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Web based survey to measuring social interactions, values, attitudes and travel behavior

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Abstract

This paper presents the data collection methodology developed for Minerva research project. The aim of Minerva is to study the influence of values, attitudes and social interactions on travel behavior. For this purpose, a web based survey has been developed, which consists of several questionnaires to collect respondents' values and attitudes; a two-day activity-travel diary; information about social interactions; and socio-demographic characteristics. To identify the social contacts, it is being used a contact diary methodology together with the activity-travel diary.

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Keywords: web-based survey; values; attitudes; perceptions; travel-behaviour; social interactions.

1. Introduction

The aim of this paper is to present the methodology of the data collection step of a wider project, called Minerva. This research project is developed by two Spanish universities (Polytechnic University of Valencia and Mondragon University) and it's founded by the I+D+i National Program of Society Challenges of the Spanish Ministry of Economy and Finance.

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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. It is of paramount importance 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 cognitive factors and the social environment of individuals. 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.

On the other hand, the term social environment refers to the way people affect the thoughts, feelings and behaviors of others. It includes the culture, the institutions, and the people with whom individuals interact (Casper, 2001). The most common form of social influence is conformity (Asch, 1958). It is generally defined as the tendency to act or think like other members of a group. The level of conformity will be determined by some determinants such as status, self-confidence, or the importance that others have for the individual. A person will tend to conform to acquire social acceptance or evade the social conflict. Nevertheless there are a number of another phenomena that make people relate to others. As an example, the principle of similarity and reciprocity, in which it is observed that people will be more likely to relate to others with whom they share beliefs.

Other important theory is the heuristic model of social validity, wherein people are more likely to perform a behavior if it is consistent with what other similar people do or think (e.g., Wood, 2000).

Consequently, people's beliefs and expectations influence other people around them. Moreover the very concept of oneself has been created influenced by the perspectives and images that others have had about him or her.

1.2. Values, perceptions, and attitudes

To study the cognitive factors of travel behavior, this work is focused on the collection of data regarding the following three cognitive aspects of people: values, perceptions, and attitudes.

Values are evaluations of abstract ideas (e.g. equality, honesty) in terms of their importance as guiding principles in one's life (Schwartz, 1992; Rokeach, 1973). Among the explicative variables of travel behavior, values have been scarcely used in travel behavior studies. In contrast, values are commonly applied in social sciences and psychology in order to explain individual attitudes and behaviors (e.g. Balaguer, Castillo, Queded, & Duda, 2007; Boer, & Fischer, 2013; Schwartz, 2016).

In the travel behavior field, Paulssen et al. (2014) examined the influence of values using Schwartz theory on travel mode choice behavior. They characterized only 3 of the 10 Values identified by Schwartz et al (2001). Their results from an empirical application support the value-attitude-behavior hierarchical model of cognition, and provide insights to planners and policy-makers on how better to sell public transit as a means of travel.

Perception is the process through which human beings receives signals and convert the outer world into psychologically meaningful information to define their experience of the world. This process is accomplished throughout the senses (sight, ear, taste, touch, and smell) that allow to structure and interpret the input information of the world (Bodenhausen & Hugenberg, 2009). These perceptions can help developing higher-order cognitions, for example inferences about intentions and social environments. Perceptions have been scarcely studied in the travel behavior field (Leanne Yong et al (2015), Nielsen et al. (2015)).

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., 200; Bopp et al., 2011; Spears et al., 2013; Runing Ye et al, 2017).

1.3. Social environment: Social Networks and Travel Behavior

Non-compulsory activities, in particular leisure activities, are increasing in importance in developed urban areas. For example, leisure activities in the area of Valencia represented 6.3% in 1991, and 9.3% in 2009 (COPUT, 1994; Generalitat Valenciana, 2010). Other non-recurrent travels represented 14.4% in 1991 and 32.0% in 2009. Leisure travel is more complex and variable than work-related travel, the former is less rigid in temporal and spatial patterns and more influenced by external factors such as social contacts or weather conditions (Kowald and Axhausen, 2015).

As stated earlier, social interactions are an important explicative variable of leisure travel. Furthermore, it is logical to expect that values and attitudes of respondents' social contacts could influence their own values and attitudes, and, therefore, their travel behavior. Consequently, there is a need to adequately characterize social interactions through Social Networks if we want to study better leisure and social travel.

Social interactions are being considered in travel behavior studies through the study of Social Networks. Axhausen's (2006) defines a Social Network as a set of persons who are linked pairwise, so that each person can reach any other through an active tie (Axhausen, 2006). It is argued that the geography of the members of the travelers' social networks together with the geography of the relevant activity locations determines the amount and style of travel. This is especially true for trips to carry out leisure and social activities.

