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Findings from measuring door-to-door travellers' travel satisfaction with traditional and smartphone app survey methods in eight European cities

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This study investigates how different travel satisfaction survey methods influence the reported level of door-to-door travel satisfaction among travellers. The travel satisfaction measurement survey tools tested consisted of two types of smartphone applications (a satellite navigation app and a game app), an on-line survey, a paper-based semi-structured questionnaire and a focus group. Each of the measurement tools comprised of a similar set of questions, but in different formats, aimed at exploring the pros and cons of each tool among different group of travellers. In total, 5,275 valid responses were collected during the survey period from eight European cities and five FIA (Federation Internationale de I'Automobile) national motorist networks. The analysis results, with ordered logit model of travellers' reported overall satisfaction, showed that the travel satisfaction reported by different survey methods and different travel modes and user groups, correlated with distinct groups of key determinants. The relationship between and within these key determinants, however, was far from straight forward. Some were more complex than others. Some issues, such as parking availability and security, that are mostly discussed by policy makers and users may not be the ones that directly correlate with the users' overall travel satisfactions. Consistent with previous studies, the travellers' mood and previous experience influenced the reported overall journey satisfaction.

Keywords: *Door-to-door journey, travel satisfaction, multimodal measurement, smartphone app survey, on-line survey, paper-based survey.*

1. Introduction

Providing an accessible and inclusive transport service for all is important to ensure that people are not excluded from reaching places of employment, health, education and leisure services, and – simultaneously - ensuring equal life opportunities for diverse communities. However, different travellers have different needs and priorities and these influence their satisfaction relating to various quality factors of provided services. In order to provide a transport service that meets individual travel needs, it is important to understand the factors that underlie travel satisfaction for different individuals. Thus, in the last decade there have been a surge of studies which investigate various aspects of passenger travel experience (e.g. Friman and Gärling, 2001; Stradling et al., 2007; Diana, 2008; Páez and Whalen, 2010, Susilo et al., 2012; Susilo and Cats, 2014; Cats et al., 2015; Abenoza et al., 2016).

Stradling et al. (2007), for example, found that non-instrumental variables such as cleanliness, privacy, safety, convenience, stress, social interaction and scenery play a significant role in influencing traveller satisfaction with journeys. Also, punctuality and reliability are likely to be at the top of a commuter's priority list (DfT, 2011), while safety, reliability and service frequency are particularly important for women (Tranter, 1995). Although adults on a low income will share the same broad travel needs as the general population, previous studies show that this group are associated with a lower level of car-ownership (e.g. Giuliano and Narayan, 2003; Hine and Mitchell, 2003), more walking and frequent use of public transport, and are less likely to chain non-work trips to their commute trips than their higher socio-economic group counterparts (Clifton, 2003; BMRB, 2004, etc.). For older people, mobility is much more closely connected with health and well-being (Banister and Bowling, 2004): mobility and the ability to get out of the home are essential to their quality of life (Farquhar, 1995; Andrews et al., 2012). Further, being unable to drive/travel independently is one of the strongest predictors of increased symptoms of depression among older people (Marottoli et al., 1997), and an individual's ability to use the transportation system freely has long been defined as one of the seven important areas in the Instrumental Activities of Daily Living (IADL) of the elderly (Fillenbaum, 1985).

Despite the complexities that underlie an individual's activity-travel participation and the travel satisfactions that relate to them, previous studies have focused on a particular travel mode

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and/or at a particular trip purpose, and have often ignored the impact of access and egress legs on overall journey satisfaction. This may lead to an inaccurate evaluation of service provision by public transport operators (and authorities) and can undermine the quality of interchanges and last-mile facilities on passenger overall travel satisfaction. Eurobarometer (2013) shows, among railways travellers in 26 EU member states, that the relationship between railway journey satisfaction and the passengers' satisfaction with the railway station is not linear. Often stations are simply regarded as change points - places where passengers have to change as quickly and efficiently as possible from one mode of transport to another. However, some authorities, such as Netherlands Railways, have the view that stations are places that need to be transformed into dynamic urban portals that not only facilitate a speedy transfer but also make the stay at the station more enjoyable (van Hagen, 2015). Thus, while passengers want travel to be safe, frequent, and reliable, Iseki et al. (2007) found that security and interchange design and maintenance (such as visibility, the absence of graffiti, and the presence of a seating area, restroom, and shelter) significantly influence passengers' travel satisfaction. Muconsult (2003, cited by van Hagen, 2015) estimated that passenger satisfaction towards stations determines about 25% of the score awarded to the total train journey satisfaction.

Beside the lack of comprehensiveness in measuring journey satisfaction, there is also a lack of knowledge on how different travel satisfaction method measurements influence the reported level of satisfaction. Susilo and Cats (2014), for example, found that there is a systematic tendency to report higher satisfaction levels immediately after the completion of a public transport or cycling trip stage when compared with a retrospective satisfaction report. This is consistent with findings based on a similar question asked years after a trip occurred (Pedersen et al., 2011). Similarly private car travellers reported significantly lower travel satisfaction levels in retrospective reports.

Therefore, from the above discussion it is deduced that the data collected by different survey methods may yield distinct answers. The fact that the method used can affect the quality of the responses and bring about some other bias (response rate, non-response bias, etc.) associated with the characteristics of the data collection tool, makes it difficult to define the ground of truth. Wiersma (2003) noted other biases such as coverage (for online), low response rates (for online and phone surveys), interviewer effects (for phone and in-person surveys), display effects (for online surveys). Recent research has compared the external and internal validity of the most technologically advanced survey methods - online, sms- with the most conventional methods - paper based, face-to-face, phone. However, the results of these studies cannot be generalized (van De Looij-Jansen and de Wilde, 2008) and found that the survey methods have a negligible effect on the results (Wells, 2014; Belisario, 2015). Nevertheless, the influence of very novel tools such as smartphone apps has not yet been studied.

In order to contribute to this research gap, this study aimed to investigate how different travel satisfaction survey methods (during and post-trip) influence the reported level of door-to-door travel satisfaction among travellers. The travel satisfaction measurement survey tools tested consisted of two types of smartphone applications (a satellite navigation app and a game app), an on-line survey, a paper-based semi-structured questionnaire, and a focus group. Each of the measurement tools comprised of a similar set of questions, but in different formats, aimed at exploring the pros and cons of each tool among different group of travellers.

In the next section, we will describe the survey and the tool design and the data collection activities. The descriptive and correlation analyses of the collected datasets from 8 different cities and five FIA's national networks are then presented. This is followed by multivariate analyses which are employed to measure the impacts of different survey methods towards the overall travel satisfaction reported. The article closes with a summary section.

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2. METPEX project and survey description

This study was part of METPEX FP7 EU project (www.metpex.eu, METPEX, 2012), which aimed to develop a Pan-European standardised measurement tool to measure passenger experience across whole journeys, whilst taking into account wider human socio-economic, cultural, geographic and environmental factors.

