XIII Conference on Transport Engineering, CIT2018

Connotative meaning of travel modes and activity-travel behavior

Tomás Ruiz[a*], Rosa Arroyo[a], Daniel Casquero[a], Ainhoa Serna[b], Lidón Mars[c]

[a]*Transport Department, School of Civil Engineering, Universitat Politècnica de València, Camino de Vera s/n, Valencia 46022, Spain*
[b]*Faculty of Engineering, Information Systems Department, Mondragon Unibertsitatea, Loramendi, 4, Arrasate, 20500, Spain*
[c]*Social psychology Department, Faculty of Psychology, Universitat de València, Spain*

Abstract

This paper aims to present results of a study regarding how the meaning of travel modes influences on the performance of activities and trips.

Connotative meaning of travel modes was measured using semantic differential scales, which collect the suggestive significance of the terms used to name current travel modes. More than 400 people provided that information together with values and other types of attitudes, characteristics of their usual companions, socio-demographics, and 2-days activity-travel diary that includes a weekend day and a weekday.

Descriptive analysis, which include frequency distributions, Factor Analysis, and correlations, have been developed to find potential relations among the studied variables.

Maintenance activities are the most frequent, followed by discretionary activities. Only 10% of the total activities are mandatory. Approximately one third of trips are carried out by private vehicle. Motorized travel modes are characterized as noisy and powerful, in particular cars, while walking and cycling are simple and quiet.

Keywords: travel behavior; travel modes; attitudes; measurement; semantic scales.

1. Introduction

Among the factors that influence travel behavior, psychological and cognitive variables play an important role. Cognitive factors refer to characteristics of the individual that affect performance and learning. These cognitive factors are internal processes that modulate behavior by increasing or diminishing the performance of a certain behavior. Their role is to serve as broad guidelines in all situations influencing a person's behavior taking into account the mental representation of the built and social environment (Roy, 2013). Some of these cognitive factors are values, attitudes, and perceptions.

Attitudes, according to the three component model, express feelings, beliefs, and past behaviors regarding an attitude object (Zanna & Rempel, 1988). All three components are the affective, the cognitive, and the behavioral. In this way, people's attitudes towards different modes may have a direct influence on their travel behavior, under certain conditions, i.e differences among people, age, and the strength of the attitude in the topic being studied. Travel behavior theory has long recognized the role of attitudes and preferences in influencing travel behavior. Even though, attitudes are often included as control variables for self-selection, many studies have concluded that attitudes 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. The assignment to a position on the dimension is based on the individual's agreement or disagreement with a number of statements relevant to the attitude object.

In this context, how objects under study are described, in particular which are the words and adjectives used, is important to understand better the behavior of individuals. Semantic Differential scale or the S.D. scale, developed by Osgood et al. (1957), is an attempt to measure the psychological meanings of words and adjectives associated to an object. There are two aspects of meaning: denotative and connotative:

- Denotation - what a name or concept refers to (denote - to mark out plainly, to indicate).
- Connotation-the suggestive significance of a word, apart from its explicit and recognized meaning

The semantic differential measures connotative meaning.

Semantic differential scales are being used since the 1980s to evaluate relative image changes is tourism attraction sites (Gartnet and Hunt, 1987). In the field of travel behavior, Steg et al (2001) used a semantic differential method for evaluating (un)attractive aspects of car use. They found that on average, respondents evaluated the independence, the availability and the instrumental (utility) value of the car (e.g., for shopping, recreation, shelter, picking up other people) as the most attractive aspects of car use. With respect to the unattractive aspects, the picture is reasonably consistent. Instrumental aspects, such as costs, environmental problems and driving conditions, were evaluated as the most unattractive (see Table 2). Some symbolic-affective factors were evaluated as moderately unattractive, particularly aggressive driving behavior of other car users (violation of traffic rules and irritating driving behavior of others) and criminality focused on cars.

Domarchi et al. (2010) used semantic scales to measure affective appraisal of the mode effectively chosen by the individual. They found that car users and walkers have much more positive emotional and affective link to their respective modes. Public transport users, despite having a rather strong habit of use and positive attitudes, still manifest lower affective appraisals towards their modes. On the other hand, car drivers appear to have a rather high affective appraisal towards their mode. The ''safe'' concept for car drivers presented statistically significant correlations with ''comfortable'', ''clean'' and ''fast'' car drivers. In contrast, bus users present the more negative affective appraisal. The level of cleanliness of the public transport mode is much more important for public transport users than for car users.