Social network data is being collected mainly in person, using ego approaches and combining qualitative and quantitative techniques. They are long surveys (two hours long), and the respondent (ego) is asked about the characteristics of their social networks (alter's demographics, spatial location, frequency of interactions, etc.) (Ohnmacht, 2015; Carrasco et al., 2008; Van den Berg et al., 2009; van den Berg and Timmermans, 2015) and information on habitual mobility, preferences and biographical questions (Axhausen and Frei, 2007).

In this study, we consider as social interactions mainly those members of the Social Network who share activities and travels with the ego. Considering that, we hypothesize that these activity-travel companions are the most influential on the ego's travel behavior.

2. Research Methods

2.1. Methodology, scope and focus of the study

A web-based survey has been 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 method involves the design of the survey, the development of the online tool, dissemination and distribution of the survey and maintenance, administration and control of the entire process.

The data collection is 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 is also used in order to reach participants' who would not be targeted using online methods.

The data collection process is specifically designed to provide clear and concise information to participants, with a simple and easy-to-use system and a responsive user-friendly interface.

In addition, a set of reminder emails is used in order to guide participant through the application. This is particularly important, because some sections and features of the survey are automatically generated using data introduced in advance by respondents. On the other hand, flexibility is important in order to engage users in the survey; with this purpose, auto-save feature has been implemented in the system.

2.2. Theoretical framework

The theoretical framework of the study is focused on the influence of values, attitudes, social influence, and sociodemographics on travel behavior, as well as the relationships between these factors. Other possible influencing

variables, such as transport network characteristics and land use are out of scope currently and will be considered in further steps. (Fig. 1)

Because values are abstract, they have the potential to influence many different attitudes, and those attitudes can affect individuals’ behavior. In this study we have used Schwartz’s theory of values (1992) that expresses ten types of motivation: achievement, benevolence, conformity, hedonism, power, security, self-direction, stimulation, tradition, and universalism. Which in turn form four structures of higher order, representing two basic dimensions of value conflict: conservation vs openness and self-enhancement vs self-transcendence.

The social environment affects attitudes and travel behavior. Values can also be affected, but to a lesser extent by demographics. The characteristics of individuals’ social network are the social environment variables to be collected in the survey.

Attitudes are defined under the direct influence of demographics and socioeconomics, values and social environment. Attitudes can affect the observed behavior. Affective, cognitive and behavioral attitudes toward travel modes are considered. Attitudes towards the use of ICT, new travel options and environmental attitudes are included as well.

In this framework, the relationships among values, attitudes, social influence and travel behavior described before are considered bidirectional. This hypothesis will facilitate the identification of possible influences in both directions.

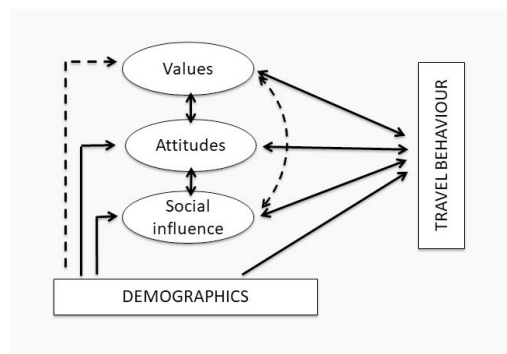


Fig. 1. Theoretical framework scheme.

3. Survey Design and Data Collection

3.1. Survey method

The online survey is composed of five parts: sociodemographic data, values, attitudes, a two-day activity-travel diary, and some additional information regarding each of the contacts (alters) introduced in the diary by the participant (ego).

Deadline given to complete all the parts is 10 days from registration time; although an additional deadline of 5 days is given to individuals who have mostly complete the survey. Next, the steps that respondents must follow to complete the survey are described.

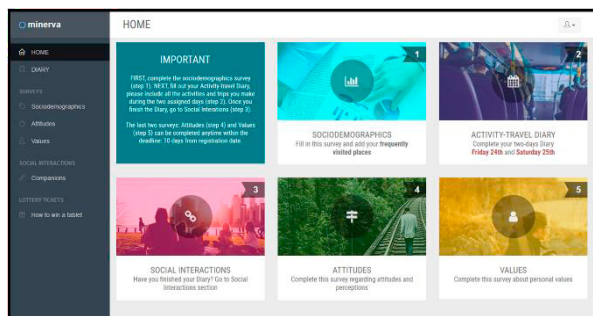


Fig.2. Welcome page of Minerva application website.