The early stage of the research comprised desktop research, stakeholder consultation and a small size experiment among approximately 550 respondents across 8 different European cities. The results were used to identify the variables that could be used to better monitor and evaluate the passenger experience during journeys by public and active forms of terrestrial transport, with special attention toward the needs of vulnerable groups, such as older people, lower income groups, rural dwellers, children and those with both physical and cognitive disabilities (METPEX, 2013; Cats et al., 2014; Susilo et al., 2015, 2017; Susilo and Cats, 2014). Based on this, a set of questionnaires were developed and consisted of the five following sections:

- Individual attributes (i.e. socio-demographic, mobility behaviour)
- Attitudes (i.e. travel preferences, mobility-related opinions)
- Contextual variables (i.e. temporal, weather conditions, trip purpose, subjective well-being indices)
- Specific user groups and travel modes specific questionnaires
- Travel experience factors (e.g. availability, travel time components, information provision, reliability, way-finding, comfort, appeal, safety and security, customer care, price, connectivity, etc.)

The questionnaire was then translated into 5 different survey methods:
1. Paper-and-pencil
2. On-line questionnaire
3. Real-time questionnaire, embedded in the route navigation (SbNavi) app for IOS and Android (Figure 1).
4. Real-time questionnaire, embedded in specially dedicated Android Game app (Figure 1)
5. Focus group

The detailed content descriptions and design considerations of these five tools can be seen in METPEX (2014), Susilo et al., (2017) and Tovey et al. (2017). These five different tools have their own advantages and disadvantages in terms of different target groups and technological support systems. All measurement tools consisted of a similar set of questions (with the focus groups asking fewer but more detailed questions relating to specific user groups, whereas the game app did not ask the specific questions related to the user groups and travel modes). For each specific user group and travel mode combination, each respondent was required to answer 50-75 questions, which required an individual to spend approximately 20-30 minutes to complete the whole questionnaire. The survey tools were available in 10 different languages - English, French, German, Spanish, Italian, Greek, Swedish, Lithuanian, Polish and Romanian.
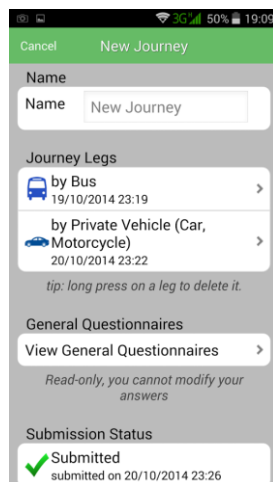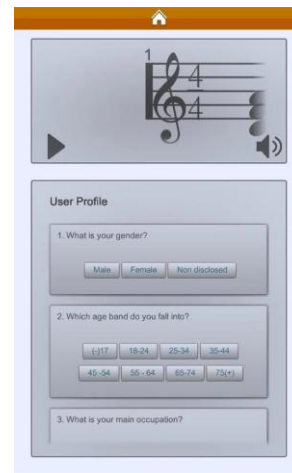
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Figure 1. a) Snapshot of navigation app interface   b) Snapshot of Game app interface

The data collection was carried out in eight different European cities - Bucharest, Coventry, Dublin, Grevena, Rome, Stockholm, Valencia and Vilnius, and five FIA motorist networks (Germany, Poland, France, Spain and the United Kingdom), between September and November 2014. The trial sites included five capital cities with a municipal population size ranging from 0.5 (Vilnius) to 2.8 million (Rome), a large (Valencia – 0.8mill.) and medium (Coventry 0.3mill.) city and a small rural town (Grevena 15.000 inhab.). All the capital and large cities have a good public transport system served by bus, tram or trolleybus, commuter train and even metro (Rome, Stockholm, Valencia) and boat (Stockholm). The most poorly covered are Coventry served by bus and train while Grevena had one urban bus and inter-city buses.

The recruitment method varied depending on the city and the collection method. The size and proportion of the target groups were calculated based on the socio-demographic and travel mode distribution of those groups in each city. The standard random number generator method with the following parameters was adopted: confidence level (95%), confidence interval (3-5%), % picking a choice (p=50%). In some cities, economic incentives were offered to attract more respondents, for example, Stockholm offered a cinema ticket whilst Coventry offered free coffee and chance to win an iPad. In other cities, stakeholders' and membership networks (e.g. FIA, Bucharest, Dublin) were used to promote the survey. There were also cities which developed a strong media campaign to encourage online survey participation (e.g. Valencia). Others received strong support from their local stakeholders and were able to carry out surveys on board or in stakeholders' premises - for example, Dublin carried out on-board surveys and Coventry was allowed to set up a stand on a main railway station and coffee shop.

In total, 6,360 completed responses were collected during the survey period. After the data had been cleaned and double checked for consistency and reliability across different sections, the total number of valid samples was 5,275 (See Table 1 below). The results were 984 responses from the paper-and-pencil survey, 3,395 responses from the on-line web survey, 231 responses from the SbNavi app, 414 responses from the game app and 251 responses from the focus group method.

As can be seen from Table 1, the traditional on-line (64%) and the paper-and-pencil (19%) methods attracted the highest number of respondents (total 83%), whilst the more technologically driven methods; game app (8%) and SbNavi (5%), attracted the lowest response rates. This low response rate, however, varied in different countries, and it is important to note that the Game app contained a fewer number of questions, which were less complex and thus more user friendly, than the SbNavi app. This may be why the former attracted a higher number of respondents than the latter. Overall, although there was a consistent agreement among respondents and surveyors that the tools were attractive, the questionnaire was found to be too

Table 1. Summary of valid number of respondents, by used survey methods

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City	Number of collected response	Paper and Pencil	Web On-line Survey	SbNavi App	Game App	Focus Group
Bucharest	411	51	281	9	46	24
Coventry	336	207	86	6	28	9
Dublin	467	146	284	8	29	0
Grevena	267	124	57	3	2	81
Rome	729	143	501	0	22	63
Stockholm	842	144	226	176	222	74
Valencia	501	17	430	13	41	0
Vilnius	247	152	55	16	24	0
FIA networks	1475	0	1475	0	0	0
TOTAL	**5275**	**984**	**3395**	**231**	**414**	**251**

long and complicated. It was also apparent from the survey feedback that - despite a surge in technology adoption and penetration in Europe in terms of smartphones in the last several years - the acceptance of a smartphone app as a survey tool was low. There were also significant privacy and data protection concerns expressed among potential respondents (e.g. Rome) in terms of installing an unknown app. In addition, a number of causes related (intrinsic) and unrelated (external) to the apps were behind the limited number of responses collected via smartphones. The intrinsic causes include: low internet speed in some sites that affected the app's functioning; app crashes due to different reasons; difficulties in filling the survey given the higher complexity of the Sbnavi app; the design of the games which needed buy in from a large number of users to be fully functional; low penetration rate of smartphones in some trial sites (Greece and Lithuania 43% Vs Sweden and Spain with about 73%). In turn, the external causes include: a lower targeted number of samples by smartphones stated on the survey plan of each city; a delay in the release date of some versions of the apps (2 weeks delay for the Game app and 5 weeks delay for the Sbnavi for Android); the platform in which the apps were released could be regarded as an issue (the Sbnavi for Android was only available the final week of the survey and the Game app was never available for iOS) and; the limited access to high-speed internet in some trial sites which hindered the downloading and use of the apps. The interested reader can read more about the possible reasons why the apps only received modest results on METPEX (2014) and Susilo et al. (2017).