In this paper, we study connotative meaning of driving, carpooling, using public transport, cycling and walking for individuals who have diverse sociodemographics and travel behavior.

2. Data

A web-based survey was developed in order to collect data about values, attitudes and social interactions, with the aim of understanding how these factors influence travel behavior.

The data collection was intended to be carried out completely online, using large mailing lists from universities and other private and public stakeholders to distribute invitations for participating in the survey. However, a printed version was also used in order to reach participants' who would not be targeted using online methods.

Data collected included: sociodemographics, values, attitudes, a two-day activity-travel diary (a working day, and a weekend day), and some additional information regarding an extended list of activity and travel companions of

each respondent. The three-component attitude model was used to study attitudes towards travel modes. This model suggests that attitudes are divided into three groups: affective, cognitive, and behavioral. Affective attitudes evaluate feelings of enjoyment or disgust towards an attitude object. Cognitive attitudes refer to the knowing if the object or phenomenon is somehow good for oneself. Behavioral attitudes express a recalling of past behaviors relevant to the study area, and in some way the intentionality existing behind the behavior (Zanna and Rempel, 1988). Additionally, the on-line questionnaire collects intentions to use travel modes; attitudes towards innovative travel modes; perceptions about pedestrians and cyclist infrastructure; perceptions about the environment, use of ICTs and personal mobility; and semantic differentials towards travel modes.

To study connotative meaning of current travel modes, seven semantic scales with two ends, were prepared to capture the meaning of each concept for respondents. Each scale was composed by two perfect antonyms adjectives in each end. Respondents were asked to state their position for each travel mode. The following pairs of adjectives were included in the online questionnaire: noisy-quiet, masculine-feminine, modern-traditional, weak-powerful, basic-complex, humble- proud, young- mature. Respondents were asked to position themselves in each scale regarding five current travel modes: car, carpool, public transport, bicycle and walking.

401 responses with valid semantic differential data were obtained. The sample is well balanced considering gender (Table 1). Although nearly 70% of respondents have less than 35 years of age. Workers represent 41% of the sample, and students nearly 35%.

Table 1. Sample characteristics. Socio-demographics

	N	%
Male	180	44.9
Female	221	55.1
18-25	143	35.7
26-34	99	24.7
35-50	101	25.2
>50	58	14.5
Student	140	34.8
Worker	164	41.0

Travel behavior of the sample is characterized by a high percentage of non-motorized trips during the two-day survey (Table 2). Walking represents nearly half of the total trips carried out during the two-day survey. Private Vehicle (PV) is utilized in 35.4% of cases. The modal share for Public Transport (PT) is 11.4%. And the participation of bicycle in the modal share is 6.6%

Table 2. Sample characteristics. Modal share

	trips/person/ 2 days	%
PV	2.8	35.4
PT	0.9	11.4
Bike	0.5	6.3
Walk	3.7	46.8
Motorized	3.8	48.1
Non-motorized	4.1	51.9
Total Trips	7.9	

3. Analysis

3.1. Travel modes in the Semantic Space

A geometric distance between the scores of the seven semantic scales regarding each travel mode has been calculated using the following formula:

$$d_{uv} = \sqrt{\sum_k^K (x_{uk} - x_{vk})^2} \tag{1}$$

where xuk and xvk are the dimensional scores assigned to modes u and v in the k-th of the K considered semantic scale. Of course, in this particular semantic differential, K = 7 (seven semantic scales). Table 3 contains the semantic distances for each pair.

Table 3. Semantic distances between travel modes

	PV	Carpool	PT	Bike	Walk
PV	0	1.84	1.57	3.12	3.28
Carpool		0	1.50	2.68	3.46
PT			0	2.56	2.73
Bike				0	5.30
Walk					0

Motorized and non-motorized are clearly evaluated as a two separated groups of travel modes. Carpool and Public Transport are evaluated in a similar way. Bike is evaluated at a similar distance from PT and Carpool. This may be related to the characteristics of the public bikes in Valencia (e.g. Valenbisi) and other cities, which is used as a substitutive travel mode of PT. Finally, cycling and walking are seen as a completely different travel modes.

3.2. Valuation of travel modes

Table 4 present semantic scores statistics for each travel mode. In general, PV is considered somewhat noisy and powerful. Carpool is somewhat noisy and modern. PT is somewhat noisy, simple and humble. Bicycle is very quiet, and somewhat weak, simple, humble and young. Finally, walking is considered very quiet and simple, and somewhat traditional and humble.

