurement model could be expressed as a series of equations, in which each item is regarded as a dependent variable and each construct is regarded as an independent variable [41]. Therefore, the measurement model in this study assumed causal relationships from a certain construct to its items [42]. Based on the literature, the measurement part of the survey included psychological variables in the VBN theory and enhanced policy factors in the transport field. Seven constructs were included in the measurement model, i.e., biospheric values (BV), awareness of consequences (AC), ascription of responsibility (AR), personal norms (PN), pull policies (PL), push policies (PS), and intention to reduce car use (IN). A five points Likert-type scale was used in the questionnaire, except for the demographic features. The measurement of the survey was arranged as follows.

According to the adapted version of Schwartz's values [43], part 1 of the questionnaire consisted of four biospheric values (BV), including "Preventing pollution", "Respecting the earth", "Unity with nature", and "Protecting the environment".

In part 2, respondents were asked to answer three questions about the awareness of consequences (AC) and four questions about the ascription of responsibility (AR). This part was adapted from Steg et al.'s [12] questionnaire on household energy. Two original items were adapted to suit the transport field, i.e., "Emissions from motor vehicles can lead to air pollution" and "I feel jointly responsible for the traffic congestion". The remaining items were borrowed from Steg et al. [12] and are shown in the Table A1.

In part 3 of the questionnaire, respondents were asked to answer five questions about personal norms (PN). The item "I feel morally obliged to use green transport instead of car" was adapted from Keizer et al. [22] to focus on green transport policy. The item "I feel obliged to bear the environment and nature in mind in my daily behavior" was adapted from Ünal et al. [32] to focus on the affected environment and nature. The remaining three items were borrowed from Ünal et al. [32] and are shown in the Table A1.

Part 4 consisted of two groups of transport policy factors, according to their coerciveness (i.e., pull policies and push policies). The questions about push policies were developed based on Nordfjærn and Rundmo's [8] work, and the questions about pull policies were developed based on Wicki et al.'s [25] work, and are shown in Table 2.

Table 2. Policy profile.

Items	Questions
PL1	Do you support government to subsidize for encouraging citizens to use public transport?
PL2	Do you support government to advocate green public buses?
PL3	Do you support government to promote new energy vehicles with monetary and nonmonetary incentive measures?
PL4	Do you support government to give public bus priority to use the bus lane?
PL5	Do you support government to improve public transport facilities?
PL6	Do you support government to campaign for green transport?
PS1	Do you support government taxes on fossil fuel?
PS2	Do you support government taxes on purchasing motor vehicles?
PS3	Do you support government road toll charges?
PS4	Do you support restrictions on car use in the city downtown?
PS5	Do you support restrictions on new car license?
PS6	Do you support the increase of parking fees in the city downtown?

Note: PL = pull policies, PS = push policies. A five points Likert-type scale was used in the questionnaire.

In part 5 of the questionnaire, participants were asked to answer four questions about their personal intention to reduce car use (IN). The items "It is possible for me to reduce car use in the next year" and "I could reduce car use in the next year" were adapted from Abrahamse et al. [44] to focus on car reduction intention. The items "I intend to use green transport more frequently" and "I will encourage people around me to choose green transport as much as possible" were adapted from Kang et al. [45] to focus on green transport intention.

4. Data Analysis

Three parts of the statistical data analysis were performed in this section. Firstly, the measurement model was analyzed to check the reliability and validity of the proposed model. Secondly, common method variance was examined using two methods to ensure that the collection of survey data would not be a possible threat to testing the hypotheses. Finally, the proposed hypotheses of the structural model were verified in SmartPLS3.0.

