STATED PREFERENCE SURVEYS IN TRANSPORT DEMAND MODELLING: DISENGAGEMENT OF RESPONDENTS

Olga Petrik[1]
João de Abreu e Silva[2]
Filipe Moura[3]

[1,2,3]*CESUR, Department of Civil Engineering, Architecture and Georesources, IST, Technical University of Lisbon, Av. Rovisco Pais, 1049-001, Lisbon, Portugal, e-mail for correspondence: opetrik@civil.ist.utl.pt*

ABSTRACT

Stated preference surveys (SPS) are an important tool to help forecasting decisions for situations that do not yet exist, using hypothetical scenarios. Practitioners often underestimate cognitive problems resulting in respondents' disengagement from SPS questions and, thus, in non-reliable answers leading to non-robust or biased models. This paper analyses the outcome of SPS for the study case of the Portuguese High Speed Railway project and suggests a methodology to quantify and reduce respondents' survey disengagement in an effort to improve the demand modelling quality. As an evidence of disengagement, we consider indicators related to Irrational Answers (IA), which occur when respondents choose different modes in scenarios with the same or better conditions for each alternative-specific scenario than in an initial scenario. We measure quantities and proportions of respondents with irrational answers and respondents who always chose the same mode (Goal-Based Disengagement), and evaluate the Survey Fatigue/lLearning (SFL). We also assess the impact of including/excluding irrational answers on the estimation results of corresponding binomial Logit models. Our results show a high level of disengaged respondents whether indicating IA or due to GBD answering. Disengagement appears to be higher in car users. There is also evidence of learning rather than survey fatigue as a respondent progress through the questions and of connection of disengagement and social-economic characteristics of a person. Finally, the findings suggest that disengagement has an important impact on the modelling results. Based on this analysis, we suggest recommendations to improve the quality of the modelling.

Keywords: survey disengagement, stated preference survey, survey design, transport demand modelling

INTRODUCTION

The stated preference survey (SPS) is an important tool which helps forecasting decisions suggesting to respondents questions about their possible choices in hypothetical situations given a specific set of conditions. It is especially useful when there is a need to assess consumers' behaviour when a new product/service is introduced or there is a substantial change in its attributes (Louviere and Hensher, 1983). The survey results are used as an input to a model which aims at predicting future behaviour, whereby the validity and reliability of inferences of this model are a major concern (Louviere et al., 2000).

The model quality depends on applied modelling techniques and algorithms itself, on how well the postulated underlying behaviour theory represents the reality and on quality of the survey. The latter is a combination of two aspects: data quality and fitness for purpose (Biemer, 2011). The fitness for purpose means that the survey meets the needs of the project for which it is designed and conducted, while the data quality includes its accuracy, timeliness, accessibility, comparability and other quality dimensions (see, for instance, Biemer and Lyberg, 2003; Statistics Canada, 2006; Biemer, 2011). As a result the main goal of survey design is to minimize the total survey error subject to cost constraints (Fellegi and Sunter, 1974; Groves, 1989), which incorporate monetary and time costs, and ethical considerations (Weisberg, 2005).

One of the main issues associated with survey quality is data inaccuracy, which manifests itself in sampling and nonsampling errors, where the former depends on how well the chosen sample represents the population, the latter includes specification, measurement, nonresponse, frame and data processing errors (Biemer and Lyberg, 2003). While in literature on survey design the sampling error traditionally gets more attention, some studies (e.g., Fuller, 1987; Biemer and Trewin, 1997) showed that the effect of nonsampling error on statistical estimators and, consecutively, on inference might be very substantial.

A measurement error includes a respondent-related error, which occurs when respondents either intentionally, or not, provide incorrect answers to survey questions (Biemer, 2011) or, in a broader sense, provide answers which do not meet the researchers' intentions (Weisberg, 2005). As the respondent-related error may substantially affect the survey quality, cognitive and social processes influencing it were defined as one of the priorities for research (Lee-Gosselin et al., 2012). These processes and resulting survey disengagement of respondents are of a major interest for this research.

This study aims to determine and analyse cognitive difficulties of the respondents based on their behavioural decision making and to propose possible solutions or further research in order to cope with these issues. Also, this paper aims at contributing to research on nonmathematical but behavioural issues associated with SPS.

BACKGROUND

In order to provide reliable information a survey should be designed so that the respondents "*understand, are committed to and can respond to tasks*" (Louviere et al., 2000). For the case of SPS this requirement becomes particularly important conditioned by the hypothetical nature of the decisions to be made. In practice this is not always easy to achieve since respondents may respond questions without trying to understand, being fatigued, uninterested or even not able to understand the questions correctly.

In order to understand the underlying processes in the case of inaccurate answers it is important to distinguish the cognitive stages as a respondent answers a survey question. Weisberg (2005) suggests distinguishing *multicomponent* and *two-track* approaches. The multicomponent theory presents the cognitive processes as a sequence of steps (Kahn and Cannell, 1957; Tourangeau, 1984, Tourangeau et al., 2000) while the two-track approach means different levels of efforts made by the respondents during answering the questions (Krosnick and Alwin, 1987; Krosnick, 1991).

Kahn and Cannell (1957) proposed five cognitive stages: encoding the question in memory; understanding the question; recalling or computing a judgment; configuring a response; editing and communicating the response. Tourangeau (1984) reduced the number of stages to four: understanding the question; retrieval of relevant information; making judgment, decision or choice required by the question; and selection of a response. For analysis of respondents' disengagement all the steps are important, however, one should keep in mind that respondents not necessarily follow the order of the cognitive steps presented above and can carry some of them simultaneously (Weisberg, 2005). The *two-track* theory of respondents' cognitive processes reflecting the efforts made by them is also applicable to every stage. This theory suggests that there is a "high road" level, which implies that a respondent tries to answer questions with full force and effect, and a "low road" or "satisficing", when a respondent tries to undergo a survey with a modicum of effort (Krosnick, 1991). This theory was developed in compliance with previous research which argued that people adhere to economizing strategies (Simon, 1957; Taylor, 1981) or heuristics (Tversky and Kahneman, 1974; Heiner, 1983) in their decision making.

The understanding stage is a process of comprehension of a question by a respondent and at this stage the "low road" approach means that a respondent does not want or is not able to put an effort into this comprehension. At the next stage of recalling from memory relevant information, forgetting is a major problem (Weisberg, 2005). In case of SPS, when an imaginary situation is presented to a respondent and the person needs to make a hypothetical choice, the recalling might be associated with previous experience necessary to rely on. For example, if a respondent needs to choose a transport mode, even if the survey is designed to make a choice dependent on modal characteristics, the respondent will draw upon some previous experience of using this mode or any other related knowledge he or she possess. In this particular case *recognition* and *current attitude* are enough and there is not much need in actual *recall* from memory. Another issue related to forgetting in SPS might be in possible discrepancy between the answers of the same respondent. The inconsistency of the responses in this case becomes a useful indicator of the respondent's disengagement.

At the retrieval stage a respondent taking the "low road" will recall just enough information from memory to make a passable choice without making an effort to retrieve all relevant information for more accurate decision.

