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Understanding car ownership motivations among Indonesian students

Prawira F. Belgiawan, Jan-Dirk Schmöcker, and Satoshi Fujii

Department of Urban Management, Kyoto University, Kyoto, Japan

ABSTRACT

Car and motorcycle ownership levels are increasing rapidly in southeast Asian developing countries, leading to unsustainable developments. In this article we focus on car ownership motivations in Bandung, Indonesia, where cars have become the main contributor to traffic congestion. We suggest that attitudes toward cars are important for explaining car ownership trends. Using data from 500 undergraduate students from one university in Bandung, this study constructs five factors regarding car perception through principle component analysis: *symbolic/affective*, *arrogant prestige*, *independence, comfort,* and *social/env. care*. These five factors plus some sociodemographic variables, such as *monthly income*, are used as explanatory variables for modeling car ownership using structural equation modeling. Our results suggest that primarily *independence, arrogant prestige,* and some sociodemographic variables significantly influence car purchase decisions. We discuss tentative implications for transport policy, given the limitations of our sample.

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Attitudes toward cars; car ownership; developing countries; structural equation modeling

1. Introduction

Car ownership levels are increasing rapidly in many developing countries. Increasing income levels allow in particular citizens of major cities to purchase more and larger vehicles. One particular trend of southeast-Asian countries is the upgrade process whereby current motorcycles owners are purchasing cars. Van, Schmöcker, and Fujii (2009) show that this trend will lead to significantly increasing congestion levels in Hanoi, and similar developments can be expected in several other major southeast-Asian cities. Other negative side effects such as air and noise pollution, accidents, and land-use development trends are also well known.

In Indonesia and other developing countries this trend toward more and larger vehicles appears to be continuing despite the lower average speeds of cars compared to motorcycles in the already congested cities and despite the other observable environmental side effects. Indonesia, with a total population of 240 million people, is the world's fourth most populous country (United Nations, 2011). In many islands of the country, the number of motorized vehicles is rapidly increasing, according to the Indonesian Central Agency of Statistics (2013): in 1987, Indonesians owned around 6 million motorcycles; in 1995, ten million; and by 2011, the 80 million motorcycles mark had been reached. Car numbers also keep increasing, though not as fast as motorcycle numbers. In 1987, there were around 1 million cars and by the end of 2011, there were already 10 million private cars on Indonesian streets (Figure 1).

Although the number of motorcycles still exceeds the number of cars by a factor of eight, the recent increase in cars is the main cause of traffic congestion. In Bandung, the city this article will focus on, car ownership levels reached 115.2 cars/1,000 people in 2010 (Bandung City Government, 2010), with rapid continuous growth expected. Furthermore, the trend toward more cars is difficult to control in Indonesia because almost all cities in Indonesia, except for Jakarta, do not have an advanced mass transportation system such as bus rapid transit (BRT). In Bandung, according to Joewono and Kubota (2005), 61.2% of public transport (PT) is operated in the form of Paratransit (Angkot), while the remainder is bus, taxi, and rickshaw.

Our aim in this article is to break down persons' motivations for purchasing cars in order to understand how one possibly can induce a shift toward more sustainable modes. Our hypothesis is that not just income but also attitudes toward cars can explain car purchases and travel behavior. This is in line with research on soft transport policy measures such as "mobility management," where it is found that through communicative methods, individual attitudes can be influenced, sustainable habits can be formed, and a change in travel behavior is possible (e.g., Fujii & Gärling, 2003; Gärling, Fujii, & Boe, 2001; Taniguchi, Suzuki, & Fujii, 2007).

According to Fujii and Gärling (2003), an increase in frequency of using a travel mode causes the development of a habit of using this travel mode and weakens the tendency toward choosing alternative modes; this is found for public transport as well as for automobile choice. Gärling et al. (2001) mention that frequent drivers who are forced to change to public transport for a short period continue to choose public transport more frequently than before the forced behavioral change. Hence, one might conclude that

CONTACT Jan-Dirk Schmöcker schmoecker@trans.kuciv.kyoto-u.ac.jp Department of Urban Management, Kyoto University, Kyoto, Japan.
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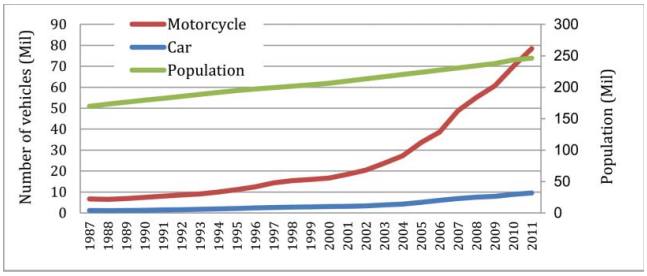

Figure 1. Population and motorized vehicles in Indonesia 1987–2011.
Source. Indonesia Central Agency of Statistics (2013).

it is possible to induce a shift to more sustainable modes by encouraging or enforcing sustainable habits at one life stage.

In particular, influencing *younger* people's habits appears to be important. According to Lanzendorf (2003) and Simma and Axhausen (2003), for example, the way one grows up influences the way one travels, including habits and one's perspectives on the car, for the rest of one's life course. Other research from the public health domain (Millstein & Litt, 1990) shows that habits developed during adolescence will have a significant impact on the lifelong lifestyle of individuals. Furthermore, commuting behavior in particular is mostly habitual and habits are usually formed immediately after getting a job. These habits are expected to be influenced, however, by behavioral intentions developed before getting a job (Fujii & Gärling, 2003).

Thus the main foci of this research are university students, whereby it is expected that their current habits could influence their commuting behavior not only in the present but also after they graduate and obtain a job. We aim to distinguish factors that lead to actual car purchases among students and factors that lead to a desire to buy cars in the future and hence survey car owners as well as (current) non-car owners.

The structure of this article is as follows: After this introduction, the second part of this article will discuss previous research on car ownership forecasting and the motivation of individuals for buying cars. The next part first discusses characteristics of our study area, Bandung, Indonesia, before explaining the survey among students regarding their motivation for buying cars. We then describe some aggregate statistics before employing principal component analysis to extract attitudinal factors that we hypothesize to determine car ownership decisions. These factors are subsequently used for regression and structural equation modeling (SEM) to understand car ownership factors. Finally, in the last section some conclusions and implications for transport planning are drawn.

2. Literature review

To model nationwide car ownership models, GDP is generally found to be the most important factor (Tanner, 1978). After considerable trials of alternatives, Tanner proposed an equation for car ownership per person that includes, besides GDP, income per person, population density, growth of population over 10 years, population proportions under 15 and over 64, and percentage of self-employed people. Together these factors "explained" 89% of the variation in car ownership between countries. Studies about car ownership in developing countries also find GDP to be a key determinant to replicate and predict car ownership levels (Button, Ngoe, & Hine, 1993; Kahn & Willumsen, 1986; Sillaparcharn, 2007).

Explaining car ownership levels by GDP development also has some important disadvantages, however. The main weakness is that there is no reason to expect relations of this kind to apply unchanged over long time periods and in particular when saturation is being approached (Tanner, 1978). Further, and possibly more important, this method cannot be used for proposing sustainable transport policies. For example, the above-mentioned literature on soft transport measures shows that one does not have to (nor want to) reduce the GDP to reduce car ownership levels. This explains the motivation for more disaggregate studies on car ownership levels.

Several studies have been carried out to identify factors that affect car purchase decisions of individuals. Although some studies consider the decision of whether to buy a vehicle or not, more often the focus has been on vehicle type choice, possibly due to easier access to data. Specifically multinomial logit (e.g., Kitamura, Golob, Yamamoto, & Wu, 2000; Lave & Train, 1979; Mannering & Winston, 1985; Manski & Sherman, 1980) and nested logit models (e.g., Berkovec, 1985; Berkovec & Rust, 1985; Hocherman, Prashker, & Ben-Akiva, 1983; Mannering, Winston, & Starkey, 2002) have been used to explain vehicle type choice. These models generally take vehicle attributes (e.g., operating cost, capital cost, and fuel efficiency), household characteristics, and principal driver characteristics as independent determinants.

