ATTITUDES TOWARDS THE ENVIRONMENT RELATED TO TRAVEL AND PERSONAL MOBILITY

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ABSTRACT

The objective of this paper is to study the relationship between personal mobility and attitudes towards the environment related to travel behavior considering sociodemographic characteristics.

The dataset used for this study was collected through a web-based survey carried out in Valencia (Spain) during 2017 and 1684 valid responses were obtained. In this research a subpart of the survey is used, including 5 items which measure attitudes towards the environment related to travel and 5 items to measure personal mobility. The items were measured using a 5 points Likert Scale. Additionally, individual and household demographic characteristics are considered.

The methodology of this research consist on descriptive analysis and frequency distributions. Factor Analysis (Exploratory and Confirmatory) is used to construct the latent variables which measure attitudes and Mann-Whitney U is test are assessed to find significant differences among the variables of the study.

Preliminary results show that environmental concerns are taken into account by women as a factor to decrease their car use, while men do not consider this factor that relevant. Next, young people and men carry our more activities while traveling in public transport, for instance: reading, listening to music or checking social networks. The results of this research are useful for the development of transport policies to promote sustainable transport.

1. INTRODUCTION

This research is part of a wider project, called MINERVA, which is funded by the I+D+i National Program of Society Challenges of the Spanish Ministry of Economy and Finance of Spain). The aim of MINERVA is to study the influence of personal values, attitudes and perceptions and social interactions on travel behavior.

This paper aims to study attitudes towards personal mobility and attitudes towards the environment related to travel considering sociodemographic characteristics.

1.1. Explicative factors of travel behavior

The prediction of individual's travel behavior is an essential component of transportation planning and policy analysis. The ultimate mission of travel demand forecasting research is to develop the capability to predict how individuals respond to changes in their travel environment (Kitamura, 1988). Such predictions are based on a set of factors that influence travel behavior. For this reason it is relevant to identify and characterize such factors.

Among the factors that influence travel behavior, one of the main objectives of the Minerva Project is to collect information regarding attitudes towards the environment and attitudes towards personal mobility.

The displacement of people towards their usual places generates a demand for modes of transport, which are largely related to certain factors that make the individual decide one or another type of transport. In this line, people's attitudes are strongly influenced for beliefs as well as individual travel behaviors. A person's intention is a function of two basic determinants; one personal in nature and the other reflecting social influence (Ajzen, 1991).

Travel behavior research has long recognized the role of attitudes and preferences in influencing mobility. Even though attitudes are often included as control variables for self-selection, many studies have concluded that they play a significant role in influencing travel behavior (Hunecke et al., 2010; Bopp et al., 2011; Spears et al., 2013; Runing Ye et al, 2017). The measurement of attitudes is carried out using scales that involve the application of standardized questionnaires to enable individuals to be placed on a dimension indicating degree of favorability towards the object in question.

This research contributes to gain more knowledge about these factors taking into account also demographic and socioeconomic characteristics.

2. OBJETIVE AND RESEARCH QUESTIONS

2.1 Objective

The aim of this paper is to study the relationship between personal mobility and attitudes towards the environment related to travel behavior considering sociodemographic characteristics.

2.2 Research questions

Main research questions are presented below:

- To what extent personal mobility and attitudes towards the environment can contribute to travel behavior analyses and how to measure these variables.

- How demographic factors and socio economic characteristics might influence personal mobility.

- How demographic factors and socio economic characteristics might influence attitudes towards the environment.

3. DATA COLLECTION

3.1 Instrument design and recruitment

The dataset used for this research is part of the data collection developed for MINERVA research. For this project, a web based survey was developed ad-hoc to gather information regarding attitudes and perceptions, personal values, social interactions and travel behavior. In this study, a subpart of this survey is used (Arroyo et al, 2017).

