Joint car ownership and car type preference model considering engagement in online activities and environmental concern

AUTHOR(S):

Kim, Junghwa; Tanaka, Hideki S.; Schmöcker, Jan-Dirk

CITATION:

Kim, Junghwa ...[et al]. Joint car ownership and car type preference model considering engagement in online activities and environmental concern. Transportation Research Part F: Traffic Psychology and Behaviour 2020, 68: 293-305

ISSUE DATE:

2020-01

URL:

http://hdl.handle.net/2433/283280

Unpublished version of: Kim, J., Tanaka, H. and Schmöcker, J.-D. (2020). Joint Car Ownership and Car Type Preference Model considering Engagement in Online Activities and Environmental Concern. Transportation Research Part F, 68, 293-305.

Joint Car Ownership and Car Type Preference Model considering Engagement in Online Activities and Environmental Concern

Junghwa Kim
Associate Research Fellow, National Infrastructure Research Division, Korea Research Institute for Human Settlements, Korea
5, Gukchaegyeonguwon-ro, Sejong-si, Korea, 30147
Tel: +82-44-960-0333, Fax: +82-44-211-4775; Email: junghwa.kim@krihs.re.kr

Hideki Tanaka
Associate Professor, Faculty of Economics and Business Administration, Kyoto University of Advanced Science, Japan
Kyoto Uzumasa Campus, Yamanouchi Gotanda-cho, Ukyo-ku, Kyoto, Japan, 615-8577
Tel: +81-75-406-9303, Fax: +81-75-406-9303; Email: tanaka.hideki@kuas.ac.jp

Jan-Dirk Schmöcker
Associate Professor, Department of Urban Management, Kyoto University, Japan
C1-2-436, Kyoto Daigaku-Katsura, Nishikyo-ku, Kyoto, Japan.615-8540
Tel: +81-75-383-7491, Fax: +81-75-383-3236; Email: schmoecker@trans.kuciv.kyoto-u.ac.jp

ABSTRACT

We investigate young people's attitudes to own a car. Our dependent variable is the desire to purchase any type of car as well as specific car types, such as small cars, sports cars or hybrid cars. We focus on Japanese aged 18 to 25 and obtain a valid sample of 1125 from Tokyo residents, Kyoto residents as well as people living in rural areas of Japan. As expected we find significant differences according to the city or rural living context. We control further for a number of attitudinal aspects that have been found significant in previous studies. We find that the perceived fun one gains from owning a car is an important factor and that more expensive and prestigious cars appear to be still desired. Our main focus and contribution is the inclusion of car's "usefulness to avoid pollution" and "online lifestyle". We find that those spending more time alone with online activities, have less desire to purchase cars. We discuss that there might be cyclic relationships which call for careful discussion on the implication of car ownership reduction in rural areas. Furthermore, there is some weak evidence for an "environmental dilemma" where pollution in fact encourages more car usage in order to avoid this pollution.

Keywords: Car ownership, Car type preferences, online activities, egoistic environmental concern

Introduction

There is a growing body of research showing that young people in developed countries have been losing interest in owning a car compared to prior generations. In Japan media describe this as "separation of young people from cars" (*Wakamono no Kuruma Banare* in Japanese). The Japan Automobile Manufacturers Association (JAMA) reported already in 2008 by their own survey that 79% of young people (age 18-29) in Japan had a drivers' license and 75 % of them had been using cars, of these "only" 54% had his/her own car. Also, JAMA reported that the younger the persons are, the less their car desire and the less their desire for specific car types and purchasing new cars. Similar trends of dropping car ownership have been reported also from other countries. Klein and Smart (2017) found that Millennials in the US do own fewer cars than previous generations did at similar age by examining recent changes in auto ownership among US families. Also business magazines have picked up on this reporting that the proportion of 18 to 34 years old in the US purchasing new cars dropped by 30% between 2007 and 2012 (CCNMoney, 2012).

Car ownership trends have to be seen within the context of other consumption and social developments. Returning to Japanese younger people, the focus of our study, the Japanese Consumer Affairs Agency (2017) reports that the consumption propensity of the young generation (18-25 years old as of 2017) is comparatively lower than that of former generations and that they tend to prefer "situation-oriented" consumption rather than "entity-oriented" consumption. The frequency of going-out activities by Japanese is declining in all generations with, again, a particular reduction among the younger people who instead more often than previous generations prefer in-home activities (JR East Move Design Lab, 2017). Younger Japanese are sometimes called "Smartphone Natives" as they spend a significant amount of money for mobile phones and

internet activities with the time spent on the smartphone by 10-29 year olds being extremely high compared with other generations (Ministry of Internal Affairs and Communication, 2017). Thus, these differences among the generations in attitudes and preferences are likely to have impacts also on factors such as car ownership and car type preferences. Supporting this, Yotsumoto (2012) also discuss that spread of internet usage might be a factor impacting car ownership. Similarly, but using UK data, Chatterjee et al. (2018) discuss comprehensively car ownership factors among young persons' and also note the importance of internet usage. Moreover they discuss the importance of urbanization trends, new forms of mobility and lifestyle changes going in-hand with this. For residents of major metropolitan areas, improved public transport, better cycling facilities as well as new forms of shared transport allow a life without a private car.

There are clearly more factors that explain less desire to own cars that are common to Japan and Western countries. Delbosc and Currie (2013) provide a literature review on reasons for declining driving license ownership. Driving license trends are likely emphasized for car ownership trends. Besides the above mentioned reasons Delbosc and Currie discuss that there is some evidence that later start of occupation, delayed marriages and family formation contribute to these trends. Such trends are also significant in Japan. Statistics Bureau of Japan (2019) reports that over the last 20 years the average marriage age has risen by 2.5 year for male and 2.7 years for female to 31.1 and 29.4 years respectively. Also the fertility rate has been declining in recent years again in Japan and reached 1.42 in 2018.

We acknowledge these overall demographics aside and aim to understand if such trends are compounded by the role of an "online lifestyle" and environmental concerns. We focus on younger

people as we expect the trends to be most pronounced in this population group. Furthermore, this market segment will have a large influence on understanding the future car market. We combine a study of car desire and "car type desire" as, according to Belgiawan et al. (2017), understanding the vehicle type desire also provides information about the value of car, especially if the car is seen as status symbol. In other words, to analyze car type desire is an important index for general vehicle desire. As will be explained the study of car ownership and car type desire will further help us to elucidate an "environmental dilemma" of a perception that the car is useful to avoid exposure to its own negative externalities. Finally, our study highlights the differences in car ownership and car desire between urban and rural regions of Japan. Whereas, it is not surprising that cars have a larger role in rural areas we will discuss that differences also exist in the car type desire reflecting not only different roles but also different perceptions of car ownership.

The structure of the remainder of this paper is as follows. The next section discusses previous research on young people's car ownership and vehicle type preferences. This is followed by a methodological section that describes our data, the latent constructs created and the analysis methodologies. In the results section, we first provide descriptive statistics before then estimating seemingly unrelated regression models. Finally, we discuss our findings and suggest some policy implications for future transportation planning.