The above literature does not consider individual behavioral intentions. According to the theory of planned behavior (Ajzen, 1991), behavior is constructed by intention and intention in turn is directly influenced by attitude toward the behavior. This explains our motivation to study attitudes toward "the car in general" to understand car purchase decisions. We define attitudes here as "a psychological tendency that is expressed by evaluating a particular entity with some degree of favour and disfavour" (Eagly & Chaiken, 1993, p. 1). In support of this approach, a study on car usage based on attitudinal factors has been carried out by Choo and Mokhtarian (2004), who conclude that future models of vehicle type choice can be substantially more powerful with the inclusion of travel attitudes, personality, lifestyle, and mobility factors. Also, Johansson, Heldt, and Johansson (2006) conclude that attitudes and personality traits can make mode choice models more powerful, and socioeconomic variables may aid in forecasting such variables.

Hence, some authors have applied attitudinal approaches to explain car purchase motivations. Steg (2003) studied the motivation of Dutch people for obtaining a driver's license and concluded that PT cannot compete with cars because people favor cars more due their "status value." This status value, an expression of personal identity, is also known as symbolic factor of cars. Steg (2005) continued her research, proving that people do not only drive their cars because it is necessary to do so, but also because they love driving. The result shows that the symbolic/affective meaning of a car becomes the most important factor for decisions to obtain a driver's license, mode choice, car purchase decisions, followed by instrumental and independence factors, respectively.

Gatersleben (2011) confirmed the Steg (2005) findings about social–symbolic factors related to car ownership and concluded that as long as the car is perceived as a symbol of success, road or public transport infrastructure investments are unlikely to result in major improvements to transport problems caused by excessive car ownership and usage. Weinberger and Goetzke (2010, 2011) obtained two further significant results by studying the effect of past personal experience on auto ownership and the effect of peer behavior on auto ownership decisions. First, people learn preferences and attitudes toward travel behavior from transportation options in their past, then they carry these preference and attitudes into current situations that influence their car ownership decisions. Second, people are influenced in their car purchase decisions by social peers and neighbors.

All of the studies on attitudes toward cars have been carried out with data from developed countries and there appears to be a lack of work with survey data from developing countries, with the exception of a study by Van and Fujii (2011). They studied attitudes toward private car usage, but not purchase, across six Asian countries, with the surprising result that attitudinal variables had significant effects on the behavioral intention to commute by car only in Japan, China, and Vietnam but not in Indonesia, Thailand, and the Philippines. In their research, based on constructing attitudinal factors through principal component analysis and regression analysis, three main dimensions of attitudes toward car are proposed and referred to as *symbolic/affective*, *instrumental,* and *social orderliness*. The latter one has been found only in this study with Asian data. It comprises beliefs such as environmental friendliness, safety, altruism, quietness, etc. Although previous studies mention instrumental factors of cars as the main reason for car usage and ownership, Van and Fujii (2011) suggest that symbolic/affective factors play a more important role, although this factor could not be observed to be significant in some countries.

Given the apparent importance of attitudinal factors in explaining car ownership, this study aims to address the lack of literature on attitudes in developing countries. In contrast to Van and Fujii (2011), we focus on car purchase decisions. Our primary objective is to understand whether attitudinal factors found by Steg (2005) as well as by Van and Fujii (2011) can be observed to be of any importance, in particular of more importance than income level.

3. Survey design and implementation

3.1 *Study area*

Bandung is located approximately 140 km southeast of Jakarta. It has a population of around 2.4 million people living in an area of 167.67 km^2, which makes it the densest city in Indonesia, with 14,283 people/km^2. Bandung has been famous as a fashion city for a long time. Because of its reputation, many visitors come not only from Indonesia (especially Jakarta) but also from overseas, in particular Malaysia and Singapore, mostly for leisure and shopping purposes. This has generated high economic growth and an increase in freight as well as passenger traffic within the city and on motorways connecting Bandung with Jakarta. All of this has contributed to severe traffic congestion within the city. The modal share in Bandung city, based on registered vehicles in 2010, is depicted in Figure 2, which shows that the city is dominated by motorcycles and private cars.

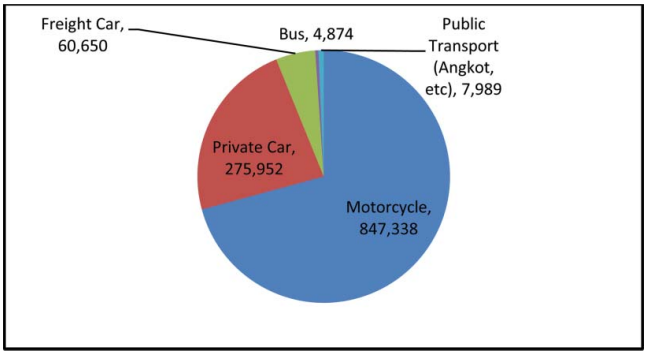

Figure 2. Modal share in Bandung based on registered vehicles in 2010.
Source. Bandung City Government (2010).

Private cars make up around 23% of the modal share, whereas buses and minibuses constitute less than 1% of the vehicle fleet. (Unfortunately data on person-trips or trip-km by modes are not available). Public transport in Bandung mainly consists of paratransit in the form of minibuses (Angkot). These have a capacity of 12–14 passengers and operate on fixed routes through various parts of the city (Joewono & Kubota, 2005). Angkot minibuses are allowed to stop everywhere without any restriction. Their departures are not fixed because the operators often wait until the vehicle is nearly full. Pradono, Rachmat, and Pitaloka (2009) discuss how the public transport system in Bandung is not designed to encourage mode choice and Tarigan, Susilo, and Joewono (2014) report that nearly 65% of public transport users in Bandung have an income nearly equal to or lower than the local standard minimum income level[1] of IDR 939k (IDR 1,000k is about US$100). The public transport network does not serve the city well and if residents do not want to, or cannot afford to, purchase cars, they either have to stick to motorcycles or adjust their residential location. Therefore, PT alone is not a competitive alternative for many students if they do not live very close to campus.

Our focus is on undergraduate students. There are three state universities and 78 private universities/academies in Bandung (Bandung City Government, 2010). Students' economic situations are obviously closely related to the support they obtain from their families. Intani (2009) reports that the parents of Bandung's public university students all have an income above the local standard minimum wage[1]. The average monthly income of students' parents is IDR 9,443k, that is, nearly ten times the minimum local income level. Intani (2009) also reports that students' monthly expenditure is on average 1,716k (with a range between IDR 500k–4,200k). Pradono et al. (2009) targeted students from two state universities (ITB and UNPAD) and two private universities (UNIKOM and UNISBA) and showed that there is no significant difference in the socioeconomic profile or modal split between the students from these four universities in Bandung. They report that 41.8% of the students own a car or motorcycle. Van and Fujii

[1] Standard minimum income level also known in Indonesian as *upah minimum propinsi* (UMP), a law issued by the provincial government as a monthly salary guideline for full-time employees.

(2011) also interviewed students in Bandung and reported that 10% own a car (they did not ask for motorcycle ownership). In our study, described in the following sections, we focus on students from one university only. This is clearly a limitation, but partly due to the Pradono et al. (2009) results we believe that our results have wider validity, as we will discuss.

3.2 *Respondents*

The targets of our survey were students of Bandung Institute of Technology (ITB). Our survey focuses on undergraduates between the ages of 17 and 23, because students, with the support of their parents, often purchase cars within their four years at university. In Indonesia, 17 is the minimum age for obtaining a driver's license as well as for buying a car. The majority of the samples were obtained through surveys in classrooms at the end of lectures. Some additional surveys were obtained through randomly approaching students in communal areas. In total, exactly 500 complete surveys could be obtained.

3.2 *Questionnaire design*

First, the respondents were divided into two groups according to whether they own a car or not. Car-owning respondents were asked 20 questions about their attitudes toward cars. It was emphasized that they should answer considering "cars in general." Respondents were asked to recall their attitude at the time of purchase as well as to provide their current attitudes. Each question was posed on a 7-point Likert scale with verbally defined endpoints (*fully disagree—fully agree*).

The first four items—*cars allow one to express oneself*, *cars brings prestige*, *cars allow one to distinguish oneself from others,* and *cars allow one to do adventurous things*—are taken with some adjustment from Steg (2005), who found that they loaded high in the construct *symbolic/affective*. Four further statements—*cars are cool*, *cars are expensive to own and maintain*, *cars are fun to have,* and *cars give an arrogant impression*—were taken from the attitudinal questions in Van and Fujii (2011), who also classified these items as *symbolic/affective*. The latter question did not load as high in Van and Fujii (2011) as the other three factors, possibly because "arrogance" is often perceived negatively, whereas "cool" or "fun" have positive connotations.