4.1. Measurement Model Analysis

To check the reliability and validity of the proposed model, three typical indicators should be tested, which was suggested by Hair et al. [46], including Cronbach's alpha, composite reliability (CR), and average variance extracted (AVE), as shown in Table 3. Cronbach's alpha and CR are important criteria to estimate the constructs' internal consistency and measure the variables' reliability. The recommended benchmark of minimum Cronbach's alpha is 0.70 [47,48], which can be satisfied in the current measurement model, whose lowest value of Cronbach's alpha is 0.841. The acceptable value of minimum CR is also 0.70 [48,49], which can be satisfied in the current measurement model, whose lowest value of CR is 0.902. AVE is a brief measure applied to assess the items' convergence for a construct. The acceptable minimum value of AVE to support a suitable convergent validity is 0.50 [48–50], which can be satisfied in the current measurement model, whose lowest value of AVE is 0.649. In addition to AVE, factor loadings can also be used to assess the convergence validity of a construct. The factor loading of each item reflects the statistical significance of each item to a certain construct by calculating the correlation between items and constructs in SmartPLS3.0. As shown in Table 3, values of factor loadings are all greater than the recommended value of 0.70 [48], indicating a good convergence validity of the constructs.

Table 3. Reliability and validity.

Constructs	Factor Loadings	Cronbach's α	CR	AVE
Biospheric values (BV)	0.876–0.917	0.918	0.942	0.803
Awareness of consequences (AC)	0.854–0.895	0.841	0.904	0.759
Ascription of responsibility (AR)	0.761–0.922	0.894	0.927	0.761
Personal norms (PN)	0.788–0.846	0.865	0.902	0.649
Pull policies (PL)	0.733–0.883	0.895	0.920	0.658
Push policies (PS)	0.780–0.845	0.906	0.926	0.677
Intention to reduce car use (IN)	0.828–0.907	0.899	0.929	0.765

Note: CR = composite reliability, AVE = average variance extracted.

Furthermore, the correlation coefficients of constructs were examined to test the discriminant by evaluating the square root of each construct's AVE. As shown in Table 4, the value of the square root of each construct's AVE is much higher than its corresponding correlation coefficients with other constructs, indicating adequate discriminant validity [48,49].

Table 4. Discriminant validity.

Constructs	AC	AR	BV	IN	PL	PN	PS
Awareness of consequences (AC)	0.871						
Ascription of responsibility (AR)	0.445	0.872					
Biospheric values (BV)	0.492	0.479	0.896				
Intention to reduce car use (IN)	0.440	0.412	0.380	0.874			
Pull policies (PL)	0.540	0.476	0.555	0.610	0.811		
Personal norms (PN)	0.578	0.586	0.539	0.637	0.661	0.806	
Push policies (PS)	0.438	0.355	0.262	0.503	0.330	0.428	0.823

Note: The bold data represents the square root of AVE.

4.2. Common Method Variance

Common method variance is a systematic error caused by the measurement method. Two methods were used to ensure that the collection of survey data would not be a possible threat to the hypothesis test.

Firstly, Harman's single factor test was performed. Podsakoff et al. [51] suggested that if common method variance exists, one general factor would account for the majority of covariance. A test was performed using SPSS 22.0 and resulted in a 24.985% covariance accounted by one general factor. A 24.985% covariance seems a little higher. However, Podsakoff et al. [51] reported that common method variance varied considerably by discipline and by the type of construct investigated,

and found an average of 40.7% common method variance in surveys concerning attitudes. Therefore, a 24.985% covariance could be acceptable, because the current questionnaire includes attitude constructs. This indicates that the survey data was not contaminated by common method variance [51].

Secondly, according to Liang et al. [52] and Zhang et al. [34], common method variance can be tested with a common method factor produced by all items. Every construct's variance is calculated with both substantive factors and a method factor. As shown in Table 5, the average value of $R1^2$ (square of substantive factors variance) is 0.7154, and the average value of $R2^2$ (square of the method factor variance) is only 0.0128. The ratio of $R1^2$ to $R2^2$ is 56:1, and all substantive factor loadings are significant ($p < 0.001$), which demonstrates that common method variance is not a possible threat to the hypothesis test [52].

Table 5. Common method variance.