The cognitive processes at the judgment stage depend on survey types (Weisberg, 2005). For a case of SPS this stage is the most important since the respondents' task is to evaluate correctly the options and imagine which would be the most appropriate one. After making a judgment a respondent selects and reports to the interviewer the final answer, which is the last stage. A respondent "on the low road" tends to omit actual judgment and choose the first answer or a random one.

While choosing an answer respondents might be affected by different kinds of bias. Krosnick (1999) suggests considering *acquiescence bias* when respondents are more likely to choose a positive answer without trying to think on their real attitudes, and *social desirability* bias when respondents give more socially acceptable in their opinion answers. Walker et al. (2002) define three different kinds of bias: *affirmation bias*, when respondents choose answers, which in their opinion are consistent with the study objectives; *rationalization bias*, when the answers justifying the actual behaviour are chosen and *strategic or policy response bias* when respondents' choice is conditioned by belief that their choice might affect the future policy changes.

The "low road" approach may be a result of many reasons related with the survey design, the way and environment in which the interview is made, motivation and mood of the respondent (Krosnick, 1991). One of the main issues is the task complexity and amount of efforts which a respondent needs to make in order to assess each option (Blair and Burton, 1987, Street and Burgess, 2007). The survey modellers often overestimate the knowledge of respondents on some subject and their ability to comprehend the question (Weisberg, 2005) while people usually tend to answer questions even if they do not understand them (Ferber, 1956). The task complexity includes the questionnaire length and number of attributes (see, for example, Huber and Hansen, 1986; Agarwal, 1989; Brazell and Louviere, 1995; Holling et al., 1998). The motivation of the respondent and the question formulation, including the order of words and instructions also affect respondent's cognitive processes (Blair and Burton, 1987; Wänke et al., 1995; Schuman and Presser, 1996). Finally, if a respondent is tired, not interested or in a playful mood, he or she is more likely to take the "low road" (Biemer and Lyberg, 2003) and even the social characteristics of the respondent such as the education level and age are the factors affecting the cognitive processes (for example, Narayan and Krosnick, 1996) as well as gender (e.g., Ladenburg and Olsen, 2008).

Weiner et al. (2011) argue that the SPS researchers do not pay enough attention to the cognitive processes at data collection stage. One of the problems associated with these processes is a discrepancy between the two-track behavioural theories and random utility theory, on which the SPS modelling is based and which relies on an assumption of rational behaviour of a respondent who acts and make choices in order to maximize the economic

welfare (Domencich and McFadden 1975). The experimental design, which is usually derived from the random utility theory and which aims to manipulate numbers of questions, attributes and their levels in order to provide the best possible inference from the data with respect to the research purpose and hypotheses (Louviere et al., 2000), in practice usually does not take into account the cognitive difficulties of respondents.

When speaking about "irrationality" one should recognize that some important cognitive aspects in the decision-making process can lead to answers which might seem irrational for the modeller because of some indicators but in reality these responses make part of the natural randomness of the population's behaviour and therefore still make part of the "random utility maximization" principle. One of such aspects is when apparent irrational answers could be justified by the respondent past experiences (which sets a primer for future preferences' evaluation when recalling similar situations) to which the analyst is not aware or which were not captured in the questionnaire (Weber and Johnson, 2006). Another aspect which might influence decision-making is the emotional state of a respondent. For example, Ben Akiva et al. (1999) highlighted the role of affect in decision-making whereby emotions can "*not only induce impulsive decisions, but also colour perceptions*". There is also a tendency when the respondents are "happier and decision-making becomes more efficient", in other words, happiness induces more creative and effective responses (Loewenstein, 1996). Similar ideas are present in the concept of "experienced utility" referred by Kahneman and Thaler (2006), which differs from the common understanding of "decision utility", and refers to the "hedonic experience" (or pleasure, satisfaction). Quite recent hybrid choice models allow the inclusion of respondents' perceptions and attitudes with the use of latent variables (for instance, Morikawa and Sasaki, 1998; Abou-Zeid and Ben-Akiva, 2009).

Among SPS designers still there is no common consensus on the optimal number of questions, alternatives, attributes and their levels. Recent studies showed that a larger number of questions, alternatives, sets of attributes and their level demand more cognitive efforts from respondents. Thus due to the survey fatigue people may answer randomly without making an attempt to understand the questions or without taking into account all the attributes, which reflects in discrepancies in their answers (e.g., Carson et al., 1994, Iyengar and Lepper, 2000, Bateman, 2002; DeShazo and Fermo, 2002; Schwartz et al., 2002; Arentze et al., 2003; Caussade et al., 2005) and that respondents might be susceptible to *social desirability* bias (Carlsson, 2003). In case the alternative specific attributes and their combinations are not appropriate and realistic the respondents might be confused and not to take the task seriously (Street and Burgess, 2007). Dellaert et al. (1999) and Caussade et al. (2005) found out in their experiments that the range of attributes' levels also affects the results and a narrower range decreases the cognitive difficulties for the respondents, which is demonstrated through reduced variance of answers. Extensive review of research on number of questions, alternatives, attributes, and their levels for SPS is presented in Weiner et al. (2011).

The most common method for studying the survey quality with respect to respondent-related error is based on comparison of results of surveys with different design (Weiner et al., 2011).

DeShazo and Fermo (2002) suggested a model in order to estimate the variance of parameter estimates calibrated based on survey answers. Hensher (2004) measured sensitivity of willingness to pay to different components of survey design by means of regression analysis. McNair et al. (2011) tested the effect of increasing the number of binary choice tasks for a respondent, found out that the responses were influenced by cost levels from previous questions and suggested that the changes in results could be affected by respondents' *strategic misrepresentation* (meaning respondents belief that their answers will let them buying goods at lower cost), *reference point revision* (when respondents shift their value function (DeShazo, 2002)) and *cost-driven learning*. The latter idea was introduced by Plott (1996) who argued that often when respondents give answers to the first questions their preferences are not completely formed and they tend to progress through a sequence of questions. This idea is also in compliance with so called starting-point bias theories (Boyle et al., 1985; Flachaire and Hollard, 2007; Ladenburg and Olsen, 2008).

CASE STUDY

The case study for this paper is the High Speed Railway (HSR) projected link which will connect Lisbon to Oporto in Portugal. The project is foreseen as a component of the Trans-European Transport Network, which will consist of three links Lisbon-Madrid, Lisbon-Oporto, and Oporto-Vigo, with a total length of about 650 km and an investment of around eight billion euro. HSR is viewed as an important strategic investment that could bring strong economic benefits and contribute to creating a megalopolis in the corridor between the two largest cities in Portugal and between the two countries – Portugal and Spain (de Abreu e Silva et al., 2011).

The high-speed train will compete with alternative existing modes, which include air transport, conventional train, bus and private car. Based on these alternatives, a Stated Preference survey was conducted by Steer Davies Gleave (SDG) for RAVE (RAVE, 2006) in order to quantify the weights and relative values of the different variables associated with the choice of each mode of transport and get parameters of the variables that explain the choice of transport modes. The target population of the survey consisted of potential users of high speed train which comprehend all passengers currently travelling in the corridors of interest using the existing modes and that could potentially shift to the new HSR service focusing on the corridors Lisbon-Madrid and Lisbon-Oporto. The respondents were approached through the roadside interviews taken along the present routes and at the terminal stations and airports.