A further item, *cars are comfortable*, was used in both Steg (2005) and Van and Fujii (2011): Steg (2005) classified this item into her *instrumental* factor in contrast to Van and Fujii (2011), who found this factor correlates more with the *symbolic/affective* factor. The questions *cars allow one to travel safely*, *cars allow one to pick up or see off others* (from Steg, 2005), and *cars are convenient* (from Van and Fujii, 2011) were all classified as instrumental factors in previous research. Further questions taken from Steg (2005) are *cars allow one to travel anytime*, *cars allow one to be independent*, *cars allow one to travel anywhere,* and *cars help one to save time for travel,* which were found to form a factor referred to as *independence.*

As mentioned above, Van and Fujii (2011) propose that there is an additional attitudinal factor referred to as *social orderliness*. To verify its importance we also include questions on whether respondents consider that *cars are environmentally friendly*, *cars allow one to care about others*, and *cars are disturbing one's neighborhood*. A final item, *cars are trendy,* is included in accordance with Weinberger and Goetzke (2010, 2011), who find that people are influenced in their transportation decision by social peers and neighbors. Table 1 summarizes the attitudinal questions and in which literature they have been used before. In the second section of the survey, non-car owners were asked the same attitudinal questions and, to improve comparability, we emphasized again that answers should be based on their attitude toward "cars in general."

Non-car owners were asked similar questions regarding their desire to buy a car. In the final sections, all respondents were asked about their travel distance to come to university and their frequency of using public transport: "How often do you use public transport per week?" Further, we asked a limited number of questions about respondents' attitudes toward public transport in Bandung to verify whether limited PT is a reason for car ownership. These questions are also asked on a 7-point Likert scale. In particular, we ask for their perception on whether public transport is fast and reliable, variables that we refer to in the following as *PT is fast* and *PT is reliable*. We note that students who do not or only seldom use public transport might answer the PT questions based on what they have heard rather than what they experience. However, we perceive this

Table 1. Attitudinal questions towards cars used in survey; grouping according to previous literature.

Symbolic/affective	Instrumental	Independence	Social orderliness
Cars allow one to express oneself (Steg, 2005)	Cars are comfortable (Steg, 2005; Van & Fujii, 2011)	Cars allow one to travel anytime (Steg, 2005)	Cars are environmentally friendly (Van & Fujii, 2011)
Cars bring prestige	Cars allow one to travel safely (Steg, 2005)	Cars allow one to be independent	Cars allow one to care about others
Cars allow one to distinguish oneself from others	Cars allow one to pick up or see off others	Cars allow one to travel anywhere	Cars are disturbing one's neighborhood
Cars allow one to do adventurous things	Cars are convenient (Van & Fujii, 2011)	Cars helps one to save time for travel	
Cars are cool (Van & Fujii, 2011)			
Cars are expensive to own and maintain			
Cars are fun to have			
Cars give an arrogant impression			
Cars are trendy (Weinberger & Goetzke, 2010, 2011)			

difference as not important for the purposes of this study because both direct as well as indirect experiences will have formed a respondent's attitudes (Eagly & Chaiken, 1993). The questionnaire concluded by asking for sociodemographic characteristics, including students' monthly income obtained jointly from parents, scholarships, part-time jobs, etc. We provided five income categories: 0–500,000 IDR (US$0–50), US$50–100, US$100–250, US$250–500, and more than US$500. We do not have additional information about their parents' income, but we believe that the students' available budget also, to some degree, reflects their parents' economic status. Few undergraduate students obtain scholarships and the possibilities to significantly increase one's income by part-time jobs are limited during the first years of study. We do not include parking availability because in Bandung, as well as other parts of Indonesia, it has never been a problem for car owners to find a parking space given that parking restrictions in most places are not enforced.

4. Descriptive analysis

4.1 *Sociodemographics*

Table 2 illustrates some of the sociodemographic characteristics of our respondents. The majority of the respondents are aged 19–21 ($\mu = 19.83$, $\sigma = 2.15$). The youngest one is 17, which means all are allowed to apply for a car driver's license. Because the difference in age between the respondents is minor, it is not used in the subsequent analysis. We have slightly more males in our sample, in line with the overall student composition at ITB.

One hundred and thirty-four respondents, or 27% of the sample, are car owners. Based on the vehicle ownership statistics of students in Bandung discussed in Section 3.1, this seems fairly representative. Figure 3 groups the percentage of students owning a car based on income level. The category "more than US$500" only contains four respondents, so that we combine it with the category "US$250–500." Based on the above-reported standard minimum income, more than 50% of the students are below this. If we compare this with the results of Tarigan et al. (2014), this income distribution seems fairly representative. As one might expect, from Figure 3 it can be seen that the number of car owners does increase with income level, although low-income students also own cars and not all of the students with a higher income own cars.

We further find that many respondents live fairly near the campus ($\mu = 4.4$ km, $\sigma = 5.1$ km, max 30 km), reducing the need to own a car for commuting for some. Our respondents, both car owners and non-car owners, further answer that they use PT on average 4.93 times per week, although this frequency varies significantly among respondents ($\sigma = 4.9$). As expected, respondents rate the service quality as fairly low ("PT is fast": $\mu = 2.75$, $\sigma = 1.47$; "PT is reliable": $\mu = 2.94$, $\sigma = 1.55$).

Table 2. Characteristic of respondents.

Descriptive statistic		Number	Percentage
Total sample		500	100%
Gender	Men	282	56.4%
	Women	218	43.6%
Car ownership	Non-car owner	366	73.2%
	Car owner	134	26.8%

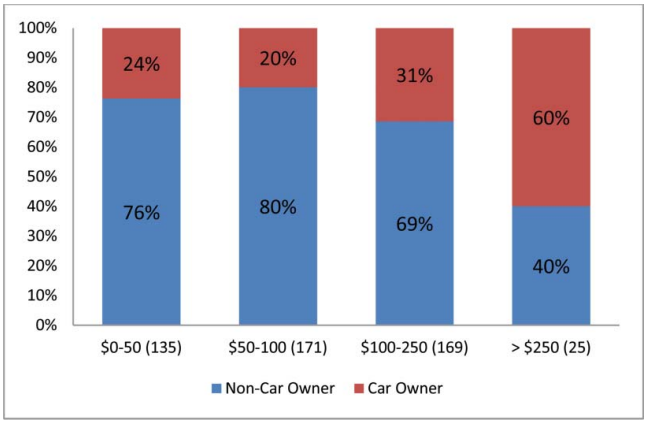

Figure 3. Car ownership ratio by income level (number of samples in brackets).

4.2 *Attitudinal variables*

We analyze whether there are significant differences in attitudes toward cars between the car owners and non-car owners in our sample. Since our variables are ordinal we use the Mann–Whitney U test. As can be seen from Table 3, there are some significant differences between the two groups. Fourteen out of 20 attitudinal variables are significantly different at the 5% level, and one variable is significantly different at the 10% level, while only the answers to five attitudinal questions are not significantly different.

In line with our expectation, in general car owners have more positive attitudes toward cars. They tend to agree more with the statements that *cars allow one to travel anytime*, *travel anywhere*, *allow to be independent*, and *help save time to travel*. These are *independence* reasons valued by car owners and possibly reasons for their eventual purchase of a car.

For the potentially negative images of cars such as *cars allow one to distinguish oneself from others* and *cars are expensive to own and maintain*, car owners tend to disagree with these statements while non-car owners give more value to it, which is also expected. Car owners also agree less with *cars bring prestige* and *cars allow one to express oneself*, possibly because of a negative undertone perceived with these statements. Further, non-car owners might overestimate the effect of car ownership on prestige and the possibility of self-expression because they will not have had the experience of owning a car themselves.

Surprisingly, the statement *cars allow one to pick up or see off others*, a positive attribute of cars, is also more agreeable to non-car owners than car owners. One might argue that this potential benefit of cars is not utilized as much as non-car owners expect, explaining this result. Finally, regarding "direct negative effects" such as *cars are environmentally friendly* (reversed scale) and *cars are disturbing one's neighborhood*, non-car owners disagree more with the first statement and agree more with the second statement, which is according to our expectations. We emphasize, however, that there are various different possible explanations for this effect. Car owners

Table 3. Attitudinal differences between car owners and non-car owners.