Literature Review

A well-established early body of literature explains influential factors on vehicle and vehicle type choice, describing all, among others the importance of socio-demographics and income (Lave and Train, 1979; Manski and Sherman, 1980; Hocherman et al., 1983; Berkovec and

Rust, 1985; Mannering and Winston, 1985; Brownstone et al., 2000; Mannering et al., 2002). Studies with Japanese data point out that travel distance per year, family composition and the number of persons per household have a comparatively strong impact on car type decisions. (Yamamoto et al., 2001; Zhang et al., 2013). Recent literature has focused particularly on eco-friendly vehicles such as hybrid and electric car. Kim et al. (2014) use stated preference data from a Dutch sample and show the importance of costs as well as, to a lesser degree, the importance of social influence for the purchase intentions of electric cars. Hoen and Koetse (2014) discuss instead the perception of limited driving range perceptions as argument against purchasing electric cars also with a sample from the Netherlands. Ziegler (2012), to some degree similar to our subsequent work, discusses with German data preferences between different vehicle types and suggests that younger men are more open to vehicle types such as hydrogen powered vehicles.

A large number of studies have pointed out attitudinal factors as important determinants of car ownership (Wu et al., 1999; Steg et al., 2001; Gatersleben, 2011; Weinberger and Goetzke 2011). A seminal study is the one of Steg (2005) who showed and distinguished the importance of symbolic-effective, independence and instrumental values of the car. A number of other studies have refined these findings and developed partially different factors, but in general most agreed with the basic classification. For example Tanaka et al. (2015) compared the motives of car use among young urban drivers in Kyoto and Sao Paulo and also confirmed Steg's scales. They further pointed out the need to distinguish the importance of car as "fun". Further, Belgiawan et al. (2016) added the factors "arrogant prestige". Similarly, for car type choice, Choo and Mokhtarian (2000) and Nayum et al. (2013) show the importance of attitudinal factors and Choo and Mokhtarian in addition discuss personality and lifestyle relevance.

Gatersleben (2011) explored the influence of materialism on car ownership and showed that individuals who have stronger materialistic values are more likely to perceive the car as a status symbol and are less likely to be willing to reduce car use. Weinberger and Goetzke (2010, 2011) demonstrated the effect of past personal experience as well as the role of car ownership levels in one`s neighborhood on car ownership. Following this, a recent focus in the literature has been on the social influence through peers and others. Belgiawan et al. (2016) compared the role of attitudes and influence of others on car ownership from China, Indonesia, Lebanon, Taiwan, Japan, Netherlands, and USA. They found that there is significant correlation between attitudes towards car and influence of others on car purchase decision. Belgiawan et al. (2017b) extended the study and derived a number of formulations to include peer effects within a Structural Equation Model (SEM) in order to understand student's car ownership behavior. Nishihara et al. (2017) explored whether the significant others, especially parents, influence the decision of students to purchase a car or not. They collected data by surveying fathers, mothers and their adolescent children considering attitudes towards car ownership. By collecting 300 sets of family respondents in Japan, it was found that parents' car attitudes and the respect for their parents strongly influence the attitudes of the children.

Nayum et al. (2013) conducted post-purchase interviews with Norwegian buyers and suggest that sociodemographics are of relative little importance once psychological factors are controlled for. They further show that one's desire to purchase environmental friendly cars is strongly related to the resulting carbon emissions of the car. Belgiawan et al. (2017) adopted seemingly unrelated regression (SUR) and identified that besides the importance of the symbolic-affective value of a

car also awareness to negative effects of cars to some degree explain car-type preferences. The role of environmental concern for car purchase decisions has been explored in several studies though often not for first time car purchases specifically. Marell et al (2004) discuss its impact on car replacement decisions as an indirect factor via “aspiration level” which indicates the minimum quality one expects of a car. Siguradardottir et al (2013) discuss adolescents intentions to commute by car and with it car ownership and show some significance of environmental concern. Anable (2005) discusses with cluster analysis that environmental concern is part of a set of attitudes that can explain travel patterns and car ownership but only in conjunction with other attitudinal factors. This conclusion is in line with later studies such as Delbosc and Currie (2013) who review factors explaining declining mileage among younger people and Hopkins (2016) who looks into the role of environmental concern for obtaining a driving license. The general conclusion of these studies might be summarized as environmental concern having some influence but mostly minor and in a complex way.

We conclude that there is a rich literature on car ownership and preference of several car types, but few studies have been targeting only young people and even less have considered car ownership and car type preference together. Compared to Belgiawan et al. (2017), which is the study closest to this work, we consider new factors to understand young people’s car ownership behavior. We hypothesize that online activities and vehicle availability as a means to avoid environmental pollution affect car ownership.

Following the in the introduction discussed study of Chatterjee et al. (2018), changes to social-economic conditions and living circumstances are the main factors responsible for a drop in car

ownership among young people. They also identified that growing urbanization and a preference for young people to communicate online, rather than face to face, are other contributory factors to lose their interest in owning a car. They suggest that the social importance of having a car is diminished with the rise of social media on the internet. Even without going out by car, young people are able to meet and interact with others. We aim to quantify the importance of this compared to other factors.

Related to our hypothesis of car usefulness in order to avoid pollutants, some studies have demonstrated how much more public transport users are exposed to air pollution than car users. According to Moore at al. (2012), while waiting at bus stops, transit patrons may be exposed to greater amounts of vehicle-based pollution including particulate matter (PM). Won et al. (2012) analyzed the distribution of particulate matters including PM2.5 in public facilities and identified that subway stations had the highest indoor level of particulate matters followed by the waiting area in bus terminals, railway terminals and indoor parking lots. Though the general car user might not be aware of these facts, we suggest, that general concerns of inhaling or being exposed to pollution and extreme weather conditions can be another motivation for persons to use cars. Our study therefore investigates what can be referred to as “egoistic” or “personal” environmental concern; that is, the impact of environmental pollution on oneself (Schultz, 2001). We do not focus on concerns the car might have on other people or the environment in general.

Methods

Survey Implementation

In order to understand young people’s attitude towards having cars and decisions to choose car

types, we conducted a web-survey with data collected from various regions in Japan from October 10 to 24 in 2017. We aimed to include metropolitan areas, mid-size cities, and rural area. The metropolitan area we targeted are respondents living inside Tokyo prefecture with a population of 13.6 million (excluding population in surrounding prefectures that are still part of the Tokyo metropolitan area). Especially compared to Tokyo, we consider Kyoto City with a population of about 1.5 million as a mid-size city. “Rural areas” are here defined as prefectures without cities that have a population of more than 400 thousand. We collected samples from Toyama, Aomori, Iwate and Akita prefectures that all fit this description. With the support of a Japanese survey company we were able to collect 1125 complete samples with 350-390 samples from each region (391 Tokyo; 340 Kyoto and 394 rural area samples). The targets of this study are young people between 18 to 25 years. We set a minimum age of 18 years old since this is the youngest age when one can obtain a driver license in Japan. Intention to own a car might influence purchasing desire of specific types of car and that preferred car type might not be mutually exclusive or exhaustive with other types. Therefore, we asked our respondents regarding their present car ownership status and then their intention to purchase several car types.

Measurement of Car and Car Type Ownership as well as Desire to Purchase

Car ownership and car types

We surveyed the ownership at the time of the investigation as well as what type of cars persons own. For type, we provide the respondents with eight options: “Kei cars”, compact, mid-size, large size, SUV, foreign cars as well as hybrid cars and electric cars. Clearly a car could fit multiple categories. To avoid this and extract the “dominant feature”, we ask respondents to choose the single most fitting category for their main car. With examples it is made clear that the more specific

category should be chosen if applicable. For example, a “large BMW” should be classified as “foreign car” and a “Nissan Leaf” as electric car rather than a large-size or mid-size car respectively. Kei cars are a specific type of small vehicles in Japan. Their engine size must be below 660cc and further the vehicle size is limited to a length of below 3.4m. The cars are easily distinguishable on Japanese roads due to their different color number plates. They are primarily popular because of their reduced sales tax, annual vehicle tax and their low operational costs. A large variety of Kei cars exists including micro-vans and trucks as well as “box type” cars. Kei cars are often bought by first-time buyers as well as by families owning more than one car.