This survey presents answers about modal choices in hypothetical situations of users travelling along these corridors. A respondent had to choose between a new service (HSR) and the currently used transport mode depending on attributes of the modes and so the data only allows building of binary choice models. The choice of each of the alternative modes was presented for nine different scenarios, which were built relying on a fractional factorial

design by varying certain attributes, which were assumed to have a strong influence on the decision choice of a person. These attributes were:

- Private Car: cost and travel time.
- Public transport: cost, travel time, headway time (expressed as interval average time between consecutive services) and access time.

Costs, travel time and frequency attributes have three levels and access time has two levels. The number of alternative levels and attributes considered determines the number of choices presented to the interviewees. The set of choices or scenarios was created using the following steps:

- Identification of the range of choice, the factors to consider and extent of changes more likely to happen;
- Definition of the type of stated preference surveys to be undertaken;
- Preliminary investigation by simulation;
- Pilot survey
- Evaluation of results of the pilot survey and redesign.

The pilot survey was taken in order to:

- Ensure that the respondents understand the variables presented;
- Check that the allowed ranges of the variables capture the sensitivity of the users to the attribute levels;
- Test the general operation of the survey;
- Redesign the final survey considering the aspects observed in the pilot survey.

The forms were previously coded depending on the type of collection. The design was planned so that the characteristics of a proposed journey depended on the situations likely to occur. The questionnaire presented to the respondents contained three blocks of questions although there were slight differences in the content of each of them depending on the transport mode (public transport or private car). The blocks were:

- Characterization of the current trip of a respondent (reason, frequency, etc.);
- Stated preference survey;
- Socio-economic information of a respondent (age, occupation, income, etc.).

The variables related to costs and time differences are presented by differences, while the relative frequency is presented in levels, which was performed in order to avoid showing too much information that the respondent could not properly comprehend.

Once the potential user was identified, the questionnaire was chosen according to the corresponding path made by the interviewee. In order to eliminate the problem of correlation between the explanatory variables, the orthogonal stated preference model was applied, providing that the information collected in each scenario is different and does not overlap with that coming from any other scenario, thus maximizing the efficiency of the model. Table 1 contains all the nine scenarios presented to each respondent.

Table 1 – Variable levels of the nine scenarios. Source: RAVE, 2006

Scenario	Cost	Travel time	Frequency	Access time
1	0	0	0	0
2	0	1	1	0
3	0	2	2	1
4	1	0	1	1
5	1	1	2	0
6	1	2	0	0
7	2	0	2	0
8	2	1	0	1
9	2	2	1	0

In the report, which accompanied the survey results, SDG states that in most cases the response rate and respondents' willingness to collaborate were quite high. The interviewers encountered some difficulties with certain types of passengers but this was solved through increasing the time frame for the survey and all the planned answers were obtained and their number even exceeded the one outlined in the project proposal. After the data collection SDG reported the presence of 12% of irrational answers in average for all modes and removed them from the survey. The criteria for non-validity of the responses were inconsistency and irrationality of answers of the same respondent with their previous choices or with their revealed preferences (RP). In addition people who claimed that their car was essential for that specific trip (for example, commercial vehicle) were dismissed from the final version of the survey. The amount of irrational answers detected and eliminated by SDG for each mode is presented in Table 2.

Table 2 – Irrational answers deleted by SDG. Source: RAVE, 2006.

	Plane	Conv. Train	Bus	Private Car	Total
Inconsistent with RP	-	1	13	7	21
Inconsistent with previous choices	23	11	21	40	95
Total	23	12	34	47	116

However, not all the irrational answers were removed from the survey. A significant number of answers was found in which a respondent stated that he or she would choose one mode under certain conditions but then the same respondent did not choose this mode under similar conditions, whereby the chosen previously mode was better (that is, cheaper faster, more frequent and with a shorter access time) given that the rest of the attributes hold the same levels. The amount of such respondents was quite high and this raised a research question on the extent of the survey disengagement and possible underlying reasons of it and explanation through behavioural theories of cognitive processes.

RESEARCH METHODOLOGY

In order to assess the respondents' disengagement we measure the number of respondents with irrational answers (IA) and the influence of their exclusion on the model goodness of fit

and coefficients. The IA means that a respondent chooses a different mode in a scenario with the same or better conditions (for the same mode) for each alternative-specific attribute than in previous scenarios already processed by this respondent. Based on this we find quantities and proportions of respondents with IA, changes in their proportion as the number of scenarios grows and changes depending on scenario ordering which is an indication of Survey Fatigue or Learning - SFL (for each pair of modes). In addition we present findings on quantity and proportions of respondents always choosing the same modes.

The theoretical framework relies on building a discrete-choice model for the analysis of the influence of IA on the model goodness of fit and coefficients is random utility theory, which assumes rationality of decision making. For different combinations of the survey data (including and excluding IA) we build a binary logit model for HSR demand (pairwise analysis with each of the alternative modes). The model development was restricted by the variables included in the survey, which were the alternative specific differences named above and the following socio-demographic variables:

- Age, gender (1 – female, and 0 – male), income and employment (1 – employed, and 0 – otherwise) of the respondent;
- Car ownership;
- Purpose of the trip (1 – work, study, 0 – other motives); and
- Who paid for the trip (1 – work, 0 – otherwise).

Income and age were treated as continuous variables in the model, while the other socio-demographic attributes were binary. For each pair of modes we found a model specification to be considered further by varying in a combinatorial way the set of the attributes (we used MATLAB for all the calculations and simulations performed in this study). The criteria for "best" model specification was the highest McFadden rho square after verifying the respective parameters' statistical significance at a confidence level of 90%, except for the alternative specific constant. The computational burden was not heavy because of the comparatively small number of attributes to be included. It should be mentioned that the coefficients for the alternative specific and 'Age' values in all tables presented below were divided by 100 and 'Income' value was divided by 10,000 (made for optimization reasons during calculation of maximum likelihood and did not affect any of the findings of this study). We use the term "best" in a conventional way and applied relatively to the model specification for the available set of variables in the survey and within the chosen simple binary logit modelling framework and goodness of fit measures.

We performed a search for the "best" model for the following cases:

- "Unclean" data whereby all the respondents and answers available in the survey are presented. We note that the 12% of non-valid data dismissed by SDG was not available for this research and was not included.
- Data without pairs of IA (in which answers are inconsistent with each other);
- Data without all answers of the disengaged respondents (i.e., respondents with at least one pair of IA answers).

Intuitively one can suggest that if a respondent has some IA it is due to his or her disengagement and it compromises the reliability of the rest of his or her answers. However, if the number of such respondents is very high the removal of all their answers may substantially increase the sampling error due to reduced sample size. In this case the compromise might be dismissing only the irrational answers rather than all the answers of such respondents. The influence of this choice is also to be tested in this study.