	Car owners ($N = 134$)		Non-car owners ($N = 366$)			
Variable	Mean	*SD*	Mean	*SD*	Mann–Whitney U	
Cars are cool	5.07	1.71	5.02	1.39	23045	
Cars are trendy	4.43	1.53	4.54	1.36	23798	
Cars allow one to express oneself	4.08	1.45	4.37	1.37	21775	**
Cars are giving arrogant impression	3.24	1.74	4.01	1.58	18223	***
Cars allow one to distinguish oneself from others	3.43	1.71	4.17	1.59	18387	***
Cars are expensive to own and maintain	5.13	1.51	5.68	1.25	19362	***
Cars are disturbing one's neighborhood	2.89	1.53	3.54	1.36	18001	***
Cars bring prestige	4.17	1.61	4.61	1.48	20522	***
Cars help one to save time for travel	4.87	1.86	3.57	1.79	14982	***
Cars allow one to travel anywhere	5.39	1.48	4.64	1.61	17980	***
Cars allow one to travel anytime	5.26	1.61	4.11	1.75	15238	***
Cars allow one to be independent	5.43	1.46	4.69	1.40	17099	***
Cars allow one to travel safely	5.75	1.27	5.43	1.24	20301	***
Cars are comfortable	5.95	1.16	5.77	1.09	21660	**
Cars allow one to pick up or see off others	5.68	1.37	5.97	1.03	22321	
Cars are fun to have	5.69	1.29	5.56	1.16	22393	
Cars allow one to care for others	4.07	1.52	3.60	1.43	19807	***
Cars are environmentally friendly	3.40	1.62	2.80	1.33	19184	***
Cars are convenient	4.98	1.67	4.70	1.37	21247	**
Cars allow to do adventurous things	5.27	1.61	5.10	1.49	22596	

**$p < 0.05$; ***$p < 0.01$.

might downplay the negative effects of their driving and/or not be aware of the side effects. Alternatively, one might argue that non-car owners are truly more aware of the externalities caused by driving. Yet another explanation would be that non-car owners use the negative side effects as an excuse or "pretended argument" if they might not be able to afford a car. This projection of a negative image on an item that one currently does not own and cannot afford to buy was termed "cognitive dissonance" by Festinger (1957). We return to this concept of cognitive dissonance in the following discussion.

5. Car ownership models

5.1 *Principal component analysis*

To construct uncorrelated factors of attitudes toward cars, a principle component analysis (PCA) with varimax rotation was performed with the attitudinal variables. PCA is a method of data reduction where in the process it groups correlated variables into uncorrelated factors (Fabrigar, Wegener, MacCallum, & Strahan, 1999; Wright & Villalba, 2012). The results of the PCA can be seen in Table 4.

At first, factors were constructed based on all 20 attitudinal variables and 500 samples. The two variables *cars are convenient* and *cars allow one to do adventurous things* gave low loading factors, however, so we excluded these two. All factors with eigenvalues larger than 1 are selected, which leaves us with five constructs that explain 57.4% of the variance.

The first factor accounts for 13.2% of the variance. Variables loaded on this factor mostly refer to emotional perceptions such as the car being cool or trendy. Therefore, this factor was named *symbolic/affective* in line with the Steg (2005) study. The second factor accounts for 12.6% of variance and describes negative associations with car ownership such as cars giving an arrogant impression, being a symbol of prestige, and being expensive. Therefore this factor was named *arrogant prestige*. The third factor (explaining 12.4% of variance) includes attitudes that were grouped as *independence* in previous research.

Variables loaded on the fourth factor (explaining 11.5% variance) are *cars allow traveling safely*, *are comfortable*, *allow picking up or seeing off others,* as well as *are fun to have*. Because comfort and pleasure aspects for the driver as well as other passengers seem to be a central theme, we refer to this factor as *comfort*. The last factor accounts for 7.6% of variance and includes the two items *cars allow one to care for others* and *cars are environmentally friendly*. These variables were also key variables in Van and Fujii (2011) for their definition of a *social orderliness* factor. However, because our construct is slightly different, we prefer to name it *social/env. care* in the following discussion. These five attitudinal factors along with sociodemographic variables will be used for subsequent analysis to explain car ownership.

Table 5 shows the descriptive statistic of variables used in the correlation analysis. The attitudinal factors were extracted using the Bartlett refined method (Bartlett, 1937). We choose this method (instead of using, for example, weighted means) because it produces unbiased estimates of the true factor scores with a sample mean of zero and a standard deviation of one (for details, we refer to Hershberger, 2005 in DiStefano, Zhu, & Mîndrilă, 2009). Note that for income we use the 4-point ordinal scale as in Figure 3. Although this imposes the assumption of linearity between the categories, we prefer this scale instead of a continuous scale or a dummy-coded variable because first, our categories have been only broad and second, as discussed above, ideally for a precise income effect model one should have better knowledge of the parents' income situation. We further note that we found a better model fit by using the ordinal category. Needless to say, the ordinal variable is presumed to be strongly correlated with actual income, therefore we use the ordinal variable as a substitute of actual continuous income that is more difficult to observe.

Table 6 shows the correlation between these variables. (We omit correlation between attitudinal factors because these are

Table 4. Rotated factor loadings on attitudes toward cars.

	Variables	Symbolic/ affective (13.2%)[a]	Arrogant prestige (12.6%)	Independence (12.4%)	Comfort (11.5%)	Social/env. care (7.6%)
X1[b]	Cars are cool	**.806**[c]	−.008	.022	.270	.058
X2	Cars are trendy	**.765**	.195	.034	.109	.080
X3	Cars allow one to express oneself	**.568**	.106	.141	.035	−.093
X4	Cars are giving arrogant impression	.263	**.732**	−.083	−.054	−.109
X5	Cars allow one to distinguish oneself from others	.370	**.688**	−.150	−.158	.100
X6	Cars are expensive to own and maintain	−.121	**.638**	−.109	.332	−.177
X7	Cars are disturbing one's neighborhood	−.056	**.578**	−.026	−.217	−.178
X8	Cars brings prestige	.470	**.527**	−.223	.145	.182
X9	Cars help one to save time for travel	.125	−.191	**.764**	−.098	.017
X10	Cars allow one to travel anywhere	.048	−.082	**.708**	.158	.090
X11	Cars allow one to travel anytime	.037	−.200	**.707**	.124	.209
X12	Cars allow one to be independent	.003	.137	**.608**	.352	.072
X13	Cars allow one to travel safely	.169	−.183	.065	**.694**	.186
X14	Cars are comfortable	.027	−.063	.227	**.644**	.103
X15	Cars allow one to pick up or see off others	.206	.146	.017	**.603**	−.209
X16	Cars are fun to have	.479	−.080	.225	**.545**	−.054
X17	Cars allow one to care for others	−.129	−.052	.128	.188	**.762**
X18	Cars are environmentally friendly	.178	−.166	.192	−.145	**.713**

[a]Numbers inside brackets are total variance explained by each factor.
[b]Numbering X1 to X18 will be used for subsequent analysis.
[c]Bold means that the variable in the row is grouped to the respective column factor.

(near) zero due to construction by PCA.) We find nonsignificant correlations between attitudinal factors and sociodemographics except that the construct *symbolic/affective* is correlated with *monthly income* and that *social/env. care* is correlated with *frequency of using PT*. The positive significant correlation between *symbolic/affective* and *monthly income* is understandable indicating that students from the highest income groups might consider it mandatory to own a car. The negative significant correlation between *social/env. care* and *frequency of using PT* is more difficult to explain. We suggest that these students either make in general fewer motorized trips or possibly this correlation supports the above-proposed "cognitive dissonance" argument.

Some other expected significant correlations can be observed between the sociodemographic variables. We observe that the higher the commuting distance, the lower frequency to use PT. This might reflect the inconvenience of taking longer distance trips with public transport in Bandung. The negative significant correlation between commuting distance and monthly income is also expected given that housing near the campus is very expensive.

5.2 *Car ownership models*

The previous discussion showed significant correlation between explanatory variables that might influence car ownership. In order to better understand indirect effects toward car ownership, especially related to income, we conducted a structural equation modeling (SEM) analysis. The model further allowed us to directly estimate our latent attitudinal constructs.[2]

Table 5. Descriptive statistics of five attitudinal factors and sociodemographics.