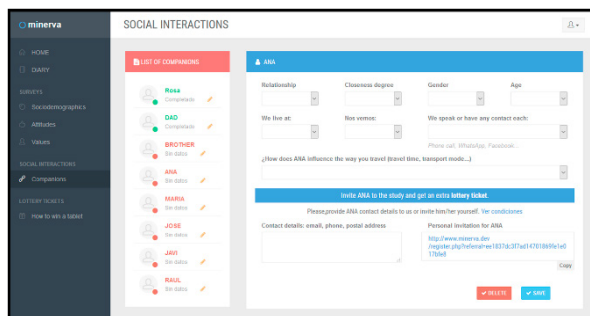


Fig.3. Social interactions page of Minerva application website.

3.1.1. Signing up

First of all, participants must create an account, introducing simply their contact data and credentials. Immediately, a welcome email is sent, which informs respondents when they will be asked to fill in their activity-travel diary.

3.1.2. Sociodemographic data

Secondly participants are requested to provide some sociodemographic data, such as personal characteristics, household information, vehicle availability and accessibility to public transportation stations. In the same section, users can optionally define up to 5 places that are visited frequently (writing name and address). Automatically, the places already declared appear in the activity-travel diary as pre-defined places.

3.1.3. Activity-travel diary

The third step consists of completing an activity-travel diary. A weekday and a week-end day are assigned to each individual based on the registration date. Participants are asked to define all the activities and travels they do 24 hours per day. For each activity or travel episode, the attributes requested are: initial and final time, travel mode or activity type, origin and destination or place, and companions. All the answers should be selected from predefined options except for companion definition, where respondents are asked to type their names for each trip or activity.

3.1.4. Social interactions: companions

As explained earlier, social interactions consist mainly of activity and travel companions. After the completion of the activity-travel diary, the Social Interactions section displays the list of the companions introduced before. For each contact, a brief questionnaire is generated requiring the following information: age, gender, approximate residence location distance between ego and alter, type of relationship, face to face meetings frequency, communication frequency and an estimate of the influence degree of the alter in the ego's mobility.

Additionally, with the aim of increasing the number of social contacts provided, respondents are asked to add new contacts apart from those defined at the diary. In the same section, users are encouraged to invite their alters to participate in the study, either providing their contact details or using a customized link.

3.1.5. Values and attitudes

Values and Attitudes surveys can be completed at any time within the 10 days period of the study, in order to give some flexibility to respondents.

The Values survey is based on Schwartz theory of human values (Schwartz, 1994). The Schwartz Value Survey (SVS) is composed by 56 items, each one followed by a brief description for clarification. The survey evaluates 10 different value types and four values of higher order types, although values can be clustered in various ways to form a different number of higher order values (Schwartz, & Boehnke, 2004). Responses are measured on a non-symmetrical scale from -1 to 7. This scale has been implemented in the survey using a range bar, which is a dynamic and easy way of providing this information.

The three-component attitude model is 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; semantic differential towards travel modes, which measures mental representations of travel modes through certain adjectives; attitudes towards innovative travel modes; perceptions about pedestrians and cyclist infrastructure; and perceptions about the environment, use of ICTs and personal mobility. Likert scales are used in all attitudes and perception questions.

3.2. Sampling frame and sampling procedure

Sampling frame consists of two parts: e-mail lists provided by different public institutions and private companies, and a customer research panel.

First, invitations to participate in the survey were sent using lists of e-mails provided by different institutions: the two public universities of the city of Valencia; Administrative City 9 de Octubre; concerts organizers; and several business associations.

Second, the customer research panel provided responses from participants who are paid (directly or through other systems such as points programs, vouchers of gifts) for completing surveys. Participants in this panel were selected according to socio-economic and demographic criteria. Main reasons for using this panel are:

- Increase the number of valid responses. Customer research panelists take part in surveys frequently, and they are used to be awarded only if they complete surveys properly.
- Reduce bias by inviting participants from specific cohorts.
- Compare results from both sub-samples in order to contribute to web-based survey knowledge.

3.3. Instrument design

The system is integrated by a website and the survey platform itself. The dissemination actions and invitations lead users to the website (www.retominerva.es), which contains the main information of the study, such as: research goals, instructions, incentives, privacy policy, frequently asked questions, contact details and access to the survey. The survey platform requires registration, since participants must access several times in order to provide different information. In addition, this feature allows users to fill in the survey at different moments. Due to the particular features required, we decided to develop an ad-hoc web based platform.