MEASUREMENT OF IRRATIONAL ANSWERS

The results of measurements of quantity and proportion of respondents with IA are presented in Table 3. As one can see the number of respondents with IA ranges from 34% up to 69% for different modes and this result suggests a quite high level of respondents' disengagement. The highest disengagement is presented by respondents using a private car as a current mode. The number of respondents always choosing the same mode varies from 16% to 33%, where 33% corresponds to conventional train mode. Here one can observe an interesting pattern whereby the more similar two modes are, the more "rigid" the respondent is in his/her answers.

Table 3 – Quantity and proportion of respondents with irrational answers (IA).

	Plane	**Conv. Train**	**Bus**	**Car**	**Total**
Dismissed by SDG respondents with IA	23	12	34	47	116
Other respondents with IA	121	67	130	198	516
Total respondents with IA	144	79	164	245	632
Respondents who always choose the same mode	47	77	63	61	248
Total number of respondents	**287**	**231**	**292**	**356**	**1166**
Proportion of respondents with IA	50%	34%	56%	69%	54%
Proportion of respondents always choosing the same mode	16%	33%	22%	17%	21%
Proportion of the rest of the respondents	33%	32%	22%	14%	25%

It is remarkable that, out of respondents always choosing the same mode, the number of those always choosing the current mode is much higher than of those who always choose the hypothetical HSR (Table 4). This means that even under better conditions of HSR compared to the present alternative these respondents believe that they will use the present mode. This can be either due to their rigidity or their (rational or not) preferences. It is interesting that, as one can also see from Table 4, the number of respondents always choosing the bus mode against HSR is 90% while for other modes the proportion of people choosing the current alternative against HSR is approximately the same and is around 2/3 of total amount of respondents always choosing the same mode.

Table 4 – Preferences of the respondents always choosing the same mode

	Plane	**Conv. Train**	**Bus**	**Car**	**Total**
Respondents always choosing HSR	15	21	6	19	61
Respondents always choosing the current mode	32	56	57	42	187
Total respondents always choosing the same mode	47	77	63	61	248
Proportion of respondents always choosing HSR as % of respondents always choosing the same mode	32%	27%	10%	31%	32%

As it is clear from Table 3 if the modeller decides to eliminate all the IA in order to avoid the effects of disengaged respondents' answers in the results, the sampling error might dominate the result error since the number of respondents will be reduced on average by half. By removing the answers of these respondents the natural variance of the sample will be artificially reduced. Another way out in this case might be the removal of pairs of IA but not all the answers of the disengaged respondent. The quantity and proportion of IA is presented in Table 5. The proportion range is from 12% to 32% for different modes, which in average is twice as less as the proportion of the respondents with IA from Table 3.

Table 5 – Quantity and proportion of the irrational answers.

	Plane	**Conv. Train**	**Bus**	**Car**	**Total**
Irrational Answers	599	242	518	883	2242
Total amount of answers	2279	1971	2285	2781	9316
Proportion of irrational answers	26%	12%	23%	32%	24%

We have also tested if respondents' disengagement may depend on their social-economic characteristics. The results of this analysis are presented in Table 6. The results of statistical tests are in the last three columns, namely, binomial proportion confidence interval for a 95% confidence level of error and test for equality of proportions between two samples (chi-square and corresponding p-value) (see for example, Naranjo, 2009). In the latter each group of respondents is tested against the global average of the other groups. The results suggest that younger people are less susceptible to be disengaged and people of age between 35 and 64 tend to give IA more often, while for the respondents older than 64 the sample does not provide enough evidence of a significant difference between this group of people and the rest of respondents (p-value exceeds 0.05). According to the statistical tests students are less likely to give inconsistent answers. This might be explained by the fact that students perform cognitive tasks more often and for them it is easier to understand the problem. For some socio-economic characteristics, even when the percentage of disengaged respondents is high, the absolute number of this group of people is so small that no conclusions could be drawn (e.g. housewives, retired and unemployed people). The lower income respondents tend to be less disengaged, in which case the reason might be that many of this kind of respondents were students. At the same time it is difficult to explain the results of the test which rejects the hypothesis that people with income between 18001 and 27000 euro and people with income between 45001 and 60000 have the same proportions of IA answers as the other groups of income.

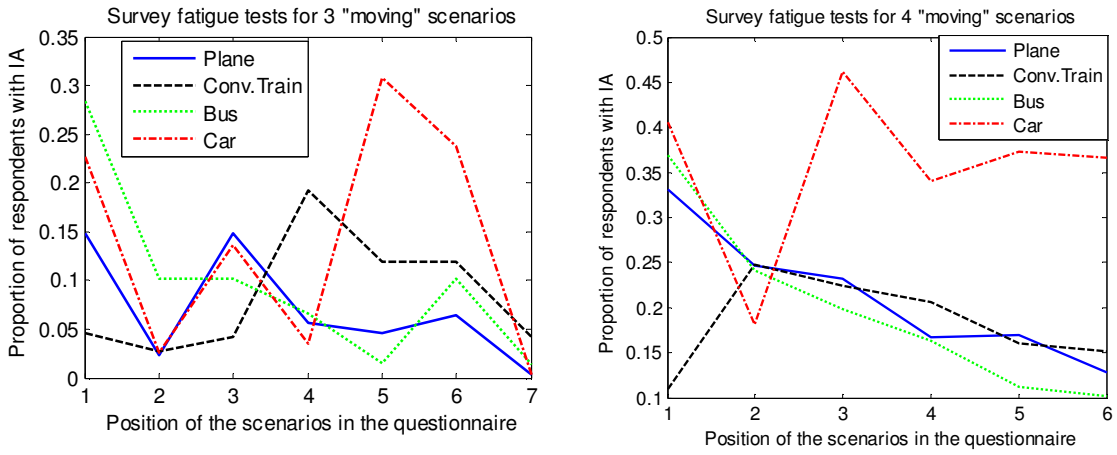
Table 6 – Disengagement for different socio-economic groups of respondents

	Respondents with IA				**Proportion of respondents with IA**					**Statistical Tests**		
	Plane	**Conv. Train**	**Bus**	**Car**	**Plane**	**Conv. Train**	**Bus**	**Car**	**All Modes**	**CI (%)**	X^2 *	**p-value**
Age												
0-15	0	0	0	0	-	-	-	-	-	-	-	-
16-34	32	41	74	69	31%	36%	49%	62%	44%	(40; 50)	**6.37**	**0.01**
35-64	83	22	48	116	54%	27%	55%	64%	53%	(49; 59)	**7.26**	**0.01**
> 64	6	4	8	13	86%	18%	42%	72%	47%	(35; 59)	0.13	0.72
Gender												
Man	81	37	90	147	45%	29%	55%	62%	50%	(46; 54)	0.92	0.34