The distribution of the respondents among different socio-demographic groups and travel modes can be seen in Table 2 and Table 3 respectively. In the recruitment stage, the respondents were sampled according to the socio-demographic and travel mode distributions in each respective city. However, few of the cities managed their socio-demographic and travel mode targets. For example, mobility restricted and elderly groups proved to be more difficult to recruit than other traveller groups, especially in Rome, Valencia and Bucharest. Presumably this is because, at some cities, these traveller groups are not travelling as frequently as other groups. Pedestrians and cyclists were also more difficult to capture than rail-based travellers. This latter is probably because many of the recruitment processes focused on the main interchanges where the travellers' main travel modes were rail/road based public transport. It is also important to note that it is very difficult, if not impossible, for pedestrians, cyclists and car drivers to participate in real-time survey (e.g. using the apps) whilst travelling.

Table 2. Distribution of valid respondents, by socio-demographic characteristics[15]

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[15] The total number of respondents by different UG (user groups, Table 2) and TM (travel modes, Table 3) are different with the total number of samples (Table 1) since the Game app did not record specific detailed questions for different UG.

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City	Comm. Impaired	Commuters	Low Income	Mobility Restricted	Elderly	Rural dwellers	Travelling with children	Travelling with dependent	Under 24	Visitors	Women
Bucharest	11	76	49	19	21	21	20	2	32	31	83
Coventry	9	67	11	5	16	16	7	1	58	44	74
Dublin	8	209	40	9	10	24	5	3	45	7	78
Grevena	2	8	35	12	38	28	31	0	56	20	35
Rome	8	165	115	22	40	44	4	5	143	32	129
Stockholm	9	110	76	55	31	13	54	3	109	9	151
Valencia	9	62	113	19	49	4	14	2	32	29	127
Vilnius	9	33	31	9	20	3	15	1	22	4	76
FIA networks	150	221	197	57	44	133	29	25	106	157	356
TOTAL	**215**	**951**	**667**	**207**	**269**	**286**	**179**	**42**	**603**	**333**	**1109**

Table 3. Distribution of valid respondents by travel mode[15]

City	Private vehicle	PT Road	PT Rail (Tram, Rail, Underground)	Pedestrian and Bike	PT Waterborne	Demand Responsive Transit	Mobility Vehicles
Bucharest	58	104	153	30	0	18	2
Coventry	87	82	87	44	0	8	0
Dublin	22	310	91	13	1	1	0
Grevena	68	133	8	50	5	1	0
Rome	182	171	328	20	1	0	5
Stockholm	131	129	286	55	3	16	0
Valencia	131	107	60	162	0	0	0
Vilnius	46	133	3	36	0	4	1
FIA networks	540	293	422	130	20	17	53
TOTAL	**1265**	**1462**	**1438**	**540**	**30**	**65**	**61**

Further distribution analysis of the survey results of each city are described in Section 3. Comprehensive multivariate analysis to explore the unique behaviour across different survey methods and travel modes are described in Section 4.

3. Descriptive analysis

As shown in Table 4, overall, there was a fair distribution of gender across different test sites, with Coventry having the lowest and FIA network having the highest proportion of women amongst their samples. The majority of respondents were less than 55 years old, high school (or less) educated, full time employed and lived in urban areas. Stockholm respondents had the

Table 4. Distribution of sample by test sites

Variable	Category	Min	Max	Average
Gender[1] (%)	Male	34.5 (Coventry)	56.7 (FIA)	46.7
Age[2] (Years)	18-24	14.0 (Valencia)	33.6 (Coventry)	21.8
	25-34	12.6 (Valencia)	34.5 (Bucharest)	23.9

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	35-44	12.2 (Coventry)	23.6 (Grevena)	20.2
	45-44	9.5 (Bucharest)	21.0 (Valencia)	15.5
	55-64	5.2 (Stockholm)	11.7 (Vilnius)	8.6
	65-74	3.0 (FIA)	13.9 (Grevena)	6.4
	>75	0.1 (FIA)	10.2 (Valencia)	2.1
Education (%)	Less than high school	1.7 (Bucharest)	31.5 (Valencia)	10.5
	High school	29.6 (Bucharest)	54.3 (Rome)	44.9
	Bachelor degree	13.5 (Valencia)	45.0 (Bucharest)	28.4
	Postgraduate qualifications	1.60 (Valencia)	30.0 (Dublin)	16.3
Occupation[3] (%)	Full time employment	15.0 (Grevena)	55.7 (Bucharest)	44.1
	Part-time employment	4.1 (Grevena)	13.4 (Rome)	10.1
	Unemployment	2.4 (Coventry)	17.6 (Valencia)	6.7
	Student	7.3 (Vilnius)	27.4 (Stockholm)	15.2
	Pensioner	4.1 (Dublin)	23.4 (Valencia)	9.6
Income[4] (%)	Under average	26.5 (FIA)	66.9 (Valencia)	40.0
	Above average	5.4 (Valencia)	21.4 (Dublin)	16.6
Disability	Yes	8.6 (Rome)	27.5 (FIA)	17.8
Type of disability (%)	Mobility impairment	15.3 (Dublin)	51.9 (Grevena)	24.7
	Hearing impairment	3.7 (Grevena)	18.6 (Dublin)	13.2
	Visual impairment	3.7 (Grevena)	48 (Bucharest)	28.6
	Learning disability	0 (Grevena, Rome)	28 (Coventry)	6.1
	Serious long term illness	5.6 (Bucharest)	40.7 (Grevena)	21.0
Area of residence (%)	Rather urban or urban	46.8 (Grevena)	92.6 (Valencia)	66.3
	Neither rural nor urban	3.4 (Bucharest)	34.5 (Grevena)	17.5
Type of building[5] (%)	Terraced house	2.2 (Grevena)	27.1 (Coventry)	11.8
	Detached/semi det. House	2.6 (Valencia)	63.2 (Dublin)	24.4
	Medium or large building (>5 hh)	13.1 (Coventry)	92.2 (Valencia)	54.4
Living with[6] (%)	Single	14 (Valencia)	30.9 (Stockholm)	22.0
	Partner/ married	22.4 (Stockholm)	32.1 (Bucharest)	26.8
	Partner/married 1 or > children	13.1 (Dublin)	34.8 (Grevena)	25.3
	Shared household	1.6 (Valencia)	27.2 (Dublin)	13.6
Cars (units)	Number in HH	0.8 (Stockholm)	1.5 (FIA)	1.2

[1] Not showing the categories Female and Non-disclosed.