Foreign brand cars instead tend to be more expensive in Japan due to higher maintenance costs, nevertheless they have gained an increasing market share recently. At the same time fuel-consuming large cars and SUVs remain to be seen driven also in Japanese city centers. Hybrid cars such as “Toyota Prius” have already gained a significant market share in Japan whereas there are few electric cars.

Car desire and car type preferences

We asked respondents in addition whether they have intention to purchase a vehicle within the next five years. This question was measured with a 7-point Likert scale (No purchase intention – neutral – will certainly purchase). For the purposes of this study this factor was transformed into a binomial one with the cut of value being the observed mean value.

We further investigate preferences for specific car types distinguishing the same categories as above as well as in addition hydrogen cars. These are clearly in their very early stages and it is

likely that a number of respondents will not have formed firm opinions on these type of cars. Nevertheless, we included it as we suggest attitudes towards hydrogen-powered vehicles provide some information regarding attitudes towards the development of environmentally friendly cars.

To understand these trends we ask for "purchasing desire" by asking respondents "Assuming you will buy a car in the future, please rate how likely you are to purchase following type of car". The response is on a 7-point Likert scale (very unlikely – very likely) for each of the car types.

Car Ownership and Car Desire Determinants

Urbanization level and sociodemographics

Besides the surveyed attitudinal factors outlined in the following we expect the area in which the respondent is living to be of large significance. We obtain information on the prefecture where the respondent is living but not further details as to the land-use in the neighborhood of the respondent's residence or workplace. For sociodemographics we obtain information as to the person's gender, income and age which we expect to be significant in line with previous literature. For age, despite our focus on the narrow age band 18 to 25, we expect to observe some influence, since those in their first eligible year of driving and those who have already driven a few years might have different attitudes.

Attitudes towards Cars; Independence and Necessity

The respondents are given a range of questions regarding their general attitudes toward cars. The questions are partially based on the research by Steg (2005), but are modified to better fit the Japanese context. Each question is posed on a 5-point Likert scale with verbally defined endpoints

(strongly disagree – strongly agree). We conducted factor and reliability analysis and accordingly determine our attitudinal constructs. We obtain an “independence” and a “necessity” construct as well as constructs “online lifestyle” and “usefulness of car to avoid pollution exposure”. Reliability analysis showed acceptable Cronbach values for these constructs as shown in Table 1 with the one for online lifestyle at the lower boundary.

The “independence” factor is in line with previous research (Stradling et al., 1999; Steg, 2005). Its four items positively expresses the possibilities the car offers to reach destinations and to travel without reliance on others. With the items in construct “necessity” we stress not the possibilities the car offers but its meaning as a “last mobility resource”. Scoring high on this attitude means that one sees owning the car not as fun but as an unavoidable cost. In contrast to above literature where “instrumental” constructs and “symbolic affective” meaning of the car are expressed positively, we therefore expect a negative correlation of this construct with car ownership. We decided for these items in the survey as we suggest that for younger people the “fun aspect” of owning a car is important in line with findings reported in Tanaka et al. (2015). We note that we could not find an additional reliable symbolic-affective construct of significance (details omitted for brevity).

Table 1 Items, constructs and their reliability for car ownership attitudes

Factor	Questions	Reliability Test
Necessity (δ_{nec})	I do not care what kind of car I have	0.838
	For me, cars only bring me from A to B	
	The functional quality of a car is more important than the make	
	I only would buy a car if I really need one	
Independence (δ_{ind})	A car gives me freedom and independence	0.860
	It is important for me to be able to choose my own route	
	A car helps me to save travel time	
	A car allows me to travel anywhere and anytime	
Online lifestyle (δ_{ol})	I do a lot of online shopping	0.708
	I spend much time on the smart phone	
	I enjoy having time alone	
Avoiding pollution exposure (δ_u)	Car is useful to avoid exposure to PM 2.5 or "Yellow send" from China	0.804
	Car is useful to avoid exposure to UV in the summer	
	Cars are useful because "extreme rain" is becoming more frequent.	

Online Lifestyle

We define "online lifestyle" in this study as the degree of one's preferences to conduct virtual activities instead of potential participation in the activities of a social group. Along with established questions, we develop our original questions and scales for this construct in consideration of living circumstances and online activities. These are also measured by a 5-point Likert scale (strongly disagree – strongly agree) and its Cronbach's alpha value is at the lower boundary of acceptability with 0.708. Our first two items are directly connected to the role of the internet. The question on smart phone usage in relation to car ownership can point to a preference of using public transport as it allows one to be online or a lifestyle of aiming to be flexible in one's appointments and "not being bothered" of having to plan about parking during journeys, or needing to care for maintenance of the car etc. It might though also hint at a general preference of using the smart phone not for travel related activities but for a "virtual life" with spending time on the internet for shopping, possibly gaming and/or satisfaction of social life based on exchanging messages. All of these activities tend to reduce the need for travel. This latter interpretation is in line with the other two questions on preference for online shopping and spending time by oneself. As we observe high correlation between this questions we suggest this is the more likely interpretation and hence term the construct accordingly.

Usefulness of car to avoid pollution/extreme weather

We hypothesize that people more concerned about the effect of environmental pollution on their health might in fact use the car more (personal environmental concern). We consider a range of pollution factors and find a stable factor with questions asking respondents regarding their desire to avoid exposure to PM 2.5, UV and heavy, sudden rain. All three factors are common points in Japanese public discussion on increasing impacts of climate change throughout different seasons

of the year. In the first question we further include "Yellow sand" (*kosa* in Japanese) as dusty air and allergic reactions to this are bothering many Japanese during some days in spring. The harmful effects of PM 2.5 and of "*kosa"* have been well published. The Ministry of the Environment started calling for attention to *kosa* problems from 2008 and for issues related to PM 2.5 since 2013 (Ministry of the Environment, 2018). Health hazard issues by PM 2.5 and *kosa* have also been discussed recently by e.g. Li (2018). Regarding the third item, summers are hot in Japan, but to avoid exposure to UV some Japanese avoid wearing short sleeve clothes or avoid outside activities in the first place. Finally, heavy rain is a fairly frequent phenomena in Japan several times in a year. During June there is a distinctive rainy season and in autumn Typhoons can bring very intensive rainfalls.

Additional Determinants of Car Type Preference

Clearly determinants of car ownership and car type choice overlap and above four factors can also influence car type preferences. We suggest, however, that "awareness of environmental negative effects" as well as "perception of car ownership costs" are two additional factors more directly related to car type preference than car ownership per se as one can control the "degree" of these negative aspects by the type of car chosen.

Awareness of environmental negative effects of car usage

The awareness of negative environmental aspects of cars has been discussed in research on car use as well as car ownership. Bamberg and Schmidt (2001) noted that performing environmentally relevant behavior is influenced by variables such as motives and general environmental attitudes (Vinning and Ebreo, 1990, 1992). Matthies et al. (2002) demonstrated that the intention to reduce

car use is mainly influenced by the ecological norm. In addition Nilsson and Kulller (2000) investigated the impact of environmental concern and hazard/efficacy perception on car use and concluded that promoting pro-environmental behavior can be effective to reduce car usage. We aim to show that awareness of environmental effects has an effect on car type preferences. We therefore create our construct "negative environmental aspects of car use" with three items as shown in Table 2. The items "I feel that I should not drive to protect the environment" and "I am concerned about car emissions " are posed in a general way to avoid endogeneity of the construct with the car types.