Constructs	Items	Substantive Factor Loading (R1)	$R1^2$	Method Factor Loading (R2)	$R2^2$
Awareness of consequences (AC)	AC1	0.8600 ***	0.7396	0.1060	0.0112
	AC2	0.8990 ***	0.8082	0.0050	0.0000
	AC3	0.8540 ***	0.7293	0.0410	0.0017
Ascription of responsibility (AR)	AR1	0.7740 ***	0.5991	0.0640	0.0041
	AR2	0.8710 ***	0.7586	−0.0200	0.0004
	AR3	0.9190 ***	0.8446	0.0030	0.0000
	AR4	0.9190 ***	0.8446	−0.0830	0.0069
Biospheric values (BV)	BV1	0.8800 ***	0.7744	0.0300	0.0009
	BV2	0.9080 ***	0.8245	0.0840	0.0071
	BV3	0.8770 ***	0.7691	−0.0070	0.0000
	BV4	0.9200 ***	0.8464	0.0360	0.0013
Intention to reduce car use (IN)	IN1	0.8510 ***	0.7242	−0.0160	0.0003
	IN2	0.9010 ***	0.8118	0.2440	0.0595
	IN3	0.8980 ***	0.8064	−0.0340	0.0012
	IN4	0.8520 ***	0.7259	−0.3440 **	0.1183
Pull policies (PL)	PL1	0.8190 ***	0.6708	0.0890	0.0079
	PL2	0.8780 ***	0.7709	0.0080	0.0001
	PL3	0.7280 ***	0.5300	0.0420 **	0.0018
	PL4	0.8130 ***	0.6610	−0.1890	0.0357
	PL5	0.7510 ***	0.5640	0.1590 ***	0.0253
	PL6	0.8700 ***	0.7569	0.0600	0.0036
Personal norms (PN)	PN1	0.8420 ***	0.7090	−0.0750	0.0056
	PN2	0.8090 ***	0.6545	−0.0320	0.0010
	PN3	0.7870 ***	0.6194	−0.1540	0.0237
	PN4	0.7960 ***	0.6336	−0.1530	0.0234
	PN5	0.7930 ***	0.6288	0.2170	0.0471
Push policies (PS)	PS1	0.8550 ***	0.7310	−0.0560	0.0031
	PS2	0.8450 ***	0.7140	0.0400	0.0016
	PS3	0.8450 ***	0.7140	−0.0450 ***	0.0020
	PS4	0.7870 ***	0.6194	0.0060	0.0000
	PS5	0.8160 ***	0.6659	−0.1160	0.0135
	PS6	0.8010 ***	0.6416	0.0530	0.0028
Average		0.8443	0.7154	−0.0012	0.0128

Note: ** means $p < 0.01$, *** means $p < 0.001$.

4.3. Hypotheses Testing

The results of the PLS-SEM path hypotheses tested by SmartPLS3.0 are shown in Table 6. All proposed paths are significant ($p < 0.001$) by running bootstrapping in SmartPLS3.0, which suggests that the proposed model is effective and convincing. Specifically, the awareness of consequences is positively triggered by biospheric values at the start point of the causal chain, and thus H1 is verified.

The awareness of consequences positively affects the ascription of responsibility, and thus H2 is also confirmed. Both the awareness of consequences and ascription of responsibility positively affect personal norms, so H3 and H4 are verified. Both the policies and intention to reduce car use are predicted by personal norms with different path strengths, so H5, H6 and H7 are confirmed.

Table 6. Hypotheses testing results.

Paths	Sample Mean	Standard Deviation	T Statistics	p Values
H1: BV -> AC	0.490	0.064	7.733	0.000
H2: AC -> AR	0.446	0.064	6.928	0.000
H3: AC -> PN	0.397	0.058	6.859	0.000
H4: AR -> PN	0.410	0.057	7.225	0.000
H5: PN -> PL	0.667	0.049	13.607	0.000
H6: PN -> PS	0.434	0.053	8.051	0.000
H7: PN -> IN	0.641	0.053	11.941	0.000

Note: BV = biospheric values, AC = awareness of consequences, AR = ascription of responsibility, PN = personal norms, PL = pull policies, PS = push policies, IN = intention to reduce car use.