[2] Not showing <17 age years old

[3] Not showing Self-employed, Working student, Housewife/Husband and Other

[4] Not showing Average income

[5] Not showing Small building apartments

[6] Not showing Single with 1 or more children

Table 4. Distribution of sample by test sites (continued)

Variable	Category	Min	Max	Average
Trip purpose[7] (%)	Commuting to work	5.8 (Grevena)	33.6 (Dublin)	24.2
	Commuting back home	0.6 (Valencia)	24.9 (Dublin)	9.4
	Work related	5 (Valencia)	13.3 (Grevena)	10.0
	Education	6.4 (Valencia)	17.9 (Grevena)	10.8

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	Shopping	4.1 (Rome)	13.2 (Vilnius)	9.6
	Leisure	9.9 (Rome)	32.5 (Grevena)	19.3
	Visiting the city-Tourism	1.9 (Dublin)	15.7 (FIA)	8.8
Frequency (%)	Daily	19.9 (Grevena)	65.5 (Valencia)	38.3
	Weekly	17.0 (Bucharest)	35.9 (Stockholm)	24.5
	Monthly	1.6 (Valencia)	12.7 (Grevena)	6.3
	Occasionally	9.2 (Valencia)	43.8 (FIA)	28.8
Duration (minutes)	<10 min	1.5 (Bucharest)	14.4 (Valencia)	6.1
	11-30	15.4 (Dublin)	59.1 (Valencia)	27.4
	31-60	17.4 (FIA)	45.5 (Bucharest)	29.9
	61-120	5.8 (Valencia)	34.0 (Dublin)	15.2
	>2h until 4h	2.4 (Valencia)	17.2 (Grevena)	8.8
	>6 hours	1 (Valencia)	30.4 (FIA)	11.7
Legs (number)	Avg. number	1.7 (FIA)	2.5 (Dublin)	2.0
Modes all legs[8] (%)	Bicycle	0.2 (Grevena)	4.1 (FIA)	2.1
	Pedestrian	13.4 (FIA)	66.4 (Valencia)	32.2
	Private vehicle	8.2 (Bucharest)	29.7 (FIA)	17.4
	PT Rail	0.6 (Valencia)	20.3 (Coventry)	11.0
	PT Road	11.5 (Valencia)	39.6 (Dublin)	23.0
	PT Metro+Tram	0.5 (Vilnius)	23.3 (Bucharest)	11.4
	Other	0.2 (Valencia)	6.5 (FIA)	2.7
Mode main legs[8] (%)	Bicycle	0 (Grevena)	4.5 (FIA)	3.0
	Pedestrian	1.7 (Rome)	32 (Valencia)	8.3
	Private vehicle	5.5 (Dublin)	36.6 (FIA)	26.0
	PT Rail	1.1 (Valencia)	28.6 (Rome)	17.5
	PT Road	19.9 (FIA)	70.8 (Dublin)	30.2
	PT Metro+Tram	0 (Vilnius)	31.8 (Bucharest)	11.8
	Other	0 (Valencia)	6.1 (FIA)	3.2
Disruption? (%)	Yes	1.1 (Grevena)	41.8 (Rome)	19.0

[7] Not showing Escorting dependents, Escorting children and Medical/social care appointments.

[8] The group "other" is composed by Waterborne, Mobility vehicle and Demand responsive

lowest car ownership rate, whilst the FIA respondents had the highest. Experiencing disruption was very common amongst Rome travellers (which had the highest share of railway users), whilst Grevena travellers experienced the least. Overall, Dublin had the highest share of public transport road users, whilst FIA motorists had the highest proportion of private car and bicycle use. Respondents from Valencia had the highest proportion of pedestrians.

As can be seen from Figure 2, Dublin travellers reported the most complex journey patterns, i.e. a higher number of trip legs per journey (on average 2.54 trip legs per journey), whilst FIA motorists respondents reported the lowest (on average 1.65 trip legs per journey). Overall, the respondents made an average of 1.96 trip legs per journey which may indicate that some of the respondents underreported their journey, perhaps not considering walking as a separate leg.
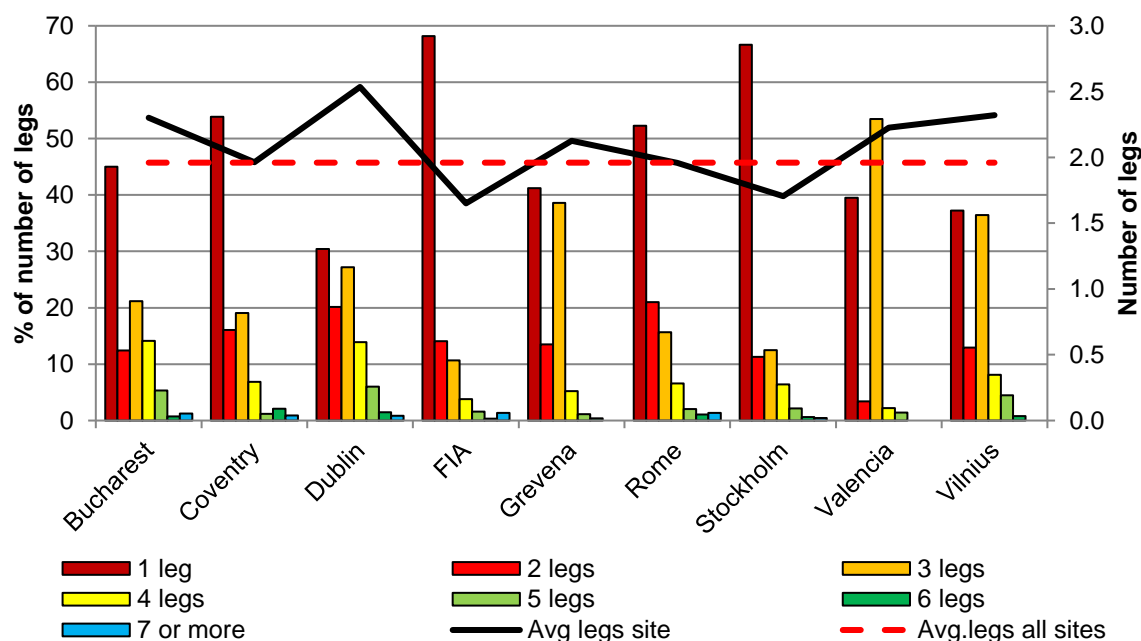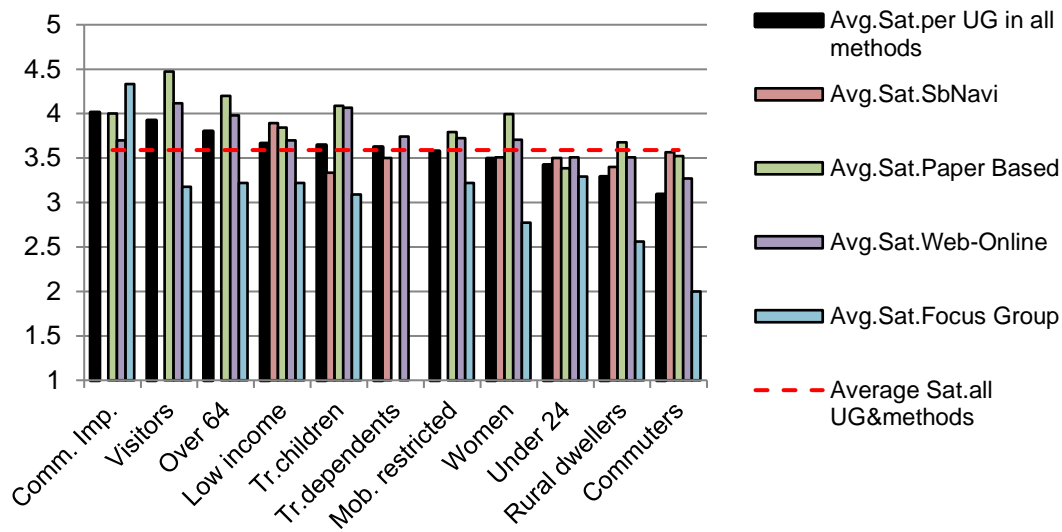
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Figure 2. Distribution of reported trip stages by trial sites