Variable ($N = 500$)	Mean	Min	Max	*SD*	*SE* of Mean
Symbolic/affective	0.00	−3.46	2.75	1.00	0.04
Arrogant prestige	0.00	−4.47	2.33	1.00	0.04
Independence	0.00	−2.91	2.68	1.00	0.04
Comfort	0.00	−5.48	2.58	1.00	0.04
Social/env. care	0.00	−2.76	3.35	1.00	0.04
Commuting distance	4.36	0.08	30.00	5.10	0.23
PT is fast	2.75	1.00	7.00	1.47	0.07
PT is reliable	2.94	1.00	7.00	1.55	0.07
Frequency of using PT	4.93	0.00	20.00	4.90	0.22
Monthly income	2.18	1.00	5.00	0.90	0.04

SEM is a multivariate regression in which the response variable in one regression equation may become a predictor in another equation (Schumacker & Lomax, 2010). This allowed us to account for correlations and to distinguish direct and indirect effects of our exogenous and latent variables on car ownership. Because our dependent variable was a dichotomous outcome (binary discrete choice model), we used the robust (mean- and variance-adjusted) method of weighted least square (WLS), also known as WLSMV (Muthén & Muthén, 2012). In general, this method is preferable to maximum likelihood (ML) estimation when the data are severely non-normally distributed (Olsson, Foss, Troye, & Howell, 2000). Because car ownership is dichotomous, we used SEM with binary probit regression for these paths toward our main dependent variable.

We used the five factors constructed by the above PCA analysis as a basis for determining exogenous latent variables. In addition, we incorporated explanatory variables as exogenous variables, including attitudes toward public transport.[3] Because in our initial regression analysis we found that *commuting distance* has a negative significant correlation with *frequency of using PT* and *monthly income,* we performed path analysis between these three variables in our SEM model. We hypothesized that *monthly income* might influence *commuting distance* because the housing location decision is often determined by income level: apartments closer to the campus area in general have higher prices in Bandung, thus we treated *commuting distance* as an endogenous variable and *monthly*

[2] We initially conducted a binary logistic regression model using car ownership as the dependent variable (Belgiawan, Schmöcker, & Fujii, 2011). However, a logistic regression model does not consider correlation between independent variables nor specify indirect paths, which we consider important for our model.

[3] We tried to construct a latent variable "attitude to PT" with *PT is fast* and *PT is reliable* and to incorporate this into the SEM model; however, the goodness of fit of the model was low and the construct was not significant.

Table 6. Correlation between the five attitudinal factors and sociodemographics.

	Commuting distance	PT is fast	PT is reliable	Frequency of using PT	Monthly income
Symbolic/affective	−0.02	−0.06	−0.05	−0.01	0.10*
Arrogant prestige	0.02	0.01	0.04	0.01	−0.08
Independence	−0.05	−0.01	−0.05	0.05	0.08
Comfort	0.05	0.06	0.05	−0.07	0.08
Social/env. care	0.09	−0.02	−0.04	−0.012**	0.04
Commuting distance		−0.01	−0.05	−0.16**	−0.21**
PT is fast			0.63**	−0.04	−0.04
PT is reliable				0.00	−0.02
Frequency of using PT					0.03

*Correlation is significant at the 0.05 level (2-tailed).
**Correlation is significant at the 0.01 level (2-tailed).

Table 7. SEM model estimation.

Latent constructs	Path		Model 1 ($n = 500$) Est.	*t*-stat		Model 2 ($n = 500$) Est.	*t*-stat		Model 3 ($n = 500$) Est.	Std	*t*-stat	
X1	←	Symbolic affective	1									
X2	←	Symbolic affective	0.87	9.03	***							
X3	←	Symbolic affective	0.48	8.73	***							
X4	←	Arrogant prestige	1			1			1	0.71		
X5	←	Arrogant prestige	1.00	11.17	***	0.93	9.82	***	1.00	0.71	9.95	***
X6	←	Arrogant prestige	0.49	8.22	***	0.55	7.94	***	0.52	0.46	7.84	***
X7	←	Arrogant prestige	0.45	7.42	***	0.54	7.33	***	0.53	0.43	7.33	***
X8	←	Arrogant prestige	0.72	9.37	***	0.66	8.10	***	0.72	0.55	8.47	***
X9	←	Independence	1			1			1	0.70		
X10	←	Independence	0.77	8.41	***	0.74	7.54	***	0.71	0.58	7.56	***
X11	←	Independence	1.01	8.67	***	1.09	7.58	***	1.04	0.77	7.58	***
X12	←	Independence	0.58	8.01	***	0.47	6.71	***	0.46	0.42	6.81	***
X13	←	Comfort	1									
X14	←	Comfort	0.76	11.15	***							
X15	←	Comfort	0.68	10.41	***							
X16	←	Comfort	0.99	10.28	***							
X17	←	Social/env. care	1			1						
X18	←	Social/env. care	1.22	3.04	***	1.04	5.42	***				
Structural model (Figure 4)												
Commuting distance	←	Monthly income	−1.18	−4.07	***	−1.20	−3.95	***	−1.20	−0.21	−3.96	***
Frequency of using PT	←	Commuting distance	−0.15	−3.45	***	−0.15	−3.47	***	−0.15	−0.16	−3.47	***
Independence	←	Monthly income				0.21	2.84	***	0.21	0.15	2.85	***
Car ownership	←	Symbolic affective	−0.04	−0.70								
Car ownership	←	*Arrogant prestige*	−0.33	−6.14	***	−0.20	−3.24	***	−0.21	−0.25	−3.69	***
Car ownership	←	*Independence*	0.44	7.35	***	0.30	4.08	***	0.33	0.43	5.70	***
Car ownership	←	Comfort	0.13	1.38								
Car ownership	←	Social/env. care	0.54	3.82	***	0.14	0.96					
Car ownership	←	*Commuting distance*	0.02	2.08	**	0.02	2.14	**	0.02	0.11	2.14	**
Car ownership	←	*PT is reliable*	−0.09	−2.35	**	−0.09	−2.35	**	−0.09	−0.14	−2.35	**
Car ownership	←	*Frequency of using PT*	−0.05	−3.92	***	−0.05	−3.92	***	−0.05	−0.24	−3.92	***
Car ownership	←	*Monthly income*	0.26	4.42	***	0.20	3.30	***	0.19	0.17	3.19	***
Car ownership	←	PT is fast	0.02	0.58								
Indirect effect to car ownership												
Frequency of using PT	←	Commuting distance							0.01	0.04	2.72	***
Commuting distance	←	Monthly income							−0.03	−0.02	−1.85	*
Frq PT + ComDist	←	Monthly income							−0.01	−0.01	−2.37	**
Independence	←	Monthly income							0.07	0.06	2.59	**
Thresholds			0.83	3.57	***	0.77	3.72	***	0.77	0.77	3.72	***
***R*-squared**			0.77			0.47			0.46			
Model fit												
Chi-2/df			5.04			1.97			1.71			
RMSEA			0.09			0.04			0.04			
CFI			0.41			0.90			0.94			
TLI			0.34			0.87			0.92			
WRMR			2.49			1.05			0.95			

*Coefficient is significant at the 0.1 level.
**Coefficient is significant at the 0.05 level.
***Coefficient is significant at the 0.01 level.
Italics represent significant factors and variables toward car ownership in Model 3.