Woman	40	30	40	49	49%	32%	43%	69%	47%	(42; 53)	0.92	0.34
Employment												
Entrepreneur / Employer	13	3	3	21	54%	30%	50%	53%	50%	(39; 63)	0.03	0.87
Administrator / Director	38	2	1	19	53%	29%	33%	63%	54%	(44; 69)	0.98	0.32
Freelancer	14	7	15	36	47%	24%	52%	73%	53%	(44; 62)	0.73	0.39
Hired worker	52	29	70	92	44%	32%	53%	65%	50%	(46; 56)	0.58	0.45
Student	1	21	28	15	6%	40%	47%	60%	42%	(35; 50)	**3.78**	**0.05**
Housewife	1	0	2	3	100%	0%	67%	100%	75%	(45;1.09)	2.16	0.14
Retired	2	4	6	11	100%	17%	35%	65%	38%	(26; 50)	2.98	0.84
Unemployed	0	1	3	0	-	50%	60%	0%	50%	(15; 75)	0.00	0.96
Others	0	0	2	1	-	0%	100%	33%	38%	(4; 51)	0.44	0.51
Income												
0 - 9000 €	0	8	11	9	0%	22%	34%	60%	31%	(22; 40)	12.16	**0.00**
9001 - 18000 €	17	9	35	32	43%	24%	50%	70%	48%	(41; 56)	0.14	0.71
18001 - 27000 €	14	17	63	68	47%	31%	56%	67%	55%	(49; 61)	4.84	**0.03**
27001 - 36000 €	13	17	14	38	38%	43%	47%	59%	49%	(41; 57)	0.01	0.92
36001 - 45000 €	20	7	4	23	47%	24%	40%	74%	48%	(39; 59)	0.09	0.76
45001 - 60000 €	34	5	3	19	61%	42%	75%	58%	58%	(49; 72)	3.74	**0.05**
> 60000 €	23	4	0	9	41%	44%	-	47%	43%	(32; 60)	1.44	0.23
Not specified	0	0	0	0	-	-	-	-	-	-	-	-

* The reference value of chi-square for the confidence level α=5% is χ^2=3.74.

Finally we tested SFL. It is obvious that if we increase the number of scenarios the probability that a respondent will give an answer inconsistent with one of the previous answers increases. Therefore, instead of comparison of different numbers of scenarios and respective amount of IA, we compared the amount of IA for the same number of scenarios but depending on scenarios' position in the sequence of the survey questions. For example, we tested the amount of IA of each respondent for only first three scenarios, then for three scenarios starting from the second and so on. We did similar tests for three, four, five and six "moving" scenarios. Figure 1 presents the results. As one can see from the figures for three, four, five and six "moving" scenarios the proportion of the disengaged respondents is decreasing for bus and plane users as a respondent progress through the questionnaire. For car and conventional train there is no so clear trend. The hypothesis which might be drawn upon the results of these tests suggests learning of the respondents as they answer more questions rather than fatigue. This might be reasonable since the amount of scenarios (nine) is relatively small.



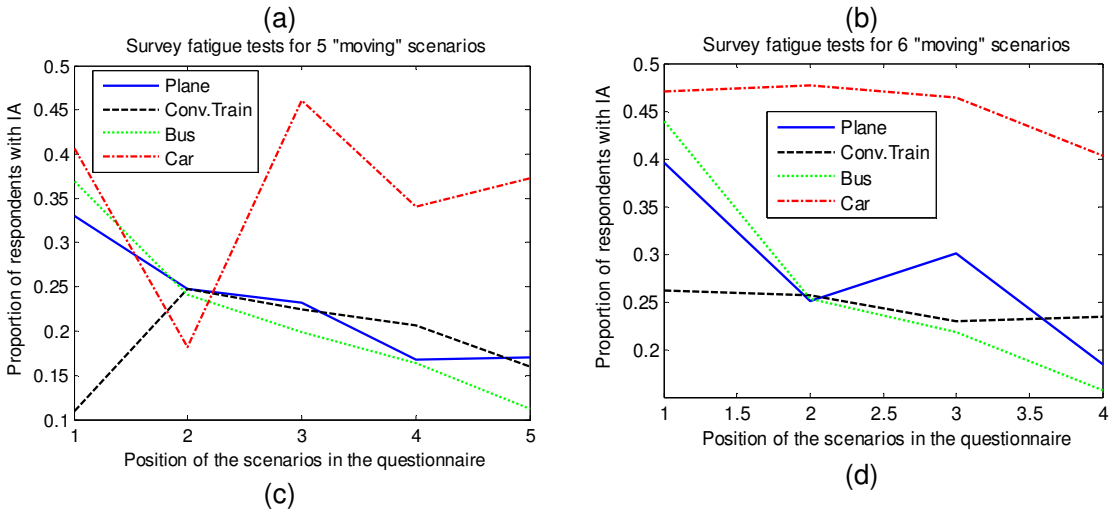


Figure 1 – Survey fatigue tests for (a) 3 "moving" scenarios, (b) 4 "moving" scenarios, (c) 5 "moving" scenarios, (d) 6 "moving" scenarios.

GOODNESS OF FIT AND MODEL COEFFICIENTS

We tested the influence of keeping or removing only IA or all answers of disengaged respondents on the statistical estimates of the corresponding binomial logit model. For the pairs HSR-plane, HSR-conventional train and HSR-bus we´ve built models based on answers of travellers along all the routes included in the survey. For the HSR-car pair we have built models to be tested only for Lisbon-Porto link because the treatment of all the data together did not provide reasonable signs of coefficients and goodness of fit statistics, conditioned by the fact that the choice models were very different for car users travelling along different links.

The "best" possible specifications were obtained in a combinatorial way for each case based on the highest McFadden rho squared value, which are presented are presented in Table 7. As one can see the removal of IA increased significantly goodness of fit of the model represented with the McFadden rho squared for all the modes. Dismissing all the answers of disengaged respondents improved the model fit statistics even more for all the modes except car, although still better than "unclean" data model. In the case of the HSR-car model we can observe substantial reduction of the number of the respondents.

Table 7 – "Best" specifications for raw data, data after removal of IA and data after removal of disengaged respondents.

	"Unclean" Data	**Data after removal of IA**	**Data after removal of respondents with IA**
HSR- Plane			
McFadden rho	0.035935	0.127256	0.142597
Number of observation	2279	1680	1236
Number of respondents	264	261	143
Number of Parameters	10	11	9

HSR- Conventional Train			
McFadden rho	0.206335	0.285304	0.332956
Number of observation	1971	1729	1368
Number of respondents	219	219	152
Number of Parameters	10	10	10
HSR - Bus			
McFadden rho	0.068316	0.240282	0.287383
Number of observation	2285	1767	1149
Number of respondents	258	258	128
Number of Parameters	9	8	9
HSR - Car			
McFadden rho	0.023996	0.111741	0.084697
Number of observation	1728	1231	810
Number of respondents	192	192	90
Number of Parameters	7	8	9

The results of the influence of the IA answers removal on the binomial model coefficients are presented in Table 8. The "hsr_ASC" is the HSR alternative-specific constant, "hsr_carown" indicates if a respondent owns a car, "hsr_age", "hsr_sex", "hsr_empl", "hsr_income" are the respondents' age, gender, employment and income, respectively, "hsr_who" corresponds to who paid for the trip and "hsr_purp" means the trip purpose. "Hsr_delta_c", "hsr_delta_tt", "hsr_delta_act", "hsr_delta_fr" corresponds to differences between cost, travel time, access time and frequency for HSR when compared to each alternative mode. As the reference model for coefficients comparison, we adopted the model specification with dismissed IA but without dismissing all answers from disengaged respondents. We did not choose models using the raw data since they presented unreasonable coefficients' signs.