In terms of reported overall travel satisfaction, on average, communication impaired, visitors and the elderly reported the highest travel satisfaction, whilst commuters, younger travellers and rural dwellers were least satisfied (see Figure 3a). However, across different survey methods, this only applied among respondents who participated in paper based and on-line surveys (the majority of the respondents). Surprisingly, low income travellers reported the highest travel satisfaction via the sbNavi app, whilst travellers with children and the rural dwellers reported the lowest travel satisfactions. Those with communication impairments significantly reported higher travel satisfaction (via focus group methods) than commuters, rural dwellers and women (who reported the lowest).

Interestingly, when comparing travel satisfaction for different travel modes when they are the main mode (Figure 3b) and when the travel modes can be in any trip legs (Figure 3c), the rank order of satisfaction is similar. The main travel modes, waterborne, private vehicle and demand responsive were reported as providing the highest travel satisfaction, whilst public transport rail, public transport road and underground modes were reported as providing the lowest travel satisfaction. Meanwhile in terms of the whole door-to-door journey trip legs, the main differences are that pedestrian legs were reported to have amongst the highest travel satisfaction, while PT tram were reported as amongst the least satisfying among all other travel modes. This difference highlights the importance of understanding and measuring the dynamic of an individual's travel satisfaction from door-to-door, and not only focus on the main trip leg, which most NGOs and authorities tend to do. Consistent with previous graphs, different survey methods in conjunction with the influence of different sample characteristics resulted in differences in the order of travel satisfaction across different travel modes.

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(a) Reported overall travel satisfaction by user groups and survey methods
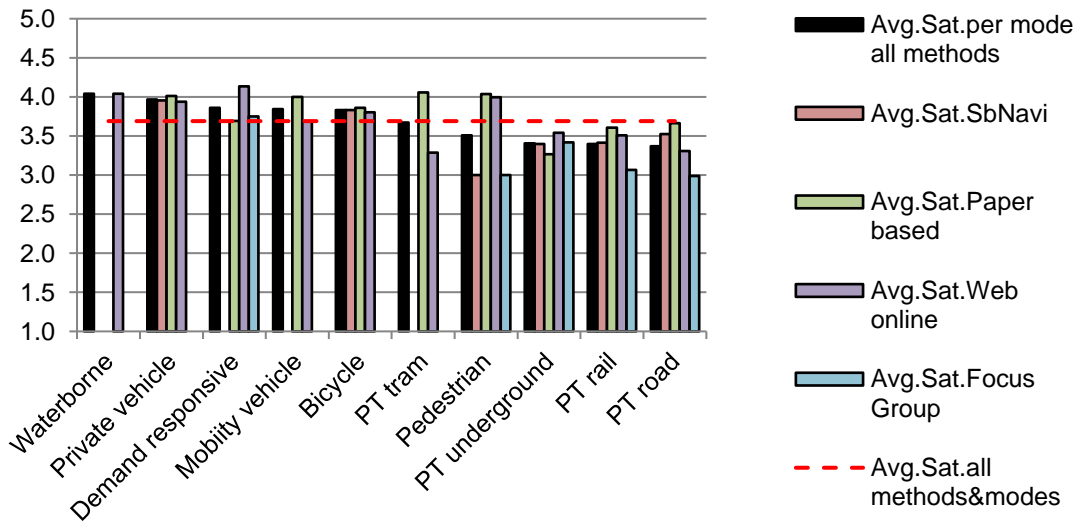
(b) Reported overall travel satisfaction by main travel mode and survey methods
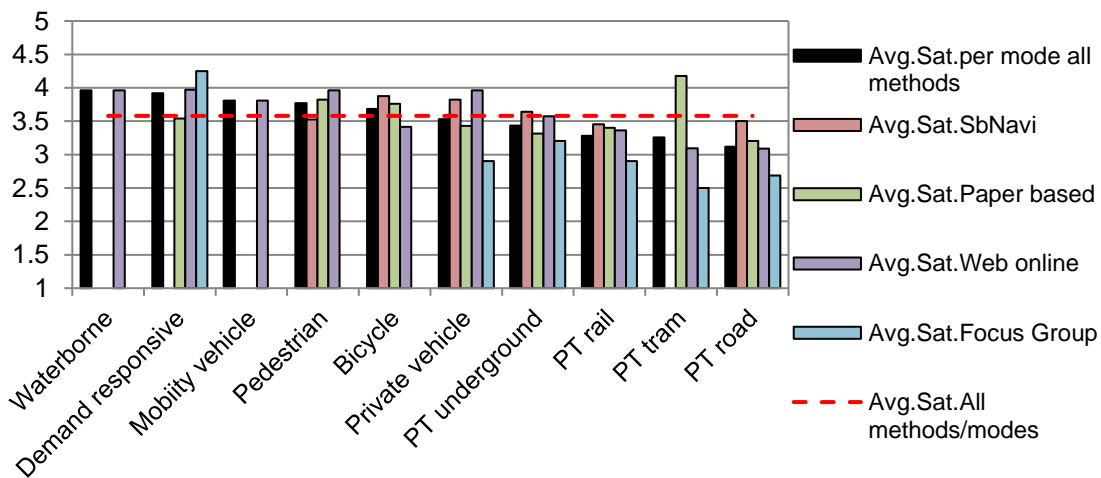
(c) Reported overall travel satisfaction by travel modes, regardless whether the given mode were used as the main travel modes, and survey methods