Table 2 Items, constructs and their reliability for car type preference determinants

Factor	**Questions**	**Reliability Test**
Perception of negative aspects of car use (θ_n)	I feel that I should not drive to protect the environment	0.711
	We should use hybrid or electric cars more	
	I am concerned about car emissions	
Perception of car ownership costs (θ_c)	Car insurance is high	0.896
	Buying a car is expensive	
	Gasoline is costly	
	Parking charge is costly	
	Getting a driver's license is expensive	

Perception of car ownership costs

To further explain car type preferences we control for the perception of the various costs associated

with car ownership and car usage. Manski and Sherman (1980) also found that even though the influence of price and operating cost varies among socio-demographic groups, those variables are all important determinants of vehicle utility. In this study, instead of suggesting the expected cost for each car type, we measure cost perception as a latent variable constructed from measuring the respondents' attitudes to several costs associated with ownership as also shown in Table 2.

Seemingly unrelated regression (SUR)

SUR models estimate two or more regressions where the error terms of the regressions are correlated for a given individual but are uncorrelated across individuals, thus this can be analyzed separately while each has its own dependent variable and potentially different sets of exogenous variables (Zellner, 1962). Similar to the study of Belgiawan et al. (2017) we apply the SUR to regress intentions to purchase different vehicle types. SUR appears appropriate as there are likely correlations between the intentions for different vehicle types.

In order to consider the nine vehicle types, our SUR model consists of j = 1,…,9 linear regression equations for i = 1,…, N individuals. The j^{th} equation for individual i is:

$$y_{ij} = \pi_i \beta_\pi + \theta^K{}_{ij} \beta_j + \varepsilon_{ij}, \quad (j = 1, 2, \dots, 9) \tag{1}$$

where y_{ij} is the buying intention for car type j for individual i, θ_{ij} is a vector of the K explanatory (exogenous) variables for individual i, β_j is the parameter vector of size K for each car type j and ε_{ij} is an error term of the j^{th} equation for individual i. The assumption of the model is that error terms ε_{ij} are independent across time, but may have cross-equation contemporaneous correlations.

In addition, we define π_i as the probability of car ownership for individual i which is estimated separately with a binary logistic regression (BLR). δ_i is a vector of the T explanatory (exogenous) variables for individual i. Our BLR for car ownership can be presented in the following form;

$$\pi_i = \frac{e^{\delta_i^T \gamma}}{1+e^{\delta_i^T \gamma}} \tag{2}$$

$$\log\left(\frac{\pi_i}{1-\pi_i}\right) = \delta_i^T \gamma + \epsilon_i \tag{3}$$

where δ_i^T, $i = 0, 1, \ldots, m$, are logistic regression coefficients. We estimate two models for car ownership, one is for investigating a probability of present car ownership, π_i^p and the other one is for understanding the probability of future car ownership that young people are going to purchase a car within five years, π_i^f. These two probabilities will be considered as explanatory variables in Eq. (1). One can therefore consider our proposed methodology as a 2-step approach with car ownership and car desire explained in the 1st level and car type preferences determined in a subsequent step. We note that instead of the predicted current car ownership we could also utilize the actual car ownership instead as explanatory variable. This was also tested but led to a worse model fit. Our rationale for using the predicted car ownership is further that it indicates persons having attributes that make them likely to be a car owner.

Results and Discussion

Descriptive Analysis

339 respondents (30.1%) of our sample own cars. Table 3 indicates the car ownership by region. As expected, significant spatial variations exist. Car ownership in the rural areas is significantly larger with 58.1% versus 16.1% in Tokyo and 13.8% in Kyoto owning cars. The slightly larger percentage of car ownership in Tokyo than in Kyoto could be related to economic conditions as well as the fact that Kyoto's young people population has a higher proportion of students who moved to Kyoto from other parts of Japan and not tend to own cars.

Table 3 further shows the car types owned by the respondents. 28 young people own two cars so that there are in total 367 responses. The proportion of those who own a Kei car is over 56% which is understandable as this is a common first buyer choice. Compact cars and mid-size cars are the next most frequently purchased groups which further shows that most young people own relatively small size cars. The general better economic conditions in Tokyo and to a lesser degree Kyoto compared to rural areas again partly explains the tendency for less Kei cars and more foreign cars in Tokyo and Kyoto.

Table 3 Car ownership by types

	Car ownership		**Car type (best fitting category)**								
	Yes	No	Kei	Compact	Mid-size	Large	Foreign	SUV	Hybrid	Electric	Total
Tokyo	63 16.1%	328 83.9%	18 28.6%	15 23.8%	20 31.7%	8 12.7%	11 17.5%	3 4.8%	6 9.5%	0 0.0%	81
Kyoto	47 13.8%	293 86.2%	18 38.3%	7 14.9%	13 27.7%	5 10.6%	3 6.4%	4 8.5%	2 4.3%	0 0.0%	52
Rural	229 58.1%	165 41.9%	156 68.1%	34 14.8%	16 7.0%	7 3.1%	5 2.2%	13 5.7%	1 0.4%	2 0.9%	234
Total	339 30.1%	786 69.9%	192 56.6%	56 16.5%	49 14.5%	20 5.9%	19 5.6%	20 5.9%	9 2.7%	2 0.6%	367

Table 4 Mean and Std. dev. of car type preference

Types	**non-AFV**						**AFV**			**Averaged value**		
	Kei	Compact	Mid-size	Large	Foreign	SUV	Hybrid	Electric	Hydrogen	Total	non-AFV	AFV
Mean	3.76	3.47	3.37	2.61	2.59	2.74	3.38	3	2.23	3.02	3.09	2.87
Std. dev.	2.01	1.86	1.83	1.69	1.82	1.83	1.89	1.75	1.51	-		

Mean and standard deviation of car type preferences are shown in Table 4. As noted, for preferences we distinguish electric and hydrogen vehicles so that there are nine vehicle types. The mean value for general car purchase intention for all samples is 3.02 which is lower than the intention to buy small size cars (i.e. Kei compact and mid-size cars) which appears to be reasonable based on the statistics of car ownership by types in Table 3. Regarding AFV, we observe that young people state that they are more likely to purchase a hybrid car compared to electric or hydrogen cars. The mean intention for this car type is 3.38 which is larger than the general car purchase intention of 3.02. However, in general the average purchase intention of non-AFV cars is higher than that of AFV.