The reduction of IA or all the answers of disengaged respondents change the t-statistics and the signs of the calibrated coefficients. In case of the "unclean" data models one can observe that the signs of some calibration parameters related to alternative-specific differences defy the assumption of rationality of the respondents (highlighted in **bold** font). This issue becomes solved for all the modes with exception of HSR-plane when only the IA are removed. We have to note that in practice one should not keep a model with parameters of unreasonable signs, however, we consider such models for comparison, in order to show how the parameters' signs might be changed due to manipulations with IA and other answers of disengaged respondents. As one can also see from the table, the removal of IA increases the coefficients magnitude and t-statistics values.

We have also calculated value of time (VOT) (Table 8) using the calibrated parameters in order to evaluate the influence of IA removal in terms of behaviour analysis. The results suggest that for HSR-Conventional Train and HSR-Bus the VOT hold, while for HSR-Plain and HSR-Car these values varies substantially. These changes can probably be explained by extremely poor goodness of fit of some of the models, especially in case of "unclean" data.

Table 8 – "Best" specification for the data with all the respondents.

HSR- Plane			
	Unclean Data	**Data after removal**	**Data after removal of**

			of IA		respondents with IA	
Paremeter	Beta	t-stat	Beta	t-stat	Beta	t-stat
'hsr_ASC'	0.771	3.673	0.790	3.211	1.449	4.926
'hsr_carown'	-0.322	-3.188	-0.317	-2.596	-0.927	-6.041
'hsr_delta_c'	-0.573	-4.980	-2.180	-12.291	-1.931	-10.131
'hsr_delta_tt'	-0.387	-3.504	-1.095	-7.491	-0.803	-4.347
'hsr_delta_fr'	**0.089**	1.556	-0.234	-3.486	-0.225	-3.029
'hsr_delta_act'	**0.650**	2.485	**0.753**	2.513	**0.463**	1.375
'hsr_age'	1.102	2.880	3.118	6.232	3.449	5.665
'hsr_sex'	0.191	1.984	0.212	1.776	-0.092	-0.642
'hsr_empl'	-0.806	-4.538	-1.048	-5.152	-0.841	-3.812
'hsr_income'	-0.619	-2.314	-1.330	-4.034	-1.830	-4.725
'hsr_purp'	-0.420	-3.966	-0.610	-4.664	-1.079	-7.057
McFadden rho	0.037		0.127		0.144	
Number of observation	2279		1680		1236	
Number of respondents	264		261		143	
Value of Time (VOT), euro/min	0.68		0.50		0.42	

HSR- Conventional Train

	Unclean Data		Data after removal of IA		Data after removal of respondents with IA	
Parameter	Beta	t-stat	Beta	t-stat	Beta	t-stat
'hsr_ASC'	-1.118	-5.257	-1.284	-5.291	-1.892	-6.394
'hsr_carown'	0.352	3.156	0.433	3.412	0.442	2.921
'hsr_delta_c'	-6.311	-6.370	-11.655	-9.924	-9.474	-7.298
'hsr_delta_tt'	-0.635	-3.162	-1.436	-6.345	-0.933	-3.619
'hsr_delta_fr'	-0.732	-5.534	-1.258	-8.218	-1.399	-7.872
'hsr_delta_act'	-0.576	-1.661	-1.771	-4.519	-0.843	-1.842
'hsr_age'	-1.345	-3.687	-1.460	-3.535	-1.075	-2.227
'hsr_income'	2.702	7.533	3.041	7.433	4.130	8.396
'hsr_purp'	-0.452	-3.624	-0.480	-3.384	-0.406	-2.446
'hsr_who'	1.679	10.472	1.958	10.620	2.159	9.797
McFadden rho	0.206		0.285		0.333	
Number of observation	1971		1729		1368	
Number of respondents	219		219		152	
Value of Time (VOT), euro/min	0.10		0.12		0.10	

HSR- Bus

	Unclean Data		Data after removal of IA		Data after removal of respondents with IA	
Parameter	Beta	t-stat	Beta	t-stat	Beta	t-stat
'hsr_ASC'	-1.099	-6.928	-1.307	-6.338	-2.252	-7.866
'hsr_carown'	-0.089	-0.982	-0.075	-0.635	-0.352	-2.205
'hsr_delta_c'	-3.831	-6.771	-13.638	-14.052	-9.167	-8.553
'hsr_delta_tt'	-0.375	-5.883	-1.353	-12.087	-0.886	-6.502
'hsr_delta_fr'	-0.031	-0.767	-0.576	-8.056	-0.600	-6.437
'hsr_delta_act'	**0.393**	1.883	-1.725	-6.226	-0.095	-0.258
'hsr_age'	0.710	2.433	0.870	2.374	1.930	4.185
'hsr_sex'	0.203	2.125	0.221	1.824	0.218	1.373
'hsr_income'	1.467	3.135	1.596	2.738	2.500	3.334
McFadden rho	0.067		0.240		0.283	
Number of observation	2285		1767		1149	
Number of respondents	258		258		128	
Value of Time (VOT), euro/min	0.10		0.10		0.10	

HSR- Car

	Unclean Data		Data after removal of IA		Data after removal of respondents with IA	
Parameter	Beta	t-stat	Beta	t-stat	Beta	t-stat
'hsr_ASC'	0.190	0.872	-1.064	-3.987	-0.277	-0.888
'hsr_delta_c'	0.710	2.751	-1.110	-3.136	-1.095	-2.602
'hsr_delta_tt'	0.415	1.796	-1.780	-5.544	-1.237	-3.184
'hsr_age'	1.031	2.738	2.016	4.230	2.652	4.406
'hsr_empl'	-0.235	-1.618	-0.488	-2.807	-0.764	-3.531
'hsr_income'	-1.317	-3.561	-2.105	-4.343	-3.401	-5.847
'hsr_purp'	0.190	1.491	0.570	3.545	0.475	2.428

'hsr_who'	0.054	0.399	-0.319	-1.854	-0.323	-1.592
McFadden rho	0.022		0.112		0.074	
Number of observation	1728		1231		810	
Number of respondents	192		192		90	
Value of Time (VOT), euro/min	0.58		1.60		1.13	

SUMMARY OF RESULTS, DISCUSSION AND CONCLUSION

In this study disengagement of respondents was measured as a quantity and proportion of respondents with IA and respondents always choosing the same mode and as influence of the disengaged respondents' answers on the model statistical estimates. In addition the socioeconomic characteristics of the disengaged respondents have been analyzed in order to detect groups more susceptible to producing IA. The key findings of this study reveal:

- Very high level of respondents' disengagement resulting in mutual inconsistency of answers of the same respondent. The higher level of disengagement was presented by private car users (69% of the respondents). The main reason might be that while the bus, conventional train and plane users were interviewed at the stations and therefore possessed some time to answer the survey questions and to put more cognitive efforts in it, in case of car users it was very difficult for an interviewer to find a similar comfortable situation.
- The amount of respondents always choosing the same mode is also relatively high (16-33%). Most of these respondents choose the current mode rather than hypothetical HSR and the more similar the current mode to HSR is, the more "rigid" the respondents are in their answers.
- The statistical tests showed that students and younger people are less often disengaged.
- For the nine scenarios presented to the respondents survey fatigue was not clearly observed. Instead, learning tendencies were demonstrated for some modes, meaning that respondents give more consistent answers as they move through the questionnaire. This is in compliance with previous ideas of learning presented by Plott (1996) and starting-point bias theories (Boyle et al., 1985; Flachaire and Hollard, 2007; Ladenburg and Olsen, 2008).
- In terms of influence on the goodness of fit, model specification and calibrated parameters, the findings suggest that the goodness of fit increases significantly if IA are removed from the survey results. And unless the sample size becomes too small for statistical inference, the goodness of fit measures might be improved even more in case all the answers of the disengaged respondents (the respondents which has at least one pair of IA) are removed. Furthermore, by dismissing the IA the situations when a coefficient with a "wrong" sign is statistically significant is more likely to be avoided.
- Removing IA might change the behavioral analysis results in the end.

Our results suggest that even in case the pilot survey has been thoughtfully applied one, the alternative specific attributes and their combinations are appropriate and realistic, the

number of alternatives for each question, the number of questions, attributes and their levels is relatively low, and the factorial design has been applied, still, the respondents' disengagement resulting in irrationality of their answers might be quite substantial. The main issues here might be related with inability of understanding the task and taking the "low road" of the cognitive performance, satisficing, lack of motivation, even some unreported issues with the interviewers and particular circumstances under which the responses were collected. Some dependencies of disengagement from age and occupation detected in this study might lead to the idea that the understanding of the task and requirements related with abstract thinking are major problems for the respondents. The higher proportion of disengaged car users shows that environment and circumstances under which the interview is taken could be also crucial. Furthermore, the high number of people always choosing the same mode indicates either their insensitivity to changes in attributes' levels, or the adoption of lexicographic choices based on the mode label, or their irrationality from rational utility theory point of view, which also compromises the validity of the modelling results.

Simple increase of the sample in this case and deleting the IA gives better results in terms of model statistics, however, it artificially decreases the actual variance of the respondents' choices. As there is evidence that disengagement is correlated with some socio-economic characteristics of a respondent, the removal of IA might result in decreased representativeness of the sample. Due to the fact that the hypothesis of survey fatigue has not been confirmed, decrease of the number of scenarios would unlikely solve the disengagement problem. Based on this we can suggest that one possible way out to decrease the disengagement of the respondents might be a feedback from the interviewers and better explanation of the task. In case of respondents always choosing the same mode an additional open question may be asked on the particular values of the attributes for which the respondent would agree to change his or her mind. The problem in this case will be an increase of survey cost (more time consuming and interviewers should be more qualified) and impracticality of surveying situations where more thorough interview is not possible (for example, roadside interviews of car users). In the latter case additional or different survey techniques might be conducted (home interviews, interviews by phone or internet-based), which, again, will impact on costs. In this case the task for the decision maker from the modellers' side would be to find a trade-off between the acceptable survey quality and the costs.

We would suggest conducting more studies in order to understand the learning mechanisms of the SPS respondents and connection between disengagement and socio-economic characteristics of a respondent in order to take it into account in future SPS design.

ACKNOWLEDGMENTS

This research was sponsored by the EXPRESS Research Project (MIT/SET/0023/2009). The authors would like to thank RAVE (Portugal) for data support.

REFERENCES

Abou-Zeid, M. and M. E. Ben-Akiva (2009). A model of travel happiness and mode switching. In S. Hess and A. Daly (eds.), Choice Modelling: The State-of-the-Art and the State-of-Practice, Proceedings from the Inaugural International Choice Modelling Conference. Emerald, Bingley.

Agarwal, M. K. (1989). How many pairs should we use in adaptive conjoint analysis? An empirical analysis. In American Marketing Association (Ed.), AMA Winter Educators' Conference Proceedings, 7-11.

Arentze, T., A. Borgers, H. Timmermans and R. D. Mistro (2003). Transport stated choice responses: Effects of task complexity, presentation format and literacy. Transportation Research, 39E, 229-244.

Bateman, I. (2002). Economic Valuation with Stated Preference Techniques, 1st edn, Department of Transportation (UK), Cheltenham.

Ben-Akiva, M., D. McFadden, T. Garling, D. Gopinath, J. Walker, D. Bolduc, A. Boersch-Supan, P. Delquie, O. Larichev, T. Morikawa, A. Polydoropoulou and V. Rao (1999). Extended Framework for Modeling Choice Behavior. Marketing Letters, 10(3), 187-203.

Biemer , P. P. and L. E. Lyberg (2003), Introduction to Survey Quality, Wiley, Hoboken, NJ

Biemer, P. and D. Trewin (1997). A review of measurement error effects on the analysis of survey data, in L. Lyberg, P. Biemer, M. Collins, E. De Leeuw, C. Dippo, N. Schwarz, and D. Trewin, eds., Survey Measurement and Process Quality, Wiley, New York.

Biemer, P. P. (2011). Latent Class Analysis of Survey Error. Hoboken, Wiley, New York.

Blair, E. A. and S. Burton (1987). Cognitive Processes Used by Survey Respondents to Answer Behavioral Frequency Questions. Journal of Consumer Research, 14, 280–88.

Boyle, K. J., R. C. Bishop and M. P. Welsh (1985). Starting Point Bias in Contingent Valuation Bidding Games. Land Economics, 61, 188-194.

Brazell, J. D. and J. J. Louviere (1995). Length effects in conjoint choice experiments and surveys: An explanation based on cumulative cognitive burden. INFORMS Marketing Science Conference, Sydney, Australia.

Carlsson, F. (2003). The demand for intercity public transport: The case of business passengers. Applied Economics, 35, 41-50.

Carson, R. T., J. J. Louviere, D.A. Anderson, P. Arabie, D.S. Bunch, D.A. Hensher, R.M. Johnson, W. F. Kuhfel, D. Steinberg, J. Swait, H. Timmermans and J.B. Wiley (1994). Experimental analysis of choice. Marketing Letters 5, 351–368.

Caussade, S., J. de D. Ortuzar, L. I. Rizzi and D. A. Hensher (2005) Assessing the influence of design dimensions on stated choice experiment estimates. Transportation Research 39B, 621–640.

de Abreu e Silva, J., D. Silva, J. Sussman (2011). The Portuguese High Speed rail Network; Relating Financing to Strategic and Operating Issues. Presented at the Symposium Public Private Partnerships in Transport: Trends & Theory Research Roadmap, Lisbon, 12 January.

De Shazo, J. R. and G. Fermo (2002). Designing choice sets for stated preference methods: The effects of complexity on choice consistency. Journal of Environmental Economics and Management, 44, 123-143.

Dellaert, B.G.C., J. D. Brazell and J. J. Louviere (1999). The effect of attribute variation on consumer choice consistency. Marketing Letters, 10(2), 139-147.