Figure 3. Overall travel satisfaction by user groups, travel modes and survey methods

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Previous studies (e.g. Ory and Mokhtarian, 2005; Cantwell et al., 2009) reported that the level of travel satisfaction is a function of travel distance; the longer one travels, the less satisfied one becomes. However, as can be seen from Figure 4 below, this relationship only appeared to apply until 90 minutes of travel. Once the trip became longer than 90 minutes, the level of satisfaction increased and was relatively steady for longer trip durations. This is due to the purpose of longer trips – (leisure and tourist trips are increasingly important, representing a 43% in for trips between 91-120min. and 89% for trips over 6 hours) perhaps geared up for leisure and other special trips - travelers will have prepared themselves for a longer amount of travel time. However, these results should be taken with caution since other factors may influence the relationship between duration and satisfaction. Therefore, duration of the journey will be further studied in the multivariate analysis.
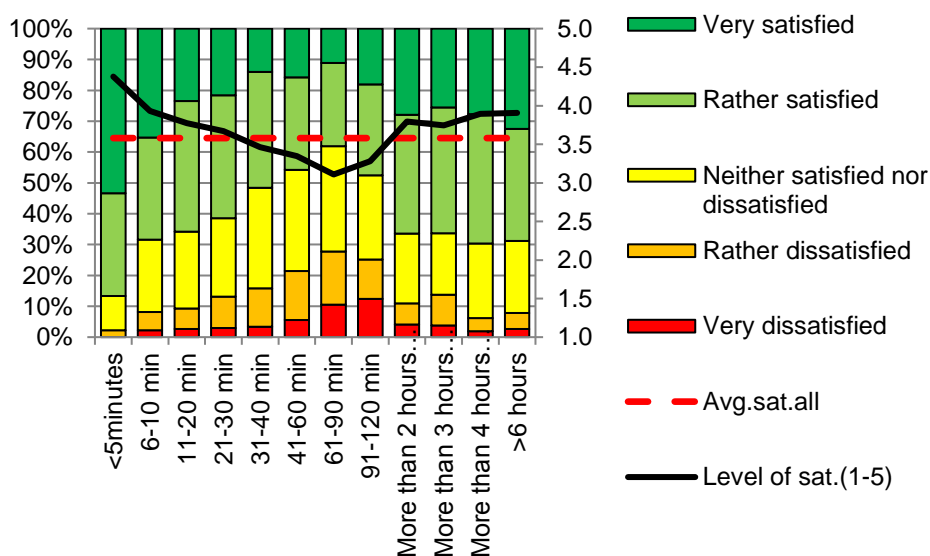

Figure 4. Overall travel satisfaction by trip duration

4.2 Cross-correlation by travel mode and survey methods

A correlation matrix was constructed in order to identify the travel experience aspects that were most strongly correlated to overall trip satisfaction, as well as the extent to which various travel experience aspects were inter-correlated. Figures 5 and 6 present cross-correlation matrices for different travel modes and survey methods, with each aspect of experience represented as a node and the correlation between two items illustrated by a link. The cross-correlation graphs were visualized using the NodeXL excel add-in and offered an intuitive glimpse of the relationships between the various factors. The line thickness corresponds to the degree of correlation. Correlations with the overall journey satisfaction are highlighted using red solid lines. Correlations among other sub/categories are displayed in blue. Correlations above 0.7 are shown with a solid line and those between 0.5 and 0.7 with a dashed line. The correlation coefficients are always positive with the exceptions of OS-Regret and Regret-Loyalty.

As can be seen from Figure 5, the overall travel satisfaction of different travel modes significantly correlate with different service attributes. Whilst the road based public transport users' travel satisfaction correlated with punctuality and reliability factors (Figure 5b), the railway users' overall travel satisfaction correlated (correlation > 0.5) with punctuality, accessibility in terms of reaching the station (public transport proximity), and air temperature and ventilation inside vehicles (air comfort on-board) (Figure 5a). Tram users, on the other hand, also appreciated the cleanliness of the vehicle (Figure 5c), whilst the overall travel satisfaction of underground users did not correlated with any factor. In contrast, the overall travel satisfaction of waterborne public transport users (Figure 5i) significantly correlated with timetable information provision and also

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with the frequency of the service. Presumably this is because, compared to other modes, waterborne public transport mode is the one which usually has a lower service frequency.

Looking at cross-correlations among private/personal based travel modes (bicycle, walking, private car, mobility vehicle, and demand responsive transport, Figure 5 e-h), there were no factors that directly influenced overall satisfaction, and none of them had direct correlations (> 0.5) with the reported overall satisfactions. This highlights that for the non-public transport modes, the components and factors that influenced the travellers' overall satisfaction were much more complex.

For example, private car users' overall travel satisfaction (Figure 5g) did not correlate with any factor while the most frequently discussed issues, such as: parking availability and security, disruption related information, inter-modality, and prioritisation, correlated with the availability and visibility of travel related information, but not directly with car users' overall travel satisfaction.

As for mobility vehicle (Figure 5h) and demand responsive (Figure 5j) users their overall travel satisfaction did not correlate with any service attribute. However, mobility vehicle transport (Fig. 5h) exhibited a very high correlation between having safer and more secure streets and factors such as the location of information signs, the quality and maintenance, cleanliness of the pavement and the lack of physical hindrances. Demand responsive transport (Fig. 5j), in turn, showed a very high correlation between driver's knowledge of the route and vehicle comfortability, helpfulness of the staff, reliability of the service and ease of booking the service. Figures 5e and 5f, show that for cyclists and pedestrians, none of the factors included in this analysis correlated with cyclists' overall satisfaction, higher than 0.5. This was because slow mode travel satisfactions are highly influenced by non-instrumental variables - such as ambience of the cycle path, confidence and sense of safety in fast moving traffic – that are very difficult to measure and generalise in tangible ways (e.g. Alfonzo, 2005).

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(a) PT Rail

(b) PT Road

(c) PT Tram

(d) PT Underground

Correlations: Solid line (> 0.7) and dotted line (0.5 to 0.7)
            In red (with overall travel satisfaction) and in blue (between other variables)

Figure 5. Cross-correlations among travel experience aspects and overall satisfaction on trip stages for
different travel modes.