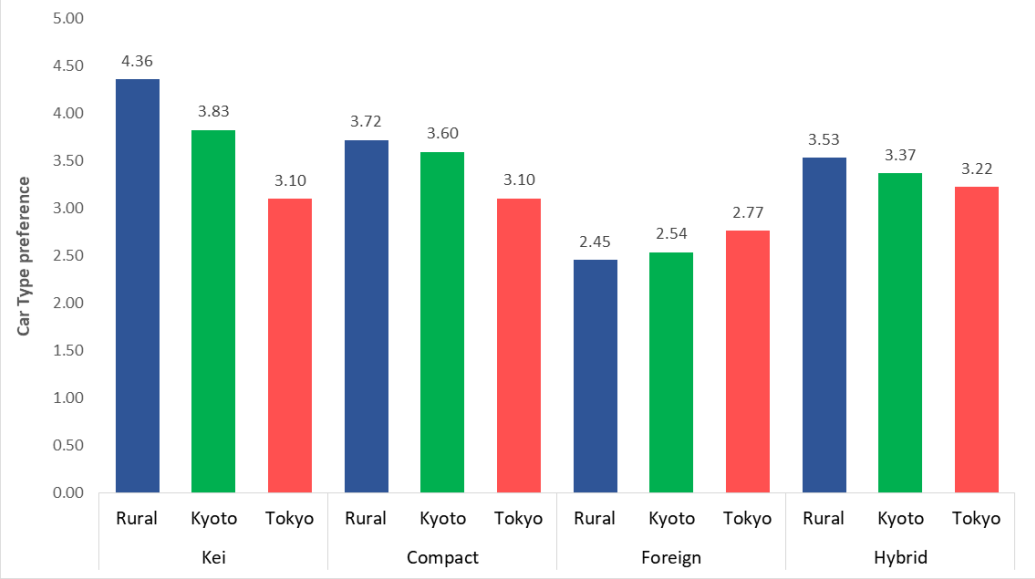

Figure 1 Significant differences in car type preferences by region (Mid-size, Large, SUV, Electric and Hydrogen show no significant differences)

We further investigate car type desire differences by area. Testing for significance we found that the differences for four car types are significant and show these in Figure 1. The trends largely follow the differences for car ownership shown in Table 3 with the exception for hybrid cars. Here

we observe a more positive attitude among the respondents in rural areas than from those in Kyoto and Tokyo. We note, however, the overall small number of hybrid car owners in Table 3. Hybrid cars are often considered as fuel efficient which might explain this result as those in rural areas tend to drive longer distance. We find the more positive attitude towards foreign cars in Kyoto and Tokyo further worth noting. A reason might be the aforementioned income level differences but suggest it also again emphasizes the functional role of the car in rural areas.

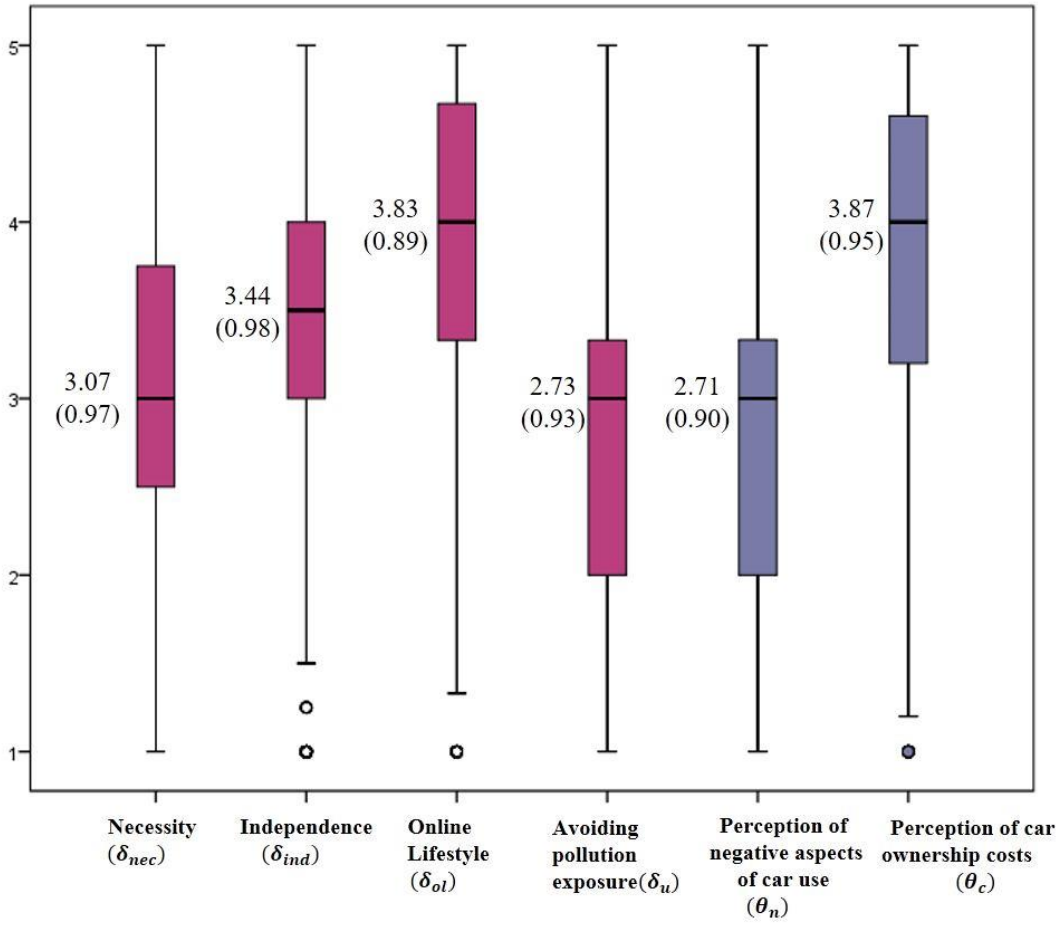

Figure 2 Mean and deviation of the four car ownership and the two car type preference determinants

Moving towards attitudinal factors, we illustrate their mean and standard deviation in Figure 2. The figure indicates that usefulness of car to avoid pollutants (δ_u) has the lowest mean value among the variables that determine car ownership. To interpret "online lifestyle" (δ_{ol}) we remind that it is measured on a reverse scale (i.e. a high value means that a person is less socially involved). Perception of negative aspects of car use (θ_n) and Usefulness of car at pollutant (δ_u) show similar mean values whereas car cost perception (θ_c) has the highest mean value of 3.87 compared to the others. Considering that all determinants were measured on a 5 point Likert scale, a response with a score lower than 3 (neutral) means a tendency to "disagree". Therefore, on average, young people tend to disagree with the statements that the "car is useful to avoid a polluted situation" and that the "car has a negative effect on the environment". Further, young people tend to agree that owning a vehicle is fairly expensive.

We further analyze correlations and discriminant validity between any pairs of the six constructs. We observe that there is significant correlation between "online lifestyle" and car cost perceptions (r = 0.601, p <0.01) which might link to less interest and knowledge about detailed car costs of non-car owners. We find that all discriminant values are less than 0.76, with the largest value again being observed for the relationship between online lifestyle and car cost perceptions. Referring to generally acceptable values of less than 0.85 we therefore suggest that all of the construct scales are significantly distinguishable.

In Table 5 we further illustrate the correlations between attitudinal factors, car ownership and car type preferences. Necessity, with its negative connotation, as well as a larger perception of the negative aspects of car usage have a negative correlation to car ownership. Furthermore, we find

in line with our expectations that those who just see the car as a means to get from A to B have less desire to purchase large cars, foreign cars or SUVs. Independence is highly positively correlated to smaller car types as well as to hybrid cars. The latter might be due to the fact that the dual combustion engine increases once perceived reliability of being able to use the car under any circumstances. Possibly in a natural disaster-prone country such as Japan this is valued higher than in other countries. For “online life” we observe a higher correlation with Kei cars than with other car type preferences but no correlation to car ownership itself. We return to this in our discussion on the subsequent regression analysis. Interestingly, usefulness of cars to avoid pollutants is positively correlated with all car type preferences without large differences.