DeShazo, J. R. (2002). Designing transactions without framing effects in iterative question formats. Journal of Environmental Economics and Management, 43, 360-385.

Domencich, T. and D. McFadden (1975). Urban Travel Demand: A Behavioural Analysis. North-Holland, Amsterdam.

Fellegi, I. and A. Sunter, (1974). Balance between different sources of survey errors — some Canadian experiences. Sankhya, Series C, 36, 119 – 142.
Ferber, R. (1956). The Effect of Respondent Ignorance on Survey Results. Journal of the American Statistical Association, 51, 576–86.
Flachaire, E. and G. Hollard (2007). Starting point bias and respondent uncertainty in dichotomous choice contingent valuation surveys. Resource and Energy Economics, 29, 183-194.
Fuller, W. (1987). Measurement Error Models. Wiley, New York.
Groves , R. (1989). Survey Errors and Survey Costs, Wiley, New York.
Heiner, R. A. (1983). The origin of predictable behavior. The American Economic Review, 73, 4, 560-595.
Hensher, D. A. (2004). Identifying the influence of stated choice design dimensionality on willingness to pay for travel time savings. Journal of Transport Economics and Policy, 38(3), 425-446.
Holling, H., T. Melles and W. Reiners (1998). How many attributes should be used in a paired comparison task?: An empirical examination using a new validation approach. Technical report, Westfälische Wilhelms-Universität Munster, Germany. Available at: http://www.3mfuture.com/articles_reiners/conjoint_analysis_how_many_attributes_in_a_paired_comparison_task.pdf
Huber, J. and D. Hansen (1986). Testing the impact of dimensional complexity and affective differences of paired concepts in adaptive conjoint analysis. In M. Wallendorf and P. Anderson (Eds.), Advances in consumer research, 14, 159-163.
Iyegar, S. S. and M. R. Lepper (2000). When choice is demotivating: Can one desire too much of good thing? Journal of Personality and Social Psychology, 79, 995-1006.
Kahn, R. L. and C. F. Cannell (1957). The Dynamics of Interviewing. Wiley, New York.
Kahneman, D. and R. Thaler (2006). Anomalies: Utility Maximization and Experienced Utility. Journal of Economic Perspective, 20(1), 221-234.
Krosnick, J. A. (1991). Response Strategies for Coping with the Cognitive Demands of Attitude Measures in Surveys. Applied Cognitive Psychology, 5, 213–236.
Krosnick, J. A. (1999). Survey Research. Annual Review of Psychology, 50, 537–67.
Ladenburg, J. and S. B. Olsen (2008). Gender-specific starting point bias in choice experiments: Evidence from an empirical study. Journal of Environmental Economics and Management, 56, 275-285.
Lee-Gosselin M. E. H., E. J. Miller, C. Morency, M. J. Roorda (2012). Paper prepared for presentation at the Session of the 2012 Conference of the Transportation Association of Canada Fredericton, New Brunswick. Available at: http://www.tac-atc.ca/english/annualconference/tac2012/docs/session18/gosselin.pdf
Loewenstein, G. (1996). Out of Control- Visceral Influences on Behavior. Organizational Behavior and Human Decision Processes, 65(3), 272–292.
Louviere, J. J. and D. A., Hensher (1983) Using discrete choice models with experimental design data to forecast consumer demand for a unique cultural event. Journal of Consumer Research,10(3), 348-381.
Morikawa, T. and K. Sasaki (1998). Discrete choice models with latent variables using subjective data. In J. de D. Ort´uzar, D.A. Hensher and S.R. Jara-Diaz (eds.). Travel Behaviour Research: Updating the State of Play. Pergamon, Oxford.
McNair, B. J., J. W. Bennett and D. A. Hensher (2010). A comparison of responses to single and repeated discrete choice questions. University Library of Munich, Germany.
Naranjo, J. D. (2009). Business Statistics. Statistical Computation Lab (SCL), Department of Statistics Western Michigan University, available at: http://www.stat.wmich.edu/s216/book/index.html
Narayan, S. and J. A. Krosnick (1996). Education Moderates Some Response Effects in Attitude Measurement. Public Opinion Quarterly, 60, 58–88.

Plott, C. R. (1996). Rational individual behavior in markets and social choice processes: the discovered preference hypothesis, In Arrow, K., E. Colombatto, M. Perleman and C. Schmidt (ed), Rational foundations of economic behavior. Macmillan, London.

RAVE (2006). MODELO INTEGRADO DE PROCURA DE PASSAGEIROS: Rede Ferroviária de Alta Velocidade. FASE I Inquérito de Preferências Declaradas. RAVE, Lisbon.

Schuman, H. and S. Presser (1996). Questions and answers in attitude surveys: experiments on question form, wording, and context. Sage Publications, Cambridge.

Schwartz, B., A. Ward, J. Monterosso, S. Lyubomirsky, K. White, and D. R. Lehman (2002). Maximizing versus Satisficing: Happiness is a Matter of Choice. Journal of Personality and Social Psychology, 83 (5): 1178-1197.

Simon, H. A. (1957). Models of Men. Wiley, New York.

Statistics Canada (2006). Survey Methods and Practices. Available online at: http://www.statcan.ca/english/edu/power/ch3/quality/quality.htm

Street, D. J. and L. Burgess (2007). The Construction of Optimal Stated Choice Experiments: Theory and Methods. Wiley, New York.

Taylor, S. E. (1981). A Categorization Approach to Stereotyping. In Cognitive Processes in Stereotyping and Intergroup Behavior, ed. David Hamilton. Hillsdale, NJ, Lawrence Erlbaum Associates.

Tourangeau, R. (1984). Cognitive Science and Survey Methods, in Cognitive Aspects of Survey Design: Building a Bridge between Disciplines, ed. T. Jabine et al. National Academy Press, Washington, DC.

Tourangeau, R., L. Rips, and K. Rasinski (2000). The Psychology of Survey Response. Cambridge University Press, Cambridge.

Tversky, A. and D. Kahneman (1974). Judgment under Uncertainty: Heuristics and Biases. Science, New Series, 185, 1124–1131.

Walker, B., A. Marsh, M. Wardman and P. Niner (2002). Modelling tenants choices in the public rented sector: A stated preference approach. Urban Studies, 39, 665-688.

Wanke, M., N. Schwarz and E. Noelle-Neumann (1995). Asking Comparative Questions: The Impact of the Direction of Comparison. Public Opinion Quarterly, 59, 347–72.

Weber, E. U. and E. J. Johnson (2006). Constructing preferences from memory. In: Lichtenstein, S. & Slovic, P., (Eds.). The Construction of Preference, 397-410. Cambridge University Press, New York.

Weiner, M. D, O. T. Puniello, R. R. Lau and R. B. Noland (2011). Stated Preference Surveys: Gridlock at the Intersection of Respondent Cognition, Survey Research Protocol, and Transportation Studies. Paper presented at the 9th International Conference on Transport Survey Methods, November 14-18, National Park Sanctuary and Biosphere Reserve, Termas de Puyehue, Chile.

Weisberg, H. F. (2005). The Total Survey Error Approach. University of Chicago Press, Chicago.