3.3. Group analysis

In order to find differences between socio-demographic and travel behavior groups in each of the semantic scales and each travel modes, t- and Mann-Whitney U- tests have been calculated. T-test are only valid for normal distributions. In this case, most of the semantic scales' distributions are non-normal. Therefore, a non-parametric test based on differences of the median is needed.

Table 4 – Basic statistics of Semantic Differential scores per travel mode

		Noisy-Quiet	Masculine-Feminine	Modern-Traditional	Weak-Powerful	Basic-Complex	Humble-Proud	Young-Mature
PV	Mean	2.56	2.86	3.29	3.79	3.17	3.49	3.27
	Median	2.00	3.00	3.00	4.00	3.00	3.00	3.00
	SD	1.28	0.47	1.04	0.85	0.90	0.77	0.69
	Symmetry	0.47	-1.66	0.07	-0.43	0.20	0.05	0.18
	Kurtosis	-0.95	5.92	-0.45	0.27	-0.08	0.35	1.27
Carpool	Mean	2.37	2.98	2.13	3.22	3.08	2.67	2.29
	Median	2.00	3.00	2.00	3.00	3.00	3.00	2.00
	SD	1.04	0.32	0.80	0.73	0.83	0.76	0.85
	Symmetry	0.59	-1.04	-0.39	0.42	0.13	-0.07	0.17
	Kurtosis	-0.14	16.14	0.10	0.82	0.08	0.39	-0.24
PT	Mean	2.27	3.05	3.27	3.15	2.46	2.33	2.96
	Median	2.00	3.00	3.00	3.00	2.00	2.00	3.00
	SD	1.08	0.35	1.02	0.89	0.91	0.75	0.70
	Symmetry	0.77	1.09	-0.09	0.15	-0.28	-0.05	0.14
	Kurtosis	-0.09	14.83	-0.72	0.24	-0.24	-0.06	1.84
Bike	Mean	4.53	2.95	2.95	2.40	2.06	2.30	2.19
	Median	5.00	3.00	3.00	2.00	2.00	2.00	2.00
	SD	0.73	0.36	1.21	0.97	0.95	0.92	0.82
	Symmetry	-1.74	-1.90	-0.27	0.21	-0.51	0.27	0.31
	Kurtosis	3.36	14.56	-0.87	-0.46	-0.31	-0.12	0.12
Walk	Mean	4.72	3.05	3.97	2.52	1.76	2.10	2.99
	Median	5.00	3.00	4.00	3.00	1.00	2.00	3.00
	SD	0.66	0.34	1.09	1.10	0.94	1.01	0.74
	Symmetry	-2.56	1.18	0.61	0.29	-0.67	0.31	0.20
	Kurtosis	6.48	21.22	-0.61	-0.31	-1.07	-0.81	2.89

The following medians of semantic differentials are significantly different for men than for women. PV is noisier, more masculine, more traditional and prouder for men than for women. Carpooling is more complex and younger for males than for females. PT is simpler for women than for men. Contrary to PV, PT is more humble for men than for women. Walking is quieter, simpler and more humble for men than for women.

According to age, PV is significantly noisier for older than 35. On the other hand, PV is more powerful for those younger than 35 years of age. Carpooling is more humble for those younger than 35 years of age. Using PT is noisier and humble for younger than 35 years of age. On the other hand, PT is more traditional for those older than 35. Cycling is considered weaker, simpler and more humble for those younger than 35 years of age. Walking is considered more traditional, weaker, simpler and more humble for those younger than 35 years of age. On the other hand, it is viewed as quieter for those older than 35.

Students consider PV significantly more powerful and complex than workers. In contrast, PV is noisier and more traditional for workers. Carpooling is more powerful for students. PT is more traditional for workers. Cycling is

considered more humble for students, and younger for workers. Walking is more traditional, weaker, basic and humble for students.

Those who use less PV than the average significantly consider this travel mode more powerful. And those who use more PV than the average, see this travel mode prouder. PT is seen as more powerful for those who use more PV than the average. Those who use less PV than the average consider cycling more masculine.

PV is considered significantly more complex for those who use PT more than the average. Cycling is seen as simpler for those who use PT more than the average.

VP is significantly considered noisier for those who use less non-motorized travel modes than the average. Carpool is seen more modern and younger for those who use less non-motorized travel modes than the average. Cycling is considered younger for those who use less non-motorized travel modes than the average. Walking is quieter for those who use less non-motorized travel modes than the average.