The web-based survey was distributed mainly online and several organizations, public administration and companies contributed with the dissemination of the survey. Data collection took place between May and October 2017, excluding August in order to avoid non-recurrent mobility and long-distance trips executed during summer holidays. The main area of the study was Valencia (Spain) and its metropolitan area, although different residential locations were also accepted.

The survey is composed by 5 parts. Firstly, a brief questionnaire gathers information about demographics and socio-economic characteristics (both at personal and household level), as well as transport accessibility and built environment attributes of the residence area. Secondly, a two-day activity-travel diary collects all the activities and trips performed during a week day and a week-end day, including characteristics of the companions of each episode. Next section collects information regarding social interactions, for this purpose the list of the companions already defined is displayed and a brief questionnaire of each person should be complimented, including: gender, age, type of relationship, closeness degree, approximate residential location distance from the respondent, frequency of face to face meetings, frequency of communication and degree of influence of the companion in the respondent's mobility. The fourth part is the Values survey, based on Schwartz theory of human values (Schwartz, 1994).

The last step consists on a survey regarding cognitive, affective and behavioral attitudes towards transport modes, attitudes towards innovative travel modes, use of ICTs and personal mobility and perceptions of the built environment. Additionally, the on-line questionnaire collects intentions to use travel modes; semantic differential towards travel modes, which measures mental representations of travel modes through certain adjectives.

Further details of the questionnaires analyzed in this paper are provided later, including individual items and constructs to measure attitudes towards the environment and personal mobility.

3.2 Sample characteristics

After data cleaning and validation, the sample is composed by 1684 individuals (Table 1). The distribution according to gender reasonably balanced. However, considering age, those over 50 years old are under-represented in the sample. Participants are mainly employed individuals, followed by students and other occupations are including in "other", for instance retired and unemployed people.

	Respondents	Percentage
GENDER		
Male	774	46 %
Female	910	54 %
AGE		
16-25	471	28 %
26-35	385	23 %
36-50	522	31 %
>50	306	18 %
OCCUPATION		
Student	398	23 %
Employed	1022	61 %
Other	264	16 %

Table 1 – Sample characteristics

4. METHODOLOGY AND ANALYSIS

4.1 Variables: description and measurement
- Demographic and socio-economic characteristics

Several demographic and socio-economic characteristics were considered both at individual and house hold level (Table 2).
- Attitudes towards the environment and personal mobility

Three latent constructs were developed in order to measure attitudes towards the environment and personal mobility. Details and validation are described in the next section.

DEMOGRAPHICS

Gender	0 = male; 1 = female	Categorical
Age	Age of the respondent	Continuous
Transport Pass	1 = respondent has an integrated public transport pass; 0 = otherwise	Categorical
Car	Bike availability (0 = low to 5 = high)	Continuous
Bike	Car availability (0 = low to 5 = high)	Continuous
Motorbike	Motorbike availability (0 = low to 5 = high)	Continuous
Bikes in HH	Number of bikes available in the household	Continuous
Cars in HH	Number of cars available in the household	Continuous
Marital status	1 = single; 2 = married; 3 = civil partner; 4 = couple; 5 = widow; 6 = divorced; 7 = others	Categorical
Education level	1 = no studies; 2 = primary level; 3 = vocational training ; 4 = secondary level; 5-6 = higher education; 7 = university degree or higher	Categorical
Occupation	1 = student; 2 = employed; 3 = self-employed; 4 = student and employed; 5 = unemployed; 6 = retired; 7 = housekeeper; 8 = others	Categorical
Income (net monthly)	1 = any income; 2 = less thant 500€; 3 = 500-1000€; 4 = 1000-1500€; 5 = 1500-2000€; 6 = 2000-2500€; 7 = 2500 - 3000; 8 = more than 3000	Categorical

Table 2 – Definition of variables

4.2 Scale reliability and validity of constructs

Attitudes towards environment and self-mobility were measured using 10 item (5 items for each type of attitude):

Attitudes towards the environment
- Item 130. I try to use less the car to improve air quality.
- Item 131. If I had to buy a car, or replace the current one, I would choose a more energy efficient one, even if it was smaller or more expensive.
- Item 132. We should increase the price of fuel to invest in improving public transport.
- Item 133. I support restricting the use of the car in the city to reduce congestion.
- Item 134. In my city, air quality is a major problem.