The platform consists on a LAMP (Linux, Apache, MySQL & PHP) based application. The back-side is implemented with MVC architectural pattern (Model-View-Controller), particularly PHP 7 version, and secure MySQL connections. Indeed, some frameworks and tools have been used, such as: Doctrine, Composer, Pimple, Monolog, Swiftmailer, JQuery and Bootstrap. Some external services have been used for complementary features:

- Mailing deliveries for reminders and invitations are sent using Amazon Web Services (AWS) through SMTP protocol from a verified domain email.
- Google Maps Places JavaScript API has been integrated in the activity-travel diary, which allows up to 150.000 requests per day.

From the front-end side, the application has been built taking into account several criteria: usability, adaptability, responsive web design, cross-browser compatibility and user-friendly interface. In this regard, it should be pointed out that every single question filled out by the user is automatically saved, which allows storing the data provided, even though the application might be closed suddenly.

3.4. Pilot surveys

Two pilot surveys have been developed with different purposes. In the first one, 30 participants were invited to complete a first version of the survey, and were asked to write a report with several questions about their impressions, doubts and technical issues. The main objective of this pilot survey was to test the application for the first time in a real environment.

As a result, psychometric validation of the cognitive questionnaires was carried out, so some questions were modified to obtain a better reliability and validity of the constructs used. Besides some repetitive actions were automated in the web-survey (such as the definition of frequent activity locations at the beginning) and the responsive interface was improved, in order to adapt the application to different devices. In addition, new instructions were added, a welcome page was developed, as well as a FAQs question in the website.

The second pilot survey took place after all the improvements mentioned before were executed. By that time, questions, instructions, and technical aspects were reshaped. In this pilot, around 70 invitations were sent to people who had no relationship with the research, neither with any team member. With this sample strategy, it could be checked that the process took place entirely online with any support.

Furthermore, the second pilot survey tested the behavior of respondents in terms of inviting their contacts. The result was that only a few participants provided their alters' contact details. Therefore, it was implemented a referral link process to allow participants to invite their contact themselves. Additionally, the incentive system was slightly changed, giving more lottery tickets to those respondents who invite more people to the study.

4. Administration of the survey

4.1. Reminder Regime

Taking into account that the survey contains several steps and some of them must be fulfilled in a certain order, a reminder regime of e-mails was established:

- Welcome e-mail. It is sent just in the moment of registration and aims to inform about the two days assigned for the activity-travel diary.
- Activity- travel daily reminder. For each of the days assigned for the activity-travel diary a quick reminder is sent at 7am, with the aim of making participants aware of the activities and trips they perform and help recalling.
- Day 9 reminder. One day before the deadline, a reminder email is sent, which lists the main task pendant to be completed in order to receive the lottery ticket.
- Day 12 last chance reminder. Two days after the deadline is over, those participants who have completed between 50% and 80% of the study receive an e-mail which details the survey parts missing and gives a last chance to complete them, with a new deadline of 5 more days.

4.2. Validation methods

Due to the amount of data requested in the survey, it is expected to receive incomplete and invalid responses. For this reason validation methods are required, the goal is twofold: assessment of the accuracy of the information provided and measurement of the progress of fulfillment of the survey. Validation actions include:

- Specific procedures to detect data introduced randomly.
- Alerts in the activity-travel diary, which show error messages to respondents so that they can correct them: time slots missing within the day; overlapping episodes; and episodes not defined properly.
- Time spent completing each questionnaire.
- Progress measurement. With the goal of implementing reminder emails automatically, it was necessary to implement a script that checks automatically the degree of fulfillment of the survey.

4.3. Use of incentives

With the aim of motivating participants to complete the survey, a scheme of incentives was designed. All participants will be eligible for a lottery prize (3 tablets) as long as they provide a minimum of information about their values and attitudes, activity-travel agenda, social contacts and demographics.

Respondents can also double their chances to win by providing valid contact information of their alters (at least six), or inviting their contacts themselves (in this case, the extra ticket will be given when at least three of their social contacts complete the study).

5. On-line survey for the customer research panel sub-sample

5.1. Customization of the survey

The survey has been modified in order to accomplish the integration with the customer research panel. The main conditioning factor is the identification of participants; due to privacy restrictions, personal and contact details are not provided by the company who owns the panel. For this reason, the registration system has been replaced, and a personal link is used instead

The first version of the web survey attempts to collect as much information as possible from each participant on the basis of flexibility. Thus, participants can navigate through the platform freely and complete the survey in their preferred order. On the other hand, reminders and pop-up messages encourage respondents to fully complete the survey. However, in the second version, participants cannot move forward to a following questionnaire if the previous one has not been completed correctly.