3.4. Exploratory Factor Analysis

An Exploratory Factor Analysis (EFA) was used to extract the groups of semantic scales that best explain the variance of the observations. Using Principal Component Analysis, three factors have been extracted, which explain 56.7% of variance detected. They were rotated, to facilitate the understanding of the constructs obtained, using the Varimax normalization method. The factors extracted and the adjectives with weights higher than 0.40 are presented in Table 5.

Table 5 – Semantic scores per travel mode

	F1	F2	F3
Noisy-Quiet		0.658	
Masculine-Feminine		0.656	
Modern-Traditional			0.733
Weak-Powerful		0.481	
Basic-Complex	.738		
Humble-Proud	.756		
Young-Mature			0.739
% Explained Variance	22.29	17.83	16.58

The first factor (F1) includes the adjectives Basic and Humble. The second factor (F2) includes the adjectives Noisy, Masculine and Weak, which indicates that gender is related to the potency dimension, as identified by Osgood et al. (1957). The third factor (F3) includes the adjectives Modern and Young.

4. Conclusions

This paper presents an analysis of connotative meaning of travel modes using semantic differential data collected in an online survey, in which respondents were asked to position themselves in seven scales composed by two antonyms adjectives regarding car, carpool, public transport, bike and walking.

Geometric distances between scores of the seven semantic differential scales reveal that motorized and non-motorized travel modes are clearly evaluated as a two separate groups. Cycling and walking are also considered very different in terms of the adjectives included in the study.

Powerful and modern are adjectives associated to car and carpool. On the other hand, public transport and non-motorized travel modes are seen simple and humble. Both cycling and walking are considered very quiet travel modes.

Private Vehicle is more powerful for those younger than 35 years of aged, students, and those with lower use of private vehicle. Carpool is seen more modern for those who use less non-motorized travel modes. On the other hand, Public Transport is simpler for women, but more humble for men.

Cycling is considered simpler for those younger than 35 years of age and for those who use PT more than the average. It is seen more humble for those younger than 35 years of age and for students. On the other hand, Walking is quieter for men than for women and for those who use less non-motorized travel modes than the average. It is simpler and more humble for men, for those younger than 35 years of age, and for students.

Transport policies with the objective of promoting alternative travel modes to (solo) car, should study more in depth how travel modes are seen by people. For example, we have identified that powerful is an important adjective associated to car, especially for younger people and students. It would be important to try to link this attractive meaning to public transport, introducing convenient messages in awareness campaigns.

On the other hand, it seems that simple and humble are being considered negatively associated to public transport. Similarly, vehicle design and images, the use of ICT, etc., should be exploited at maximum to change how people see and consider public transport.

The analysis presented in this paper is a first approximation to the study of connotative meanings associated to travel modes. More research is needed selecting other adjectives, recruiting a bigger and more diverse sample of respondents, and using predictive models that help to improve explanatory analysis.

Acknowledgments

References

Bopp, M., Kaczynski AT., Wittman P., 2011. The relationship of eco-friendly attitudes with walking and biking to work. Journal of public health management and practice, 17(5), E)-E17.

Domarchi, C., Tudela, A. and González, A., 2008. Effect of attitudes, habit and affective appraisal on mode choice: an application to university workers. Transportation, 35, 585-599.

Gartner, W.C. and, Hunt, J.D., 1987. An Analysis of State Image Change Over a Twelve-Year Period (1971-1983). Journal of Travel Research, 26, 2, 15-19.

Hunecke, M., Haustein, S., Böhler, S. and Grischkat, S., 2010. Attitude-Based Target Groups to Reduce the Ecological Impact of Daily Mobility Behavior. Environment and Behavior, 42, 1.

Osgood, C. E., Suci, G. J. and Tannenbaum, P. H., 1957. The Measurement of Meaning. University of Illinois Press, 1957, Urbana.

Roy, E., 2013. Cognitive factors. In Gellman and Turner (Eds.) Encyclopedia of Behavioral Medicine, 447-448. Springer New York.

Runing Ye et al., 2017. Satisfaction with the commute: The role of travel mode choice, built environment and attitudes.

Spears, S., Houston, D. and Boarnet, M.G., 2013. Illuminating the unseen in transit use: A framework for examining the effect of attitudes and perceptions on travel behavior. Transportation Research Part A, 58, 40-53.

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

Zanna, M. P., & rempel, J. K., 1988. Attitudes: A new look at an old concept. In D. Bar-tal & A. W. Kruglanski (Eds.). The social psychology of knowledge (pp. 315-334), Cambridge, England: Cambridge University Press.