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(e) Bicycle

(f) Pedestrian

(g) *Private vehicle*

(h) *Mobility vehicle*

Correlations: Solid line (> 0.7) and dotted line (0.5 to 0.7)
In red (with overall travel satisfaction) and in blue (between other variables)

Figure 5. Cross-correlations among travel experience aspects and overall satisfaction on trip stages for different travel modes (continued)

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(i) Waterborne   *(j) Demand Responsive Transport*

Correlations: *Solid line (> 0.7) and dotted line (0.5 to 0.7)*

In red (with overall travel satisfaction) and in blue (between other variables)

Figure 5. Cross-correlations among travel experience aspects and overall satisfaction on trip stages for different travel modes (continued)
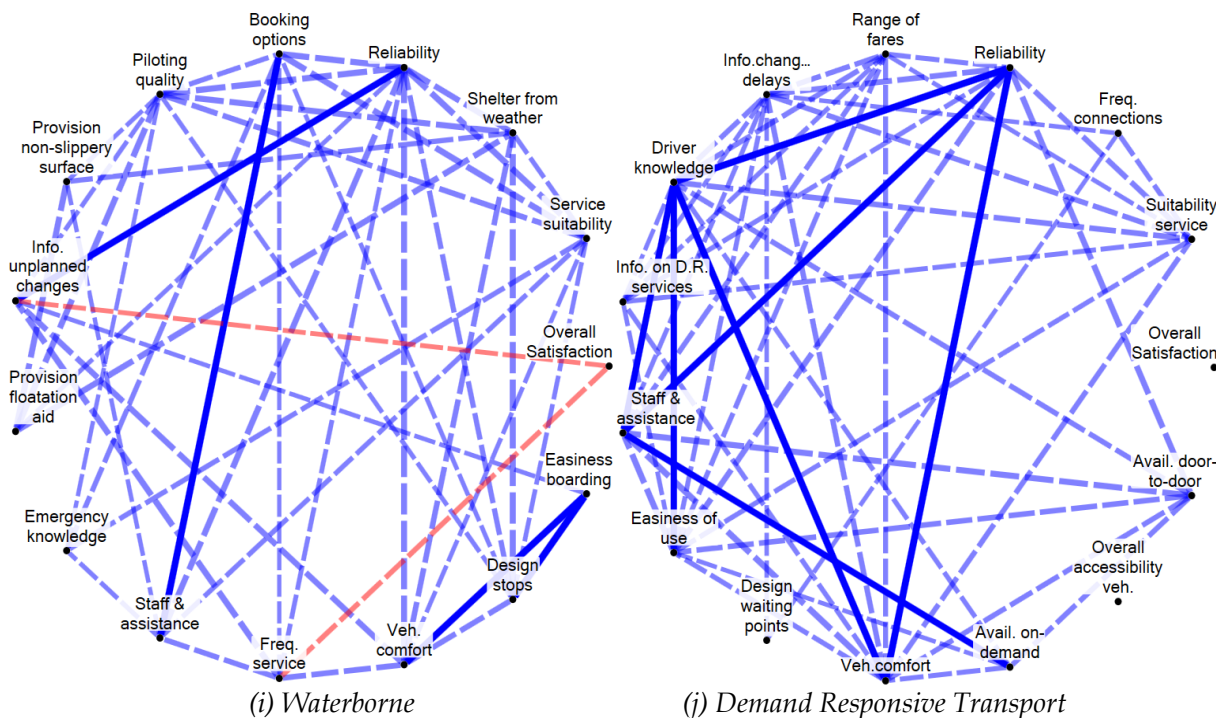
Across different survey methods, as can be seen from Figure 6, the respondents' overall travel satisfaction which was measured using different survey methods correlated with different factors. Most of the subjective well-being factors consistently correlated (at 0.3) with the reported overall travel satisfaction, despite the survey methods used. The overall travel satisfaction reported via the sbNavi correlated (>0.5) with travellers' satisfactions towards their main and previous trip legs, whilst the overall travel satisfaction reported via the game app survey method correlated with users' loyalty[16] towards certain modes. The overall travel satisfaction reported via the on-line survey highly correlated (>0.5) with users' loyalty toward a particular mode, their satisfaction towards the main and subsequent trip legs, whilst the overall travel satisfaction reported via the paper-and-pencil methods were only highly correlated with their loyalty towards particular travel methods.

Different correlations towards different combination of trip legs may also be influenced by the nature of the survey tools. The sbNavi app allowed travellers to report travel satisfaction whilst travelling, in real time. This allowed the respondents to evaluate their travel and also their previous trip legs. In contrast, the on-line survey respondents completed the survey post-trip. Thus, real-time surveys may make travellers more focused on not only their main trip leg, but also subsequent trip legs, until they reach their final destination. The paper-and-pencil method, however, were mostly distributed in the main interchanges, where people were in a hurry and so may only result on a focus on the (most recent) trip legs. Focus group respondents retrospectively evaluated trips in a group discussion, thus detached from, and with more time to evaluate, each trip leg.

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[16] 'Mode loyalty' in here refers to the unconditional preference that an individual may have towards a certain travel mode. This was inferred based on the agreement with the following statement: "I will travel with my current travel mode in any case, no matter what the conditions are"