Table 5 Correlation between attitudinal factors, car ownership and car type preferences

		Necessity	Independence	Online Lifestyle	Usef. at pollutant	Neg. aspects of car use	Cost perception
Car Ownership		**-.174****	**.213****	-.004	**.080****	**-.072***	-.021
Car Type Preference	Kei	**.168****	**.211****	**.138****	**.152****	**.083****	**.158****
	Compact	**.130****	**.254****	**.107****	**.189****	**.151****	**.195****
	Mid-size	-.035	**.282****	**.069***	**.132****	**.105****	**.125****
	Large	**-.069***	**.210****	-.022	**.191****	**.105****	.032
	Foreign	**-.172****	**.175****	-.005	**.122****	.056	.006
	SUV	**-.096****	**.206****	.006	**.166****	**.128****	.018
	Hybrid	.011	**.269****	**.083****	**.166****	**.220****	**.120****
	Electric	**.089****	**.205****	**.088****	**.178****	**.279****	**.106****
	Hydrogen	**-.124****	**.144****	**-.058***	**.088****	**.086****	-.041

Probability of Car Ownership and near furture car ownership

In Table 6, we estimated two BLR models; one for present and one for near future car ownership. We show the estimated coefficients and their standard errors. Furthermore, the last column for the two models contains odds ratios, that is, logistic regression coefficient exponents of the considered predictor. In the estimated present car ownership model, all of the hypothesized independent variables are significant. For future ownership, we find that usefulness of car and regional effects are not significant.

Table 6 Present and Future Car Ownership Regression Model

Dependent Var.		Present car ownership				Near future car ownership (within 5 years)			
Explanatory Var.		Coeff	S.E.	Wald	Odd ratio	Coeff	S.E.	Wald	Odd ratio
δ_{nec}	Necessity	**-0.415**	0.085	23.987	0.66	**-0.239**	0.070	11.731	0.79
δ_{ind}	Independence	**0.466**	0.097	22.867	1.59	**0.612**	0.074	68.354	1.84
δ_{ol}	Online lifestyle	**-0.336**	0.101	11.024	0.71	*-0.172**	0.080	4.564	0.84
δ_{u}	Usefulness of car at pollutant	*0.151*	0.090	2.801	1.16	-			
d_{sm}	Rural area dummy	**1.990**	0.154	167.968	7.31	-			
c	Constant	**-1.789**	0.109	266.927	0.17	**0.415**	0.064	42.724	1.51
-2 Log Likelihood		1091.1				1429.8			
Cox Snell R^2		0.224				0.076			
Nagelkerke R^2		0.318				0.102			

Bold *p value <0.01; Italic*p value<0.05; Italic p value<0.1*

For present car ownership the most influential psychological determinant is the independence value of the car with an odd's ratio of 1.59. This implies that if the independence attitude is increased by 1 unit, the odds of car ownership increase 1.59 times. Usefulness of car to avoid pollution has only a weakly positive significant impact on present car ownership. Necessity and online lifestyle show instead significant negative signs. The first one implies that those who consider cars only as an instrument for movement (but not fun) are less likely to purchase one. The implication of our result on online lifestyle is that those who enjoy time alone have a lower probability of (currently) owning a car. Finally, the impact of regional dummy (rural) is the strongest among the other variables with an odds ratio of 7.31. This indicates that young people in rural areas are 7 times more likely to own a car than those in Kyoto or Tokyo controlling for other factors.

The model for near future car ownership shows that regional effect and car usefulness to avoid pollution are not significant factors. We suggest that these results are reasonable and illustrate that for future car ownership decisions one considers "vague" aspects more. That is, future car purchase decisions are more influenced by the image of car use and a person's lifestyle rather than the factors related to environment and experience of car use.

Table 7 Car Type Preference SUR Model

Var.	Kei	Compact	Middle size	Large size	Foreign	SUV	AFVs		
							Hybrid	Electric	Others (Hydrogen)
θ_n	**0.217****	**0.365****	**0.252****	**0.186****	0.081	**0.327****	**0.580****	**0.652****	**0.488****
θ_c	**0.241****	**0.240****	0.082	-0.062	**-0.110**	**-0.126***	0.015	0.008	**-0.198****
π^p	**1.298****	0.449	-0.038	0.357	**-0.585***	0.268	0.154	0.065	-0.138
π^f	0.124	**1.526****	**3.473****	**2.705****	**3.851****	**3.051****	**2.977****	**1.574****	**1.348****
d_{female}	**0.760****	0.069	**-0.434****	**-0.477****	**-0.580****	**-0.567****	**-0.226***	**-0.360****	**-0.428****
d_{age}	**-0.050**	-0.031	**-0.052***	-0.017	-0.028	0.013	**-0.076****	-0.035	**-0.040***
cons	**3.186****	**3.016****	**3.190****	**2.047****	**2.027****	**1.472***	**3.624****	**3.416****	**3.054****
RMSE	1.91	1.77	1.72	1.61	1.73	1.73	1.74	1.62	1.42
R-sq	0.10	0.09	0.11	0.09	0.09	0.11	0.15	0.15	0.12
Chi2	122.55	112.67	143.75	109.65	115.47	133.41	201.71	194.91	154.03
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

*Bold** = p value <0.01; Bold * <0.05; Bold<0.1*

Car Type Desire

We now discuss the results of our subsequently estimated car type preference model shown in Table 7. We observe that the model fit for all vehicles types are acceptable with 1% error level. The perception of negative aspects of car use, θ_n, is significant for all car types except for foreign cars. This may indicate that young people who have an intention to buy such cars are not concerning car emissions. Surprisingly, we also observe a positive sign for θ_n for SUV. This might indicate that our respondents are not aware/ignore the energy consumption of such cars. Alternatively, possibly the interpretation of SUV by our respondents was different to our intention as we realized after the survey implementation that some fairly small hatchback cars are also sometimes referred to as SUV (even some Kei cars might be classified as SUV). In contrast, perception of negative aspects is much more significant for AFV (hybrid, electric and hydrogen cars) in line with our expectations. Cost concern, θ_c has a negative and significant coefficient only for foreign, SUV and hydrogen cars, while Kei and compact cars show a positive sign also in line with our expectation.

Moreover, the results show that young people who are more likely to currently own a car, are also more likely to buy Kei cars, but are less likely to purchase foreign cars. Considering this together with our observations from Table 3, one might further explore this to understand which of the Kei car owners are satisfied and will purchase a Kei car again. In addition, π_p, denoting the estimated probability of present car ownership, is positively influenced by usefulness of car to avoid pollution. Taking these results together suggests that those who have a high intention to purchase a Kei car are more likely to consider a car's usefulness to avoid exposure to PM, UV and extreme weather caused climate change. However, the model shows that they also perceive the negative

environmental aspects stemming from car use more significantly. Thus here we may refer to an *Environmental dilemma* regarding personal environmental concern and social environmental concern which can be represented by these two factors δ_u and θ_n. In other words, there is an internal conflict between personal attitudes in recognizing the adverse effects of car use on the environment, but also recognizing that cars are helpful for oneself to avoid exposure to environmental pollution. We acknowledge that this interpretation requires further verification, as we have only sufficient evidence for Kei car owners.