In addition, the coefficient of determination, R^2 , represents the explanation ratio of a construct's variance in relative to its total variance. The corresponding values of R^2 for intention, pull policies, and push policies in the proposed model are 0.406, 0.437, and 0.183, respectively (Figure 2). The values of R^2 in this study show a relatively strong explanation in predicting an individual's pro-environmental behaviors, compared with other relevant studies which presented R^2 for predicting individuals' pro-environmental behaviors within a range of 0.3 to 0.43 [13,28,30]. The explanatory power of the proposed model to predict citizens' acceptance of pull policies is strong, with an R^2 value of 0.437. The explanatory power of the proposed model to predict citizens' acceptance of push policies is weak, with an R^2 value of 0.183. Therefore, personal norms can successfully predict a citizen's acceptance of pull policies for reducing car use, while is less capable of predicting the acceptance of push policies.

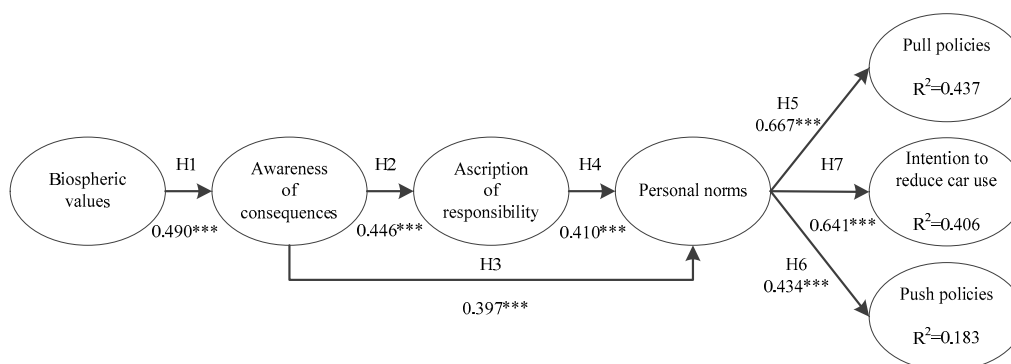


Figure 2. Test results of the research model. (Note: *** means $p < 0.001$).

5. Discussion and Conclusions

5.1. Discussion of Findings

In this study, the importance of psychological factors in predicting citizens' acceptance of different green transport policies, as well as car reduction intention, was analyzed. Specifically, general biospheric values trigger a citizen's awareness of the consequences of car use at the start point of the proposed model. After perceiving the negative consequences caused by car use, citizens may feel responsible for solving traffic congestion, air pollution, energy consumption, and global warming problems, which positively affect personal norms in the transport field. The possible path from the awareness of consequences to personal norms was also examined, indicating that citizens could form their personal norms directly from the awareness of consequences, to a certain extent. The awareness of global warming and the exhaustion of fossil fuels caused by traditional motor vehicles may also prompt

citizens to feel morally obliged to buy energy-saving vehicles when purchasing a new car. This path is consistent with recent studies that focus on other environmental behaviors, e.g., household energy and organic food [13,27,28].

On the other hand, the VBN theory was extended by applying pull and push transport policies as two separate contrastive constructs in a comprehensive framework. Results reveal that citizens' personal norms positively and significantly predicted the acceptance of pull transport policies and car reduction intention in the transport field. However, citizens' acceptance of push policies was less predicted by citizens' personal norms. Compared with push policies, pull policies are considered to be more acceptable, because they add more benefits and less costs to the public. This finding is consistent with previous studies in the transport field [14,22–24]. The possible reasons are as following.