Attitudes towards personal mobility
- Item 135. I usually make arrangements online or by phone to avoid trips.
- Item 136. When I need to buy something, I prefer to go to the nearest shop as possible.
- Item 137. When I travel, I usually do other activities (reading, listening to music, checking social networks online, etc.)
- Item 138. I try to walk or cycle as much as possible and only use a motor vehicle for long distances.

- Item 140. I plan my trips and choose the mode of transport considering my daily schedule of activities.

Firstly, descriptive analysis were carried out and basic statistics and measures of normality, symmetry and kurtosis were obtained. Some of the items presented slightly signs of asymmetry and non-normality, which lead us to select robust estimators for Confirmatory Factor Analysis.

Cronbach's alpha was used to measure internal consistency which indicates how closely related a set of items are as a group. It was observed that item 130 did not show a strong correlation with the construct and it was deleted. The obtained measures (attitudes towards the environment = 0.751; attitudes towards personal mobility = 0.713) point out an adequate value for Cronbach's alpha for both latent constructs, thus, the scale reliability can be assumed.

The Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) is used to determine the proportion of variance in the variables that might be caused by underlying factors. High values are obtained (>0.9) which indicate that factor analysis technique may be appropriate with the data. Bartlett's Test of Sphericity tests the hypothesis that the correlation matrix is an identity matrix, which would indicate that variables are unrelated and therefore unsuitable for structure detection. Null value is obtained, which also supports the use of factor analysis with the data.

Pearson correlation matrix shows strong correlation among the items belonging to each construct, as it was expected.

4.3 Exploratory Factor Analysis (EFA)

In order to evaluate the scales and validate the latent variables generated, Exploratory Factor Analysis (EFA) was conducted based on the proposed theoretical constructs: attitudes towards the environment and attitudes towards personal mobility.

The results of EFA, using Varimax rotation and a factor loading of 0.40 as the threshold to maintain items in a factor, led to two independent factors as shown in Table 3.

Variable	Mean	SD	Median	Mode	EFA (Factor loading)
Attitudes towards the environment					
a131	3.72	1.280	4.00	5.00	0.553
a132	2.51	1.427	2.00	1.00	0.735
a133	3.02	1.303	3.00	3.00	0.629
a134	3.56	1.369	4.00	5.00	0.730
Attitudes towards personal mobility					
a135	3.79	1.334	4.00	5.00	0.712
a136	3.69	1.245	4.00	4.00	0.657
a137	3.76	1.297	4.00	5.00	0.629
a138	3.74	1.332	4.00	5.00	0.478
a140	3.90	1.274	4.00	5.00	0.688

Table 3 – Exploratory factor analysis

4.4 Confirmatory Factor Analysis (CFA)

Next, Confirmatory Factor Analysis (CFA) was conducted. Unlike EFA, in this method the posited relationships of the observed indicators to the latent variables are specified previously. The following goodness of fit indices were obtained: Chi square/df = 2701.721 (36), Comparative Fit Index (CFI) = 0.958, Tucker Lewis Index (TLI) = 0.935, Standarized Root Mean Square Residual (SRMR) = 0.035 and Root Mean Square Error Of Approximation (REMSEA) = 0.031. These statistics support the validity of the constructed scales. As shown in Table 4, all coefficients exceed 0.4, and most of them are higher than 0.5. It is confirmed that all statements are strongly correlated with the latent variables defined.

Variable	STDYX Standarized Loadings (S.E.)
Attitudes towards the environment	
a131	0.650 (0.023)
a132	0.673 (0.027)
a133	0.515 (0.023)
a134	0.500 (0.031)
Attitudes towards personal mobility	
a135	0.697 (0.020)
a136	0.408 (0.042)
a137	0.489 (0.038)
a138	0.479 (0.039)
a140	0.607 (0.029)

Table 4 – Confirmatory factor analysis

Results of Exploratory and Confirmatory Factor Analyses confirm the validity of the construct and reliability of the scales employed to measure the variables of the study.