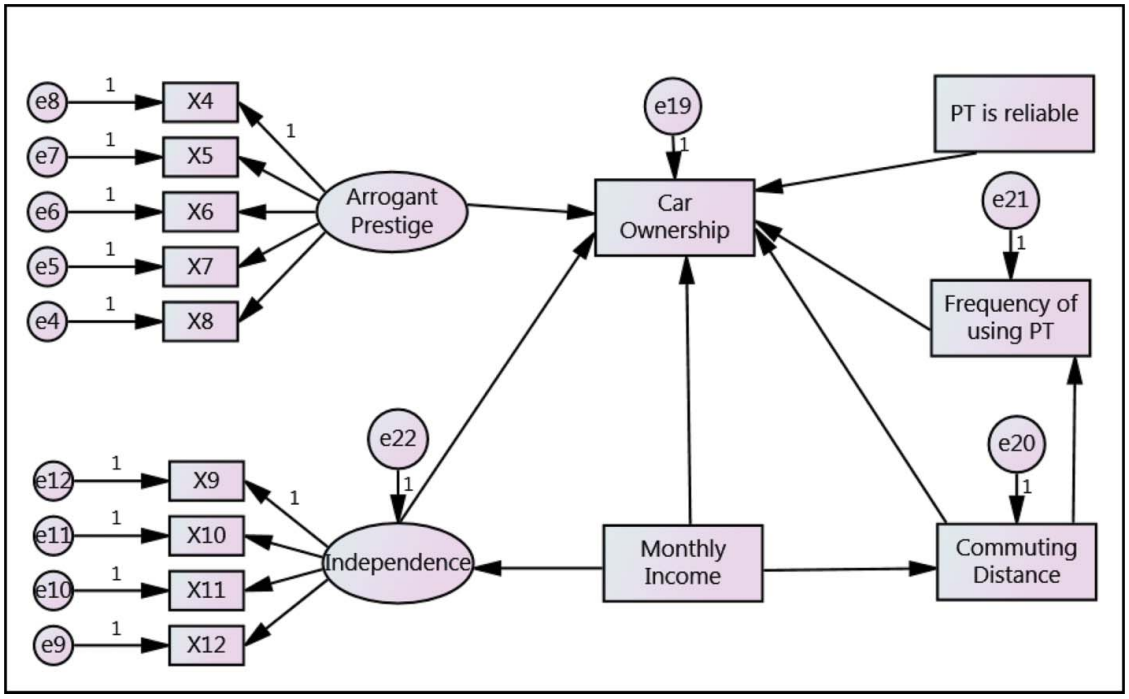

Figure 4. Car ownership SEM Model 3.

income as an exogenous variable. We also hypothesized an indirect effect of commuting distance via *frequency of using PT* on *car ownership* in line with our correlation results.

We tested different model specifications, which are shown in Table 7. Model 1 is constructed without indirect paths as in Belgiawan, Schmöcker, and Fujii (2011). The R-squared is good; however, other statistics suggest a low model fit (RMSEA = 0.09, CFI = 0.410, TLI = 0.34, and WRMR = 2.49)[4]. We further found that the *symbolic/affective* does not explain car ownership in contrast to previous literature. Instead *arrogant prestige* was highly significant. Remembering that this construct relates to the negative aspects of *symbolic/affective,* our result might hence suggest that it is the negative rather than the positive symbolic aspects that influence car ownership. Interestingly, *comfort* was further not significant, possibly indicating that our student sample is less concerned about this aspect.

Based on these observations, we hence test alternative model structures. Model 2 provides a better model fit (reduced Chi-2/df, RMSEA = 0.04, CFI = 0.90, TLI = 0.87, and WRMR = 1.05). In this model we omit *symbolic/affective* and *comfort* as well as *PT is fast* because they were not significant in the first model. We further treat *independence* as an endogenous variable influenced by *monthly income* based on correlations found in Table 6.

Our interpretation is that income level influences the car perception aspects such as *save time to travel*, *can travel anywhere,* and *can travel anytime,* which construct our *independence* factor. All variables are significant except for *social/env. care*. This might suggest that social and environmental aspects might be important to students to some degree but maybe not sufficiently to influence car ownership decisions. Omitting this factor then leads to our final Model 3 with the best model fit (RMSEA = 0.04, CFI = 0.94, TLI = 0.92, and WRMR = 0.95). The structure of this model is further illustrated in Figure 4.

5.3 *Discussion*

In our final model, there are significant paths to car ownership from the attitudinal factors *independence* ($\mu = 0.46$, $\sigma = 1.32$), *arrogant prestige* ($\mu = 0.00$, $\sigma = 1.17$), *PT is reliable* as well as from *frequency of using PT*, *commuting distance,* and *monthly income*. *Arrogant prestige* is constructed by the five attitudinal variables suggested by the PCA, which are all found significant, although the importance of the exogenous variables vary. Cars *allow one to distinguish oneself from others*, *are giving arrogant impression,* and *bring prestige* are weighted more than cars *are expensive to own and maintain* and *are disturbing one's neighborhood*. This result confirms our chosen construct name, that is, the perception one conveys to others by owning a car is the central theme for this construct. For *independence,* we find travel time-related aspects to be more important in the construct.

Income directly and indirectly influences *car ownership*. The indirect paths are via *commuting distance* and *frequency of using PT* with a different sign and also through *independence*. Although we find this effect to be significant, it is a weak effect because the combined indirect effect of monthly income is only 0.03. The path confirms our observation that high-income students, probably especially those with parents out of town, choose to stay near the campus, while the lower income students choose to stay far from campus.

[4] In general, with binary outcomes at $N > 250$, CFI > 0.95, TLI > 0.95, RMSEA < 0.05, and WRMR < 1 can be indications of good models (Yu, 2002). CFI = Comparative Fit Index; TLI = Tucker–Lewis Index; RMSEA = Root-Mean-Square Error of Approximation; WRMR = Weighted Root Mean Square Residual (WRMR is suitable to evaluate models with non-normally distributed outcomes).

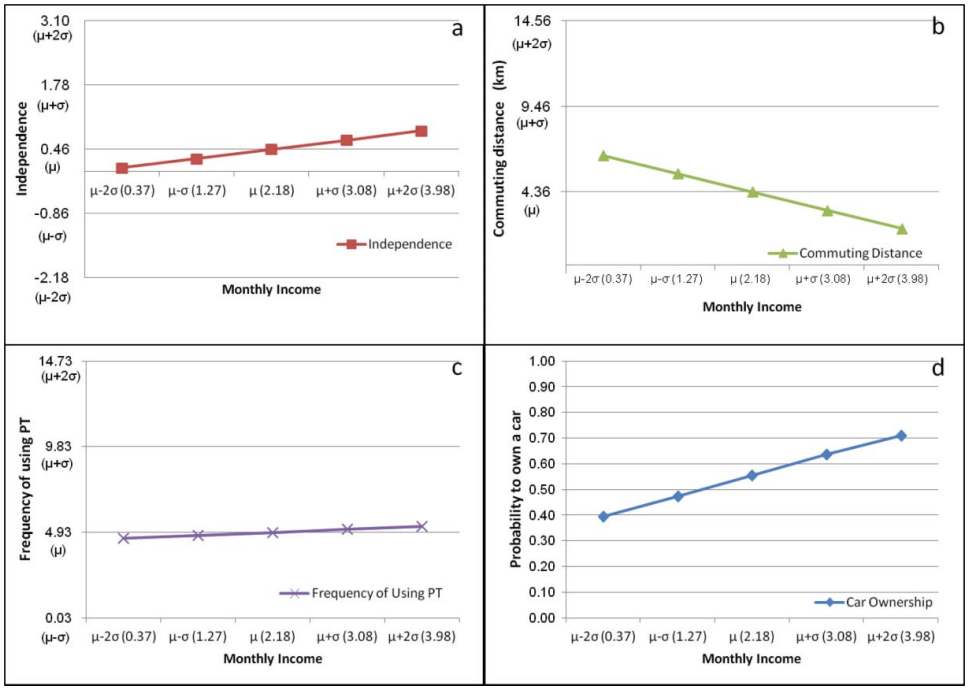

Figure 5. Combined effect of monthly income through (a) independence, (b) commuting distance, (c) frequency of using PT, and (d) car ownership intention.

In order to illustrate the estimated effect of income on other variables, we consider a person with all variables at their mean as our reference point. We then vary monthly income by one and two standard deviations using our parameter estimates. Figure 5a illustrates the resulting increase in independence in terms of standard deviations. We find that a one standard deviation increase in income results in an increase of 0.14 standard deviations for independence. With the same methodology, we find an opposite effect of income on commuting distance with a larger effect in terms of standard deviation (0.21). In Figure 5c, we find that PT is not highly influenced by the combined effect of monthly income and commuting distance. A standard deviation increase in income results in an increase of only 0.33 standard deviations, equivalent to 0.65 trips per month. Finally, 5d illustrates the combined effect of income on car ownership, taking all direct and indirect paths into account, that is, all variables are at their mean, except for independence and commuting distance as well as frequency to use PT, which deviate from their mean according to the estimated influence of income. We observe that the combined effect of monthly income is quite high, that is, an increase in income by one standard deviation (or 0.90 categories on our 4-point income scale) results in an increase of 7% probability of owning a car.