In the following table, a comparison of differences between the two on-line surveys is presented.

Table 1. Differences between the on-line surveys.

SURVEY FOR E-MAILING LISTS SUB-SAMPLE	MAIN FEATURES	SURVEY ADAPTED TO A CUSTOMER RESEARCH PANEL
Open access from a website	Sample	Personal invitations sent to selected participants according to demographic characteristics. Possible segmentation.
Online dissemination and mailings	Recruitment	Participants from a customer panel
High rate of partial responses	Response	Expected increase of completed responses
Lottery ticket for prizes	Incentives	Respondents get paid
TECHNICAL ISSUES		
Managed entirely by the research team	Panel management	The panel provider company manages their panellist database.
Ex post and less rigorous	Data validation	Real-time validation
Provided by the research team	Participant support	Provided by the company
Registration is required	Access to the survey	Personal link
Reminder emails are scheduled and personalized	Reminder regime	Not possible

6. Preliminary results

6.1. Customization of the survey

The web survey described in this paper is still on-going. During September, it is expected that the participation in the e-mailing list sub-sample increase. On the other hand, the customer research panel started their contribution on September, 5. The preliminary results presented in this section describe the participation until August, 31.

A total of 265 individuals provided valid information for all questionnaires included in the web-survey (table 2).

Table 2. Participation in the survey. E-mailing list sub-sample

	Questionnaires completed					
	Activity-Travel Diary	Social Contacts Info	Values	Attitudes	Demographics and Socioeconomics	All
Participants	374	321	526	575	1276	265

The distribution of the sample of those providing valid data for the entire survey according to gender is not very unbalanced. However, as expected, those over 50 years old are under-represented in the sample. Participants are predominantly students, although there is also a significant proportion of employed individuals.

Table 3. (a) Gender distribution; (b) Age distribution; (c) Activity distribution. E-mailing list sub-sample

a			b			c		
Gender	Participants	%	Age	Participants	%	Activity	Participants	%
Male	122	46,00%	16-25	134	50,60%	Student	123	46.4%
Female	143	54,00%	26-35	68	25,70%	Employed	88	33.2%
Total	265		36-50	45	17,00%	Student+employed	37	14.0%
			>50	18	6,80%	Unemployed	11	4.2%
			Total	265		Retired	2	0.8%
						Others	4	1.5%
							265	

The average number of activities and trips per person and per day are 11.6 and 4.1, respectively (Table 4). Non-motorized travel modes are predominant (52.5%). Among the motorized travel modes, the use of private vehicle is the most important (35.4%). These average values include a weekday and a weekend day (Table 5).

Table 4. Activity-Travel Diary and Social Interactions.

Attribute	Average
Trips per day	4.1
Activities per day	11.6
Companions defined in the 2-days activity-travel diary	7.8
Total companions	9.8

Table 5. Travel mode split.

	MODE 1	MODE 2	MODE 3
% PV	35,44%	14,29%	8,00%
% PT	11,96%	31,77%	20,80%
% Motorized	47,46%	46,06%	28,80%
% Walking	44,80%	48,03%	63,20%
% Cycling	7,74%	-	-
% Non-motorized	52,54%	-	-
Number of trips	3036	406	125

The average number of activity-travel companions included in the 2-day activity-travel diary is 7.8 per participant. Considering the additions included in the Social Interaction section, the number of social contacts is 9.8 per participant.

7. Conclusions

This ongoing research is now in the data collection step. The web-based survey has been spread online using large mailing lists from universities and other private and public stakeholders. Currently, a new version of the survey adapted to customer research panels has been launched.

The main conclusions until now are the following:

- Respondents are resistant to provide contacts details of people from their social interactions.
- It is difficult to identify relationships between egos and alters. Some participants invite their contacts to the project without following the invitation system. When this issue was identified, the registration process was modified, attempting to detect users whose details have been already provided by other participant in his social interactions section. Some extra mechanism will be applied in the future: comparing emails from different providers with a similar user name or domains from same companies or institutions.
- Instructions for completing an online survey should be carefully studied. Indeed, providing quick support is advised. In this project, a phone number and an email have been published in the website.
- Developing an ad-hoc web based survey provides great flexibility.
- Customer research panels can be an appropriate source to increase the sample and reduce bias. In this research, results from online distribution and customer panel will be compared.

8. Acknowledgements

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