Pull policies could bring relatively low costs to citizens, such as improvements in public transport infrastructure and subsidies for encouraging citizens to use public transport. Pull policies could increase citizens' travel choices and reduce the economic costs of commuting, which is usually more acceptable to citizens. According to Steg et al. [12], internal factors from the VBN theory, e.g., personal norms, have better explanatory power in predicting pro-environmental behavior with low costs rather than high costs. The cost could be in terms of money, time, and effort that people spend to do the right things. In contrast, push policies could bring high costs to citizens who are accustomed to using private cars, such as restrictions on car use in the city's downtown area and taxes on fossil fuels. Push policies could restrict one's freedom and add economic costs to driving a private car, which is usually unacceptable to citizens. In addition to internal factors, citizens' acceptance of push policies could be influenced by social factors, to a certain extent [8]. Guagnano et al. [53] also suggested that external conditions could affect attitudinal processes, and a low-cost condition is essential for activating personal norms and pro-environmental behaviors. In other words, environmental concerns such as biospheric values, awareness of consequences, ascription of responsibility, and personal norms are more likely to produce strong pro-environmental behaviors with low costs and less likely to produce strong pro-environmental behaviors with high costs [54].

5.2. Conclusions

This study was performed in Hangzhou, China, and a well-designed questionnaire was used to collect research data online. It attempted to understand citizens' acceptance of comprehensive green transport policies and explored the internal factors for predicting citizens' acceptance of different green transport policies as well as behavioral intentions in the transport field. Six pull policies with relatively low coerciveness and six push policies with relatively high coerciveness were included in the proposed framework. The proposed framework not only extends the VBN theory by including multiple green transport policies, but also evaluates and compares citizens' acceptance of pull and push transport policies. Specifically, personal norms can successfully predict citizen's acceptance of pull policies for reducing car use, while is less capable of predicting that of push ones. Strict push policies in the transport field may greatly increase the costs of purchasing or driving a private car, and internal factors become less capable of predicting citizens' acceptance of push policies in high-cost conditions. This will inspire policy makers to implement appropriate policies to encourage the public to use low-carbon transport in daily life.

5.3. Implications and Future Research

In addition to its academic value, the findings in this study may also provide practical implications for policy makers to develop and implement green transport policies. First, policy makers should take citizens' internal factors into account, such as the awareness of consequences, ascriptions of responsibility, and personal norms when developing green transport policies. Policy makers should realize that citizens with strong pro-environmental attitudes may have a greater motivation to reduce car use as well as to support green transport policies. Therefore, local governments should focus more

on pro-environmental education with social medias, aiming to improve citizens' awareness of their responsibility of reducing car use.

Second, considering citizens' high acceptance of pull policies, local governments should continue to strengthen pull policies and give priority to improving transport facilities, launching green travel initiatives, campaigning for green transport, and implementing incentive policies, which can lower citizens' travel cost in terms of money, time, and efforts. For example, organizing various green transport campaigns with social organizations could be an effective way to encourage the public to choose low-carbon travel modes, such as buses, subways, bicycles and carpooling. Moreover, new pull policies emphasis on innovation could be developed to enhance the efficiency of transport systems as well as to change the way people consume transport services [55].

Third, it is found that the citizens' acceptance of push policies is less significantly related with internal factors. How can push policies be made more acceptable? One solution is to take fairness and effectiveness into consideration [56]. The other possible solution is for policy makers to consider policy bundles [25], which combine pull and push policies into a package to reduce citizens' external barriers when launching push policies. To sum up, once the governments take citizens' internal factors into consideration and develop green transport policies with moderate costs, then citizens' internal factors like personal norms will play an important role in predicting and fostering pro-environmental behaviors. The increased citizens' acceptance of push and pull policies will effectively cultivate the public's pro-environmental behavior.