This, it can be assumed that attitudes that the items developed to measure attitudes towards the environment and attitudes towards personal mobility can be used for this purpose after this validation process.

5. RESULTS

5.1 Frequency distributions
Firstly, frequency distributions are obtained for each item individually (Figure 1) in order to explore how participants perceive each factor in general, considering the entire sample of the study.
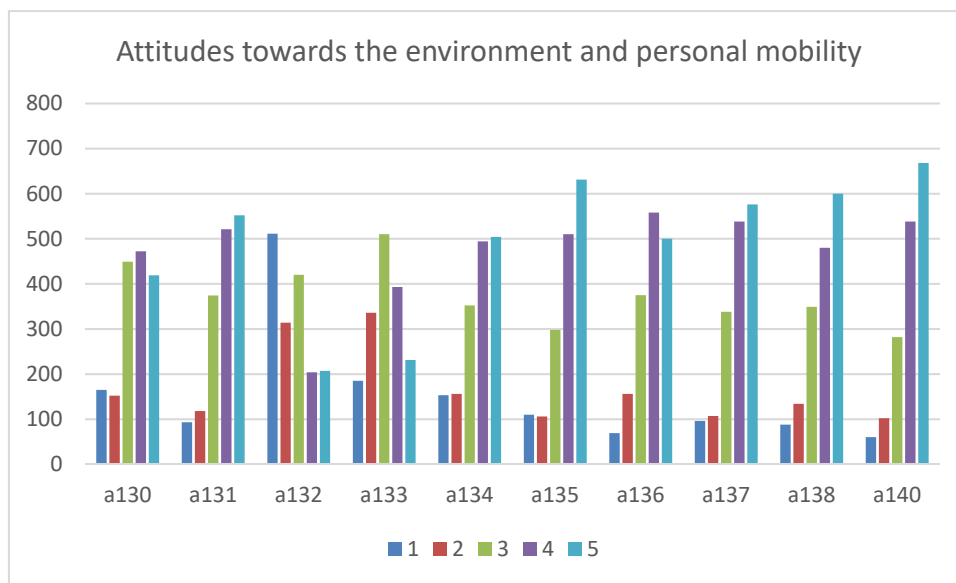

Figure 1. Attitudes towards the environment and personal mobility. Frequency Distribution.

In general, items which represent environmental concern issues related to travel (a130-a134) present lower scores that those regarding personal mobility. For instance an extended rejection to price increase of fuel is observed (item a132). The restriction of the use of private vehicle in order to reduce congestion seems controversial, with a relevant number of participant who support and who reject this measure simultaneously (a133). A higher amount of respondents reported their intention to choose a more energy efficient (a131) and a smaller part of the participants agreed with the intention to use less their cars to improve air quality.

Higher scores are observed for the items regarding personal mobility. In general, participants reported their willingness to avoid unnecessary trips which can be easily replaced with ITCs (a135), a high multitasking while traveling (a137), elevated preference for active transport for short distances (a138) and a high level of planning of their daily schedule when choosing their transport mode (a140). The item 136 was scored slightly lower, which represents the preference of buying as closest to home as possible.

5.2 Mann-Whitney test

The Mann-Whitney U test is a nonparametric test that allows two groups or conditions or treatments to be compared without making the assumption that values are normally distributed. The two independent samples are combined and ordered together, to notice if they mix randomly in the rank order or if they are grouped in opposite ends. In the first case it would indicate that the two samples are not different, while in the second it would indicate a difference between them.

In this research, Mann-Whitney U test is used to explore differences between attitudes towards the environment and attitudes towards personal mobility and sociodemographic characteristics.