Our model suggests that compared to *monthly income*, *commuting distance* has less effect on *car ownership*. We further find that commuting distance negatively influences public transport usage, as discussed before. The indirect effect of commuting distance on car ownership via *frequency of using PT* is again very small (0.01). *Frequency of using PT* and the perception that *PT is reliable* both negatively influence *car ownership* with similar regression weights. This suggests that if PT is perceived more positively, the probability to use PT more and possibly not to own a car is also higher.

We find that, even controlling for the factors discussed so far, *arrogant prestige* significantly influences *car ownership* with a negative regression value of −0.21. One might argue that, in particular for this variable, the causality is not clear. The interpretation in line with the model structure is that those who project a negative image on cars and *car ownership* tend to therefore also not purchase one. Again, another possibility could be the aforementioned cognitive dissonance argument. In other words, non-car owners might still desire a car but project a negative image onto it as a way to reduce the disappointment of not being able to afford one. We cannot fully solve which of these two explanations is more likely with the data available to us.

Independence has a significant positive influence on *car ownership*. We note that the construct refers to time and space travel flexibility which hence suggests that "classic utility factors" play a more important role for purchase decisions compared to the other attitudinal factors. We find the regression weight (0.33) to be the highest parameter value among all the significant paths. This result is partly in disagreement with findings from Steg (2005) or Gatersleben (2011), who find that independence is less significant compared to *symbolic/affective*. However, one should remember the different public transport situation in Bandung, Indonesia, compared to many European cities. Given the current PT conditions in Bandung, one cannot guarantee punctual arrival when using minibuses. When traveling by car, one might also get stuck in congestion; however, at least one does not have the uncertainty of having to wait until a vehicle has collected enough passengers for the driver to decide to depart. Furthermore, as discussed above, the route network is fairly limited.

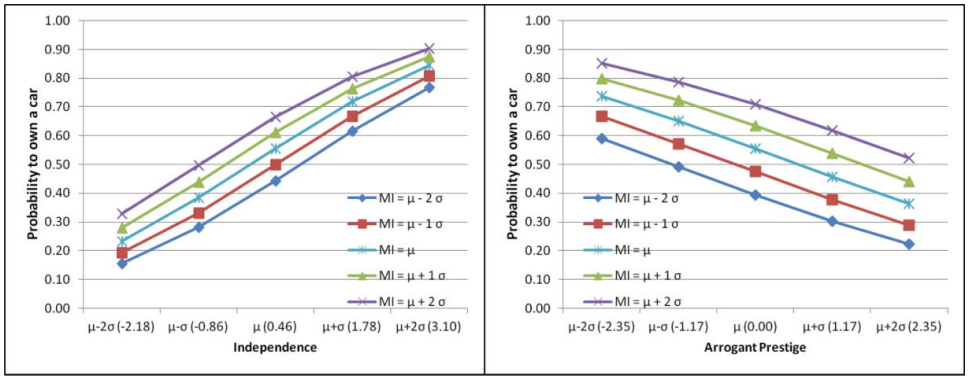

Figure 6. Probability of owning a car by a change of standard deviation of (a) independence and (b) arrogant prestige.

To further illustrate the importance of attitudes and income, Figure 6 shows the probability of students owning a car for varying the attitudes in units standard deviation and for different levels of *monthly income* (also in units of means plus/minus standard deviations). Similar to Figure 5, all other parameters have been held constant at their mean sample value. (Note that for independence the total effect equals the direct effect on *car ownership*). Figure 6 (a and b) illustrates the effect of one and two standard deviation increases and decreases in the attitudinal construct and *monthly income* mean value.

The figures clearly illustrate the relative importance of attitudes. For a "mean person," a standard deviation in independence perception increases the probability by nearly 20%, whereas a standard deviation increase in income only increases the probability of owning a car by about 10%. The impact of *arrogant prestige* is not as large, but an increase in one standard deviation in this attitudinal construct still has a larger impact than a standard deviation increase in income.

6. Conclusions

Our objective was to understand factors determining car purchase decisions among younger people in developing countries. Through a survey among Indonesian students in Bandung asking for attitudes as well as sociodemographic characteristics, we reached several conclusions that we believe have policy implications and provide hope that, at least to some degree, adequate transport policy could reduce the trend toward a rapid increase in car traffic.

Clearly with higher GDP and increasing income in southeast Asian countries, we expect the modal share of cars to increase. However, we find that attitudes are important determinants of *car ownership* and that attitudes such as the perception of whether the car is a prestige object and income are not significantly correlated, so that there might be some hope that rapid economic growth will not necessarily mean a motorization development as experienced in Western countries several decades ago. We find that *independence*-related aspects are the most important factor for students' decision to purchase a car. The result suggests that in Bandung and generally in situations where there are insufficient convenient public transport options, such services need to be improved first before one in fact has a choice.

Note that we further find that *independence* is also positively influenced by *monthly income*; therefore, if monthly income changes, *independence* will also. This finding might also have policy implications. With improving economic situations, policymakers concerned about increasing *car ownership* not only have to deal with the higher affordability of cars but also with an increase in the perception of how much independence a car can bring due to the generally increased financial possibility to travel. Therefore, for this reason, it will be important to create early on a public transport system that can fulfill the more diverse travel needs of rapidly developing countries. Further, the connection between *income*, *commuting distance,* and *car ownership* leads to some obvious policy implications highlighting the need for affordable housing or dormitories near the campus.

The high importance of *independence* might also imply that the status symbol factor of cars is decreasing, at least for some parts of the population. This interpretation is supported by our findings regarding our construct *arrogant prestige*, which describes negative attitudes one has toward cars. We find *arrogant prestige* to be negatively significant, implying that those who think cars are arrogant also tend to not own one. We discuss some reservations regarding causality of this factor that should be explored with further research, but believe that, regardless of this discussion, this result indicates that students start to realize the negative societal effects of the car more. If the negative side effects of cars for the society and city are highlighted, the car might eventually become a kind of "anti-status symbol." Also, the discussion on *arrogant prestige* and its correlation to behavior or car desire implies that some campaigns or public education to induce *arrogant prestige* to reduce car ownership might be helpful.

In line with these findings, Van and Fujii (2011) found that in some Asian countries, the car has become less desirable compared to PT usage. Because our survey is focused on young students, one might even connect this to a discussion on values of "Generation Y." For example, Newman (2011) argues that "previous generations found freedom and flexibility through the car. But Generation Ys find their freedom and flexibility by staying connected to their friends, family and workplaces through the various information devices—like their laptops, or iPhones." Insofar as this value shift could be used to encourage public transport, usage should be further explored. Generally, we believe that our results suggest that, besides necessary improvements in the

public transport system, soft policy measures such as communicative measures discussed in Taniguchi et al. (2007) that aim to change the attitudes of younger people should also be considered as one way in developing countries to control the growth in car ownership and car usage.

In summary, we believe this article contributes to explaining determinant factors of car ownership decisions among Bandung students. We acknowledge that for wider generalization of our results, the data limitations of our study should be addressed. Besides repeating this study with additional data from a wider population group, we believe an important further research direction is to include the "influence of others" more directly in car ownership modeling. Schmöcker, Hatori, and Watling (2014) discuss the role of "informational mass effect" in predicting mobility trends. They define this mass effect as positive influence to adjust one's choice to be in line with observed choices of others. Similarly, Abou-Zeid, Schmöcker, Belgiawan, and Fujii (2013) review the influence of descriptive norms on mobility decisions, including car ownership. In current work, Belgiawan et al. (2014) are exploring the role of such norms by expanding the work published here with an international survey.

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References

Abou-Zeid, M., Schmöcker, J.-D., Belgiawan, P. F., & Fujii, S. (2013). Mass effects and mobility decisions. *Transportation Letters, 5*(3), 115–130.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*(2), 179–211.

Bandung City Government. (2010). *Bandung in Figures 2010*. Bandung, Indonesia: Statistics of Bandung City.

Bartlett, M. S. (1937). The statistical conception of mental factors. *British Journal of Psychology*, *28*, 97–104.

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

Belgiawan, P. F., Schmöcker, J-D., & Fujii, S. (2011). Psychological determinants for car ownership decisions. *Proceedings of the 16th International Conference of Hong Kong Society for Transportation Studies (HKSTS), Hong Kong*, 17–20 December 2011. Hong Kong: Hong Kong Society for Transportation Studies. 315–322.