Probability of near future car ownership understandably influences most vehicle purchase likelihoods positively. The exception is Kei car, suggesting that if one is planning - or in this context we might say “hoping” - to buy a car in the future, one is not considering Kei cars until budget constraints have become clear. π^f is largest for foreign cars supporting this argument that one wishes for an expensive car. We further observe that, compared to other types of vehicles, π^f is relatively low for electric and hydrogen cars suggesting that these are not yet seen really as a desirable option. Considering the gender dummy variable, we find that female respondents are more likely to purchase Kei cars compared to the others. Middle, large-size, Foreign, SUV, hybrid, electric and hydrogen cars are more likely purchased by men. Also younger respondents (among our 18-25 year old response group) are more likely to purchase Kei cars, mid-sized cars, hybrid cars and hydrogen cars.

Conclusion

This study investigated the relationship between various aspects influencing the vehicle purchase decisions and vehicle type preferences of young Japanese by constructing a 2-step seemingly

unrelated regression where we consider the likelihood of owning a car and the car desire as determinants of vehicle type preference. Our major findings are as followings:

Through establishing the car ownership model, we confirm that the significance of living in metropolitan versus rural areas on car ownership preferences with the expected effect. We further demonstrate that young people's attitudes related to necessity and independence values of the car influence car ownership. We note also that we do not find symbolic-affective to be an important determinant, which is in line with some of the reviewed literature showing the declining importance of the car as a status symbol.

Our study mainly contributes to existing literature by showing the importance of two additional factors which are the car's "usefulness to avoid pollution" and "online lifestyle" and find evidence for this. In case of the former factor our evidence is weak, in case of the latter factor we have strong support from our sample. We find that those spending more time alone with online activities, have less desire to purchase cars. Considering both environmental and wider societal impacts this might be seen ambivalent, especially in Japan where effects such as "hikikomori" (extreme social withdrawal) are not insignificant. In fact, one might argue that there is not a cause-effect relationship as our regression analysis implies, but that there is a cyclic effect. More online activities will lead to less car desire but also less car ownership will lead to more alone, online activities. We suggest therefore that the effects of less car ownership among young people in rural areas requires further careful discussion and analysis.

We hypothesized the pollution avoidance factor to be a determining factor for car intentions due

to the increasing importance this appears to be given in the public recently. Increasing environmental problems mean one wants to minimize "exposure to the elements". At the same time the car is accepted as a pollutant by many. Though car usage is clearly not the only cause of pollution we suggest this in fact leads to an environmental dilemma. We defined this as recognizing the adverse effects of car use on the environment, but also perceiving the car as useful (or even necessary) to avoid (the same) environmental pollution.

We discuss that this environmental dilemma effects on specific car type desire and our model demonstrated this to some degree. Our model suggests that one's awareness of negative effects of car use influences car type preferences for more environmentally friendly car types and our results confirm this partially. The above defined environmental dilemma requires a positive sign for both θ_n (awareness of negative consequences of car usage) and for π_p (likelihood of car ownership which includes perception of cars being useful to avoid pollution/extreme weather exposure). We obtain this combination only for Kei cars which appears reasonable. We suggest that repeating this survey in countries with higher level of pollution problems than Japan might provide additional evidence for our findings. To provide stronger evidence in addition general environmental concern (independent of car usage) should be included in subsequent surveys and controlled for.

We further find it noteworthy that perception of negative aspects of car usage is largest for AFVs. To some degree this is expected, but it can also be interpreted as providing evidence for a strategy of promoting AFVs as an alternative to gasoline use vehicles. Our results suggest that through education on negative car impacts, one might not reduce car ownership but can promote the purchase of more environmentally friendly cars among young people. Especially in rural areas

it appears difficult to promote a "no car" lifestyle, but at least one can promote AFVs. Finally we note that, taken more generally, our study contributes to understanding the "safety perception" functions a car has. We discuss "protection against environmental aspects", similarly, further studies might explore the importance of a perceived gain in security against crime for car purchase decisions in different contexts.

ACKNOWLEDGEMENTS

The research is financially supported by JSPS project Kaken *PI 90567801 (category "Kiban C").*

REFERENCES

Anable, J. (2005). 'Complacent Car Addicts' or 'Aspiring Environmentalists'? Identifying travel behaviour segments using attitude theory. Transport Policy 12, 65-78.

Azuma, M. (2009). Analysis of Vehicle Selection Criteria of University Students: Case Study Using Evaluation Grid Method, Proceedings of Japan Ergonomics Society Conference, pp. 468-469.

Badland, H. M. and M.J. Duncan (2009). Perceptions of air pollution during the work-related commute by adults in Queensland, Australia, Atmospheric Environment, 43, pp. 5791-5795.

Bamberg, S. and P. Schmidt (2001). Theory-driven sub-group-specific evaluation of an intervention to reduce private car use. Journal of Applied Social Psychology, 13(6), 1300-1329.

Barker, M. (1976). Planning for environmental indices: Observer appraisals of air quality. In

"Perceiving environmental quality" (K. Craik and E. Zube, Eds.), Plenum, New York, pp. 175-204.

Belgiawan, P. F., Schmöcker, J.-D., Abou-Zeid, M., Walker, J., Lee, T.-C., Ettema, D. F. and S. Fujii, S. (2014). Car ownership motivations among undergraduate students in China, Indonesia, Japan, Lebanon, Netherlands, Taiwan, and USA., Transportation, 41, 6, pp.1227-1244.

Belgiawan, P. F., Schmöcker, J.-D., and S. Fujii (2016). Understanding car ownership motivations among Indonesian students, International Journal of Sustainable Transportation, 10(4), pp.295-307.

Belgiawan, P.F., Schmöcker, J.-D., Abou-Zeid, M. and S. Fujii (2017). Analysis of Car Type Preferences Among Students Based on Seemingly Unrelated Regression. Transportation Research Records, 2666.

Belgiawan, P.F., Schmöcker, J.-D., Abou-Zeid, M., Walker, J. and S. Fujii (2017b). Modelling social norms: Case study of students' car purchase intentions. Journal of Travel Behaviour and Society, 7(1), pp.12-25.

Berkovec, J. and J. Rust (1985). A nested logit model of automobile holdings for one vehicle households. Transportation Research Part B, 19(4), pp. 275–285.

Brownstone, D., D. S. Bunch, and K. Train (2000). Joint mixed logit models of stated and revealed preferences for alternative-fuel vehicles. Transportation Research Part B, 34(5), pp. 315–338.

Chatterjee, K., Goodwin, P., Schwanen, T., Clark, B., Jain, J., Melia, S., Middleton, J., Plyushteva, A., Ricci, M., Santos, G. and G. Stokes (2018). Young People's Travel – What's Changed and Why? Review and Analysis. Report to Department for Transport. UWE Bristol, UK.

Choo, S., and P. L. Mokhtarian (2004). What type of vehicle do people drive? The role of attitude

and lifestyle in influencing vehicle type choice. Transportation Research Part A, 38(3), pp. 201–222.

Consumer Affairs Agency (2017). White Paper on Consumer Affairs Agency 2017.

Delbosc, A. and Currie, G. (2013) Causes of youth licensing decline: a synthesis of evidence. Transportation Reviews, 33, pp. 271-290

Evans G. W., Colome, S. D., and D.F. Sheaper (1988). Psychological Reactions to Air Pollution, Environmental Research, 45, pp.1-15.

Gatersleben, B. (2011). The car as material possession: Exploring the link between materialism and car ownership and use. In K. Lucas, E. Blumenberg, & R.Weinberger (Eds.), Auto motives: Understanding car use behavior, Bingley, UK: Emerald Group Publishing Limited, pp. 137-148.