The p-value chosen as a threshold to reject the null hypothesis that imply that both samples are equal in the population of the study was 0.005. Hence, p-value minor to 0.05 are taken into account. Two items related to attitudes towards the environment (a130 and a132) provided significant differences when gender is considered. Similar results were obtained for attitudes towards personal mobility, where other two items were found significant for gender (a137 and a140) (Table 5).

	Gender			
	U Mann-Whitney	W Wilcoxon	Z	p
a130	327447	625053	-2.313	0.021*
a131	347124	644730	-0.266	0.791
a132	327475.5	739253.5	-2.304	0.021*
a133	346235	758013	-0.354	0.723
a134	344477	756255	-0.540	0.589
a135	346559.5	644165.5	-0.327	0.744
a136	330770.5	628376.5	-1.984	0.047
a137	308381	605987	-4.352	0.000*
a138	338749.5	636355.5	-1.148	0.251
a140	315024	612630	-3.690	0.000*

Table 5 – Mann-Whitney U test. Gender

The items aforementioned which provided significant differences are considered now. Table 6 shows the percentage of frequency distribution of responses for each factor and score (1 to 5) considering gender. As it can be seen, women score higher than men in most of the responses (a130, a137 and a140). This means that women try to use less the car to improve air quality, usually do other activities while travelling (reading, listening to music, checking social media, etc.) and try to use active transportation as much as possible. It should be taken into account that women use more public transport and active modes than men in general in the area of the study. Contrary to that, men seem slightly less reactive than women to the increase of carburant prices to invest it on public transport improvements. However, in this case the general reaction to this measure is negative.

	1		2		3		4		5	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
a130	11%	9%	9%	9%	28%	26%	27%	29%	23%	27%
a132	30%	32%	17%	20%	25%	26%	12%	12%	16%	10%
a137	6%	5%	7%	6%	23%	18%	34%	31%	29%	40%
a140	4%	3%	8%	5%	19%	16%	33%	33%	36%	44%

Table 6 – Distribution of responses. Significant variables. Gender

In order to study how age is related to the variables of the study, percentiles of the sample were obtained. None of the items related to attitudes towards the environment provided significant differences among participants under 25 years and those over 47. Thus, no conclusions can be obtained according to age. On the other hand, three of the five factors which measure attitudes towards personal mobility (a135, a136 and a137) resulted significant when both age groups are taken into account (Table 7).

	Age			
	U Mann-Whitney	W Wilcoxon	Z	p
a130	99487	212537	-0.875	0.382
a131	99967.5	193928.5	-0.758	0.449
a132	99398	193359	-0.896	0.370
a133	96518	190479	-1.643	0.100
a134	102667.5	215717.5	-0.044	0.965
a135	91427	204477	-3.002	0.003*
a136	94020	207070	-2.325	0.020*
a137	69718	163679	-8.755	0.000*
a138	102320	215370	-0.137	0.891
a140	99951	193912	-0.774	0.439

Table 7 – Mann-Whitney U test. Age

Following the same methodology as in the previous case, the next step consists in the analysis of responses distribution of the variables that provided significant differences. As it is shown in Table 8, respondents over 47 seem more inclined to make arrangements online/ by phone in order to avoid unnecessary trips (a135) and prefer to do the shopping as close to their home as possible. In this case the differences observed are smaller. On the other hand, a relevant contrast if found for item a137. Younger individuals of the sample (those under 25) seem more inclined to multitask during their trips. This could be related to a higher use of ICTs of those under 25 who use their phones for multiple purposes while traveling.

	1		2		3		4		5	
	AgeQ1	Age Q3	Age Q1	Age Q3	Age Q1	Age Q3	Age Q1	Age Q3	Age Q1	Age Q3
a135	9%	6%	10%	5%	22%	19%	28%	32%	32%	38%
a136	4%	3%	11%	9%	22%	20%	34%	35%	29%	34%
a137	2%	11%	4%	10%	14%	25%	31%	30%	49%	24%

Table 8 – Distribution of responses. Significant variables. Age

Similar results are obtained for different occupation status (Table 9). In this case, the differences between the variables of the study are assessed considering students and employed individuals. Although attitudes towards the environment did not provided significant differences, much more interesting results are obtained for attitudes towards personal mobility, with four significant factors: a135, a137, a138 and a140.