Berkovec, J. (1985). Forecasting automobile demand using disaggregate choice models. *Transportation Research Part B: Methodological*, *19*(4), 315–329.

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

Button, K., Ngoe, N., & Hine, J. L. (1993). Modelling vehicle ownership and use in low income countries. *Transport Economics and Policy*, *27* (1), 51–67.

Choo, S., & Mokhtarian, P. L. (2004). What type of vehicle do people drive? The role of attitude and lifestyle in influencing vehicle type choice. *Transportation Research Part A: Policy and Practice, 38*(3), 201–222.

DiStefano, C., Zhu, M., & Mîndrilă, D. (2009). Understanding and using factor scores: Considerations for the applied researcher. *Practical Assessment, Research & Evaluation*, *14*(20). Retrieved from http://pareonline.net/getvn.asp?v=14&n=20

Eagly, A. H., & Chaiken, S. (1993). *The Psychology of attitudes*. Orlando, FL: Harcourt Brace and Company.

Fabrigar, L. R., Wegener, D. T., MacCallum, R. C., & Strahan, E. J. (1999). Evaluating the use of exploratory factor analysis in psychological research. *Psychological Methods*, *4*, 272–299.

Festinger, L. (1957). *A theory of cognitive dissonance*. Stanford, CA: Stanford University Press.

Fujii, S., & Gärling, T. (2003). Development of script-based travel mode choice after forced change. *Transportation Research Part F: Traffic Psychology and Behaviour*, *6*, 117–124.

Gärling, T., Fujii, S., & Boe, O. (2001). Empirical tests of a model of determinants of script-based driving choice. *Transportation Research Part F: Traffic Psychology and Behaviour*, *4*, 89–102.

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 behaviours* (pp. 137–148). Bingley, UK: Emerald Group.

Hershberger, S. L. (2005). Factor scores. In B. S. Everitt & D. C. Howell (Eds.), *Encyclopedia of statistics in behavioral science* (pp. 636–644). New York, NY: John Wiley.

Hocherman, I., Prashker, J. N., & Ben-Akiva, M. (1983). Estimation and use of dynamic transaction models of automobile ownership. *Transportation Research Record*, *944*, 134–141.

Indonesia Central Agency of Statistics. (2013). Number of motor vehicles by types, Indonesia 1987–2011. Retrieved 30 April 2013 from http://www.bps.go.id/eng/tab_sub/view.php?kat=2&tabel=1&daftar=1&id_subyek=17&notab=12

Intani, M. A. S. M. (2009). *Identification of ability and willingness to pay of students living outside Bandung to live in an apartment in Bandung* (Undergraduate thesis; in Indonesian). Bandung Institute of Technology, Bandung, Indonesia.

Joewono, T. B., & Kubota, H. (2005). The characteristics of paratransit and non-motorized transport in Bandung, Indonesia. *Journal of the Eastern Asia Society for Transportation Studies*, *6*, 262–277.

Johansson, M. V., Heldt, T., & Johansson, P. (2006). The effects of attitudes and personality traits on mode choice. *Transportation Research Part A: Policy and Practice*, *40*, 507–525.

Khan, A., & Willumsen, L. G. (1986). Modeling car ownership and use in developing countries. *Traffic Engineering and Control*, *27*(11), 554–560.

Kitamura, R., Golob, T. F., Yamamoto, T., & Wu, G. (2000). *Accessibility and auto use in amotorized metropolis*. Paper presented at the 79th Transportation Research Board Annual Meeting, Washington, DC.

Lanzendorf, M. (2003, August). *Mobility biographies: A new perspective for understanding travel behaviour*. Paper presented at the 10th International Conference on Travel Behaviour Research, Lucerne, Switzerland.

Lave, C. A., & Train, K. (1979). A disaggregate model of auto-type choice. *Transportation Research Part A: Policy and Practice*, *13*(1), 1–9.

Mannering, F., & Winston, C. (1985). A dynamic empirical analysis of household vehicle ownership and utilization. *Rand Journal of Economics*, *16*(2), 215–236.

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

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

Millstein, S. G. & Litt, I. (1990). Adolescent health and health behaviors. In S. S. Feldman & G. Elliott (Eds.), *At the threshold: The developing adolescent* (pp. 431–456). Cambridge, MA: Harvard University Press.

Muthén, L. K., & Muthén, B. O. (2012). *Mplus user's guide* (7th ed.). Los Angeles, CA: Muthén & Muthén.

Newman, P. (2011). High-tech draws new generation to trains. *The West Australian*. Retrieved from https://au.news.yahoo.com/thewest/wa/a/9683930/high-tech-draws-new-generation-to-trains/

Olsson, U. H.. Foss, T., Troye, S. V., & Howell, R. D. (2000). The performance of ML, GLS, and WLS estimation in structural equation modeling under conditions of misspecification and nonnormality. *Structural Equation Modeling, 7*(4), 557–595.

Pradono, P., Rachmat, S. Y., & Pitaloka, N. D. (2009). Level of acceptance of the TDM implementation in Indonesian cities. *Journal of the Eastern Asia Society for Transportation Studies*, *8*, 374–388.

Schmöcker, J.-D., Hatori, T., & Watling, D. (2014). Dynamic process model of mass effects. *Transportation*, *41*(2), 279–304.

Schumacker, R. E., & Lomax, R. G. (2010). *A beginner's guide to structural equation modelling* (3rd ed.). New York, NY: Routledge, Taylor and Francis Group.

Sillaparcharn, P. (2007). Vehicle ownership modelling: A case study of Thailand. *Transportation Research Record*, *2038*, 98–104.

Simma, A., & Axhausen, K. W. (2003). Commitments and modal usage: Analysis of German and Dutch panels. *Transportation Research Record*, *1854*, 22–31.

Steg, L. (2003). Can public transport compete with the private car? *IATSS Research*, *27*(2), 27–35.

Steg, L. (2005). Car use: Lust and must. Instrumental, symbolic and affective motives for car use. *Transport Research Part A: Policy and Practice*, *39*, 147–162.

Taniguchi, A., Suzuki, H., & Fujii, S. (2007). Mobility management in Japan: Its development and meta-analysis of travel feedback programs (TFPs). *Transportation Research Record*, *2021*, 100–117.

Tanner, J. C. (1978). Long-term forecasting of vehicle ownership and road traffic (with discussion). *Journal of the Royal Statistical Society, Series A*, *14*, 14–63.

Tarigan, A. K. M., Susilo, Y. O., & Joewono T. B. (2014). Negative experiences and willingness to use paratransit in Bandung, Indonesia: An exploration with ordered probit model. *Transportation Planning and Technology*, *37*(2), 200–218.

United Nations, Department of Economic and Social Affairs, Population Division. (2011). *World population prospects: The 2010 revision*, *Volume I: Comprehensive Tables. ST/ESA/SER.A/313*. Retrieved from http://www.un.org/en/development/desa/population/publications/pdf/trends/WPP2010/WPP2010_Volume-I_Comprehensive-Tables.pdf.

Van, H. T., & Fujii, S. (2011). A cross Asian country analysis in attitudes toward car and public transport. *Journal of the Eastern Asia Society for Transportation Studies*, *9*, 411–421.

Van, H. T., Schmöcker, J.-D., & Fujii, S. (2009). Upgrading from motorbikes to cars: Simulation of current and future traffic conditions in Ho Chi Minh City. *Proceedings of the Eastern Asia Transportation Studies*, *8*, 335–349.

Weinberger, R., & Goetzke, F. (2010). Unpacking preference: How previous experience affects auto ownership. *Urban Studies, 47*(10), 2111–2128.

Weinberger, R., & Goetzke, F. (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 behavior* (pp. 121–135). Bingley, UK: Emerald Group.

Wright, D. B., & Villalba, D. K. (2012). Exploratory factor analysis. In G. M. Breakwell, D. B. Wright, & J. A. Smith (Eds.), *Research methods in psychology* (4th ed., pp. 279–318). Los Angeles, CA: Sage Publications.

Yu, C. Y. (2002). *Evaluating cutoff criteria of model fit indices for latent variable models with binary and continuous outcomes* (Doctoral dissertation). University of California, Los Angeles.