Hocherman, I., J. N. Prashker, and M. Ben-Akiva (1983). Estimation and use of dynamic transaction models of automobile ownership. Transportation Research Record: Journal of the Transportation Research Board, No. 944, pp. 134–141.

Hoen, A., and M.J. Koetse (2014). A choice experiment on alternative fuel vehicle preferences of private car owners in the Netherlands. Transportation Research Part A, 61, pp. 199–215.

Hopkins, D. (2016). Can environmental awareness explain declining preference for car-based mobility amongst generation Y? A qualitative examination of learn to drive behaviours. Transportation Research Part A, 94, pp. 149-163.

Hosmer, W. D. and S. Lemeshow (2003). Applied Logistic Regression, John Wiley & Sons, Hoboken, NJ, USA, 3rd edition.

Hunecke, M., Bloebaum, A., Matthies, E. and R. Hoeger (2001). Responsibility and environment: Ecological norm orientation and external factors in the domain of travel of mode choice

behavior. Evironment and Behavior, 33(6), pp. 830-852.

JAMA (2008) “Henka-suru Wakamono no Kuruma heno Kitai” (in Japanese) [Change in Young Person’s Expectation of Car]. Available from <http://www.jama.or.jp/lib/jamagazine/200805/01.html>. [Accessed July 2018].

JR East Move Design Lab (2017). Move Jittai Chousa 2017 (in Japanese) [The Report of MOVE, 2017] https://www.jeki.co.jp/info/files/upload/20170928/170928hpMDL1.pdf [Accessed September 2019].

Klein, N. J. and M. J. Smart (2017). Millennials and car ownership: Less money, fewer cars. Transport Policy, 53, pp.20-29.

Kim, J., S. Rasouli, and H. Timmermans (2014). Expanding scope of hybrid choice models allowing for mixture of social influences and latent attitudes: Application to intended purchase of electric cars. Transportation Research Part A, Vol. 69, pp. 71–85.

Lave, C. A., and K. Train. (1979). A disaggregate model of auto-type choice. Transportation Research Part A, Vol. 13, No. 1, pp.1–9.

Li, Y. (2018). Health Effects of PM2.5. Journal of Nippon Medical School (Japanese), 14(4), pp.152-156. Ministry of the Environment (2018) Web: http://www.env.go.jp/air/osen/pm/info.html (in Japanese)

Mannering, F., and C. Winston (1985). A dynamic empirical analysis of household vehicle ownership and utilization. The RAND Journal of Economics, Vol. 16 (2), pp. 215–236.

Mannering, F., C. Winston, and W. Starkey (2002). An exploratory analysis of automobile leasing by US households. Journal of Urban Economics, Vol. 52(1), pp. 154–176.

Manski, C. F., and L. Sherman (1980). An empirical analysis of household choice among motor vehicles. Transportation Research Part A, Vol. 14(5-6), pp. 349–366.

Marell, A., Davidsson, P., Gärling, T., and Laitila, T. (2004). Direct and indirect effects on households' intentions to replace the old car. Journal of Retailing and Consumer Services, 11(1), pp. 1-8.

Matthies, E., Kuhn, S. and C.A. Klöckner (2002). Travel Mode Choice of Women: The Result of Limitation, Ecological Norm, or Weak Habit? Environment and Behavior, 34(2), pp.163-177.

Ministry of Internal Affairs and Communication (2017). White Paper Information and Communications in Japan

Moore, A., Figliozzi, M. and C.M. Monsere (2012). Air Quality at Bus Stops: Empirical Analysis of Exposure to Particulate Matter at Bus Stop Shelters, Transportation Research Record: Journal of the Transportation Research Board, 2270, pp.76-86.

Nayum, A., C. A. Klöckner, and S. Prugsamatz (2013). Influences of car type class and carbon dioxide emission levels on purchases of new cars: A retrospective analysis of car purchases in Norway. Transportation Research Part A, Vol. 48, pp. 96–108.

Nilsson, M. and R. Kuller (2000). Travel behaviour and environmental concern." Transportation Research Part D, 5, pp.211-234.

Nishihara, N., Schmöcker, J.-D., Kim, J., Nakamura, T. and Uno, N. (2017). Understanding intergenerational relationship in car ownership desire: The influence of parents on young people. International Conference on Environmental Psychology (ICEP 2017). A Coruña, Spain, August 30 – September 2.

Sigurdardottir, S. B., Kaplan, S., Møller, M. and Teasdale, T.W. (2013). Understanding adolescents' intentions to commute by car or bicycle. Transportation Research Part D, 24, 1-3.

Statistics Bureau of Japan (2019). Statistical Handbook of Japan 2019. Available from < http://www.stat.go.jp/english/data/handbook/c0117.html> [Accessed October 2019].

Steg, L., Vlek, C. and G. Slotegraaf (2001). Instrumental-reasoned and symbolic-affective motives for using a motor car. Transportation Research Part F, 4(3), 151–169.

Steg, L. (2005). Car use: lust and must. Instrumental, symbolic and affective motives for car use. Transportation Research Part A, 39(2-3), 147–162.

Schultz, P.W. (2001). The structure of environmental concern: Concern for Self, Other People, and the Biosphere. Journal of Environmental Psychology, 21(4), 327-339.

Stradling, S.G., Meadows, M.L. and S. Beatty (1999). Factors affecting car use choices. Transport Research Institute, Napier University, Edinburgh, UK.

Tanaka, H., Amatucci, M., Luethge, D. and P. Byosiere (2015). A Social-Constructionist Comparative Study of Instrumental, Symbolic and Affective Motives of Car Use in Young Urban Drivers in Sao Paulo and Kyoto" Presented at GERPISA (International Network of Automobile) Conference, Paris.

Weinberger, R., and F. Goetzke (2011). Drivers of auto-ownership: the role of past experience and peer pressure. In K. Lucas, E. Blumenberg, & R. Weinberger (Eds.), Auto motives: Understanding car use behaviors, Bingley, UK: Emerald Group Publishing Limited, pp. 121-135.

Won, S.R., Lim, J.Y., Shim, I.K., Kim, E.J. Choi, A. R., Han, J.S. and W.S. Lee (2012). Characterization of PM2.5 and PM10 concentration distribution at public facilities in Korea, Journal of Korean Society for Indoor Environment, 9(3), pp.229-238.

Wu, G., Yamamoto, T. and R. Kitamura (1999). Vehicle ownership model that incorporates the causal structure underlying attitudes toward vehicle ownership. Transportation Research Record, 1676, 61-67.

Yamamoto, T., Kitamura, R. and I. Kohmoto (2001). An Analysis of Vehicle Type Choice,

Allocation and Use by Households. Infrastructure planning review (Japanese), 674, pp.63-72.

Yotsumoto, M. (2012). Loss of Interest among Youth toward Automobiles: Analysis of the Present State and the Possibility of a Breakthrough. IATSS Review (International Association of Traffic and Safety Sciences), 37(2), pp.123-131.

Ziegler, A. (2012). Individual characteristics and stated preferences for alternative energy sources and propulsion technologies in vehicles: A discrete choice analysis for Germany. Transportation Research Part A, Vol. 46 (8), pp. 1372–1385.

Zhang, J., Mang, J., Kuwando, M. and A. Fujiwara (2013). Comparative Analyses of Group Discrete Choice Models: A Case Study in the Context of Household Choice of Vehicle Type. Infrastructure planning review (Japanese), 23, pp. 463-472.