Though the current study has shown that citizens' internal factors are capable of predicting pull policies and the intention to reduce car use, this does not include external factors. In order to improve the public acceptance of push policies, external factors and more internal factors, such as one's economic situation, social norms, trust in government, and personal expectations could be included to enrich the proposed framework in a future study. Compared with Western countries, cities in China have their own characteristics, including high population density, rapid urban growth, soaring vehicle ownership, and a powerful government relative to civil society [57]. Therefore, future research could take these characteristics into account. In addition, limitations related to the sample collection should also be addressed. First, the questionnaire was designed in advance, so the respondents' answer choices are relatively limited, in a five points Likert-type scale. Future research should apply multiple scales of options and types of questions in the questionnaire, such as open-ended questions, to obtain more detailed information. Second, the quality of the sample depends on respondents' willingness to express their honest attitudes and provide authentic information, because the data acquisition process was performed online and anonymously. In addition to conducting an online survey, future research should adopt other methods to ensure the reliability of the samples, such as adding face-to-face interviews or cooperating with local governments to collect relevant data. Third, although Hangzhou is a pilot city in implementing comprehensive green transport policies and the PLS-SEM approach supports small sample analysis, more data could be collected from different areas and cities in China. Then, more samples could be used to examine the model's validity in predicting pro-environmental behaviors, especially the acceptance of green transport policies.

Author Contributions: Conceptualization, L.Z. and L.S.; Data Curation, L.S.; Formal Analysis, L.Z. and L.S.; Investigation, L.S.; Methodology, L.Z. and L.S.; Project Administration, L.Z.; Supervision, L.Z., S.Z. and W.Z.; Writing—Original Draft, L.Z. and L.S.; Writing—Review & Editing, W.Z. and S.Z. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Conflicts of Interest: The authors declare that there is no conflict of interest regarding the publication of this article.

Ethical Standard: The authors state that this research complies with ethical standards. This research does not involve either human participants or animals.

Appendix A

Table A1. Questionnaire items.

Constructs	Items	References
Biospheric values (BV)	BV1: Preventing pollution. BV2: Respecting the earth (living in harmony with other species). BV3: Unity with nature (fitting into nature). BV4: Protecting the environment (preserving nature).	Stern et al. [43]
Awareness of consequences (AC)	AC1: Emissions from motor vehicles can lead to air pollution. AC2: The exhaustion of fossil fuels is a social problem. AC3: Global warming is a social problem.	Steg et al. [12]
Ascription of responsibility (AR)	AR1: I feel jointly responsible for the traffic congestion. AR2: I feel jointly responsible for reducing air pollution. AR3: I feel jointly responsible for the energy problems. AR4: I feel jointly responsible for the global warming.	Steg et al. [12]
Personal norms (PN)	PN1: I feel morally obliged to use green transport instead of a car. PN2: If I would buy a new car, I would feel morally obliged to buy an energy-saving one. PN3: People like me should do everything they can to reduce car use. PN4: I feel obliged to bear the environment and nature in mind in my daily behavior. PN5: I would be a better person if I protected our environment.	Keizer et al. [22]; Ünal et al. [32]
Pull policies (PL)	PL1: Do you support government to subsidize for encouraging citizens to use public transport? PL2: Do you support government to advocate green public buses? PL3: Do you support government to promote new energy vehicles with monetary and nonmonetary incentive measures? PL4: Do you support government to give public bus priority to use the bus lane? PL5: Do you support government to improve public transport facilities? PL6: Do you support government to campaign for green transport?	Wicki et al. [25]
Push policies (PS)	PS1: Do you support government taxes on fossil fuel? PS2: Do you support government taxes on purchasing motor vehicles? PS3: Do you support government road toll charges? PS4: Do you support restrictions on car use in the city downtown? PS5: Do you support restrictions on new car license? PS6: Do you support the increase of parking fees in the city downtown?	Nordfjærn and Rundmo, [8]
Intention to reduce car use (IN)	IN1: It is possible for me to reduce car use in the next year. IN2: I could reduce car use in the next year. IN3: I intend to use green transport more frequently. IN4: I will encourage people around me to choose green transport as much as possible.	Abrahamse et al., [44]; Kang et al. [45]

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