Occupation				
	U Mann-Whitney	W Wilcoxon	Z	p
a130	177099.5	255309.5	-0.688	0.492
a131	177935	599756	-0.557	0.578
a132	172816	251026	-1.383	0.167
a133	173810	252020	-1.222	0.222
a134	179719	601540	-0.260	0.795
a135	155877.5	234087.5	-4.222	0.000*
a136	180235	258445	-0.176	0.860
a137	138018	559839	-7.188	0.000*
a138	167844	589665	-2.223	0.026*
a140	164422.5	586243.5	-2.823	0.005*

Table 9 – Mann-Whitney U test. Occupation

Next, the significant factors for occupation are explored (Table 10). Participants with employment reported a highest inclination to make arrangements online in order to avoid trips (a135). This could be explained by a better time management of those who work.

Next, students tend to multitask more that employees during their trips (a137) which is in line with previous results related to age. Last, students seem to plan their trips considering their daily schedule slightly more than employees. However, it should be taken into account that high scores are observed in the whole sample for this factor.

	Students	Employees	Students	Employees	Students	Employees	Students	Employees	Students	Employees
a135	11%	5%	10%	6%	19%	16%	26%	33%	34%	40%
a137	2%	6%	5%	7%	12%	23%	30%	36%	51%	29%
a138	5%	6%	9%	8%	16%	24%	30%	30%	41%	32%
a140	4%	3%	6%	6%	13%	19%	29%	36%	48%	36%

Table 10 – Distribution of responses. Significant variables. Occupation

6. CONCLUSIONS AND FUTURE RESEARCH

This research aims to study attitudes towards personal mobility and attitudes towards the environment. The latent variables constructed to evaluate these attitudes have been validated and the scale reliability is confirmed in this research. Thus, it can be assumed that the instrument developed to measure these factors is adequate and could be used in future research.

Results of this study reveal interesting conclusions which could be useful for policy making in order to promote sustainable travel modes. For instance, the increase of fuel price and restriction of private vehicle use are perceived as controversial measures by the participants of this research with divided opinions. On the other hand, respondents are inclined to avoid unnecessary trips which can be easily replaced with ITCs. Multitasking (reading, listening to music, checking social media, etc.) while traveling was also evaluated positively.

Considering gender, it was found that women try to use less the car to improve air quality, usually do other activities while travelling and try to use active transportation as much as possible. Taking into account that women use more public transport and active modes than men in general in the area of the study, more gender perspective studies are encouraged to better plan and design public transport systems as well as pedestrian and cyclist infrastructures.

Older respondents were more inclined to make arrangements online/ by phone in order to avoid unnecessary trips and prefer to do the shopping as close to their home as possible.

On the other hand, younger individuals prefer multitasking during their trips. The different use of ICTs for traveling should be considered for the promotion of sustainable travel.

Specific campaigns should be addressed to each cohort of the population. Additionally, special attention should be paid to design of public transport systems so as to facilitate multitasking, i.e. charging station for devices, wifi connection, comfortable spaces, etc.

Participants with employment reported a highest inclination to make arrangements online in order to avoid trips. Further cooperation among public administrations is still needed to enhance online services.

These results suggest interesting relationships between attitudes towards personal mobility and attitudes towards the environment. In order to confirm how this variables can explain travel behavior further analyses will be conducted based on Structural Equation Modelling.

Additionally, similar analyses will be assessed for the subsample of the survey which includes information about the activity and travel diary to include observed mobility.

Limitations of this study include sample size and underrepresentation of the older population cohort, which is a common limitation in web-based surveys. Additional attention should be paid in the future in order to enlarge participation of older respondents.

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