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(a) All survey methods

(b) SbNavi

(c) Game App
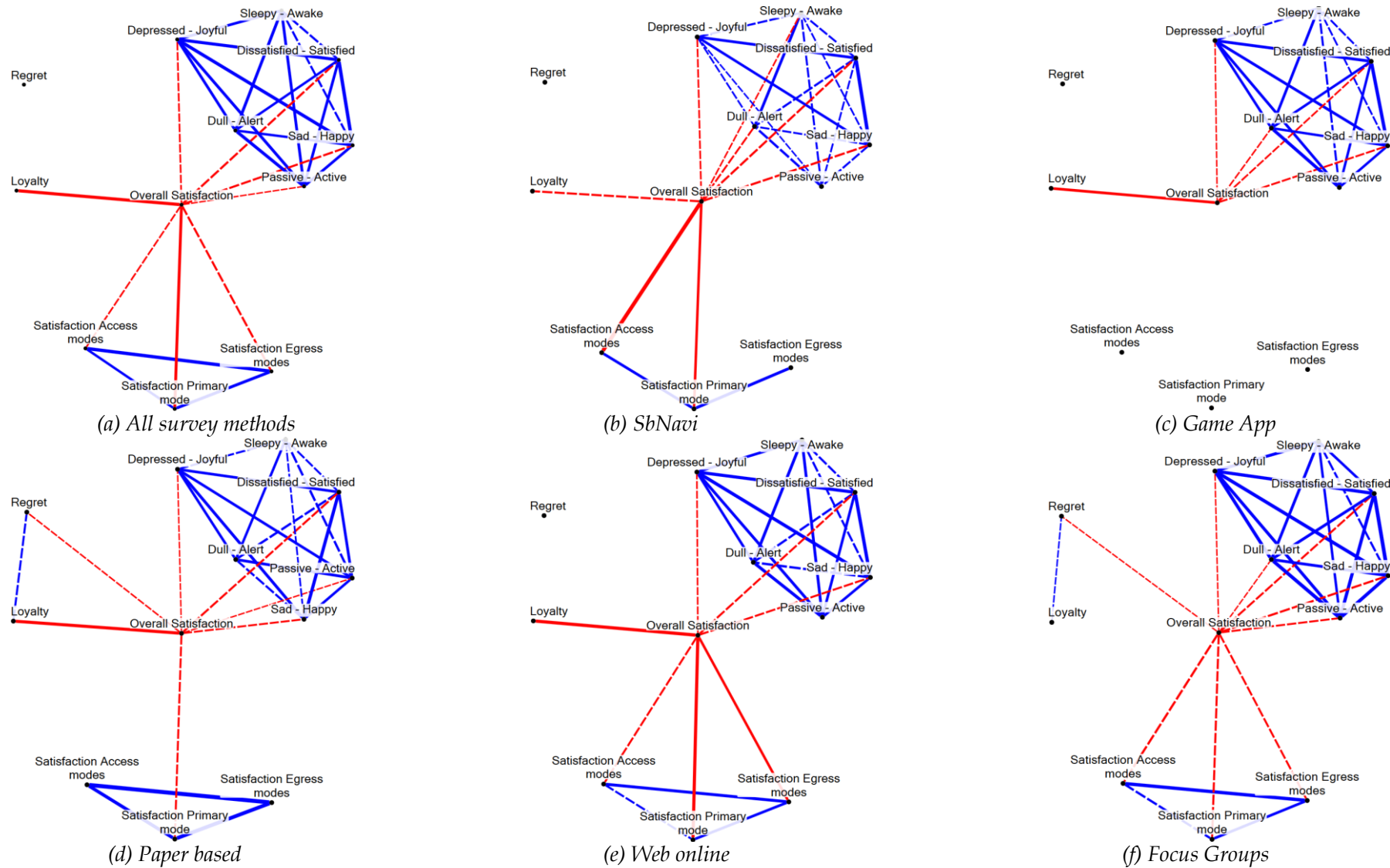
(d) Paper based

(e) Web online

(f) Focus Groups

Figure 6. Relationships between overall journey satisfaction and satisfaction with various trip stages, subjective well-being spectrums, past experience and related trip appreciation factors, by different survey methods

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As for the game app, like also with other methods, the reported passengers travel satisfaction is strongly correlated with travellers' loyalty towards a particular mode. This loyalty towards a particular travel mode could be interpreted as cognitive dissonance - where one aims to reassure or reconfirm his or her choices (Steg, 2005; Jakobsson-Bergstad et al. 2011; Susilo and Cats, 2014).

Nevertheless, it is also important to take into account that these discrepancies in correlations across different factors may also be due to the different proportion of main travel mode users across different survey methods. Thus, to analyse this further, multivariate analysis (an ordered logit model) was used to analyse the factors that correlated with the reported individual's travel satisfaction.

4. Multivariate analysis

The previous analysis showed that within the trial site cities, survey methods and groups of travellers with different trip purposes reported different level of satisfactions. This is presumably because travellers have different needs and interests, thus they would display a different appreciation towards different determinant service attributes. To understand and to measure the impacts of each determinant factor in a more tangible and systematic way, multivariate analysis approach was adopted in this study.

A simple regression cannot be used in this case because the dependent variable, the overall journey satisfaction, is not a continuous variable. Multinomial logit and Ordered Logit models are the two most common models used to analyse individual selection over a specific set of choices. Multinomial logit assumes the probability of an individual choosing different choices following logistic distribution assumption but without any specific sequence/order, whilst ordered logit model assumes that the individual selection will follow a certain order. In this specific analysis ordered logit regression model is used. Given the fact that overall travel satisfaction is an ordinal variable, ranging from 1 (very unsatisfied) to 5 (very satisfied), ordered logit models was felt to be the most appropriate.

The reported "overall travel satisfaction" was used as the dependent variable. The explanatory variables used in the models reflect a combination of subjective well-being indices, travel modes and user groups, individual socio-demographics and the impact of different survey methods and location (as dummy variables of different cities).

It is important to remember that data gathered via smartphone applications was not identical with that collected via paper-and-pencil and on-line survey. The game app did not record travellers' socio-demographic and travel mode specific questions. The SbNavi app did record travel mode related questions, but it did not specifically ask individuals to identify themselves to which group of traveller they belonged to, but automatically assigned them with a specific questionnaire, based on the information provided. Consequently, in order to analyse the impact of individual socio-demographic, user groups, travel modes, subjective well-being and survey methods in terms of travel satisfaction, two different models were developed. The first model (M1) focused on analysing the influence of an individual's socio-demographic, travel duration, subjective well-being and chosen travel modes and user groups towards their overall travel satisfaction, and the second model (M2) focused on examining the impact of different survey methods, including the same variables as for Model 1 but, due to the data limitations, without individual travel mode and user group information[17]. Table 5 presents the estimation results of M1 and table 6 those of M2.

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[17] Given the differences in the data collection techniques and variables controlled in different survey methods, there is most likely significant scale heterogeneity across data sources. It is immensely important to control the scale heterogeneity in the modelling methods. Thus, we applied the generalized ordered logit model (e.g. Yasmin

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As can be seen from Table 5, in most cases gender, age, income, employment status and level of education were found insignificant in influencing the reported overall travel satisfaction of the respondents. FIA respondents were the exception with males more likely to report a lower satisfaction rate, and travellers above 65 years reporting a higher level of travel satisfaction compared to other age groups. The Vilnius younger travellers (24 years old or below) also reported a lower travel satisfaction than travellers from other age groups, while in Grevena, those aged between 45-64 years old reported higher.

In Dublin, lower income travellers reported higher travel satisfaction, whilst in Coventry and Vilnius, the highest educated (postgraduate, the reference group) travellers were the most dissatisfied.

The correlations between travel distance and trip frequency in terms of reported travel satisfaction were not clear. In Bucharest, Stockholm and Valencia, travel distance and trip frequency were not found significant. In other cities, there were tendencies toward a longer travel distance correlating with a lower reported travel satisfaction, except for longer (2-3 hours) trips in Coventry. Presumably this is due to the nature of the travel - more likely related to leisure trips, which have different time and mood constraints. Dublin, FIA, Grevena and Rome travellers reported lower travel satisfaction towards their route/daily travels, and experience of a disruption during journeys also negatively correlated with reported travel satisfaction.

In line with previous studies (Ettema et al., 2012; Friman et al., 2013), subjective well-being factors significantly correlated with the reported overall travel satisfaction. For example, being happy and satisfied with one's life positively correlates with reported travel satisfaction. Being awake corresponds with a lower travel satisfaction in Coventry and Grevena, but in Bucharest and Stockholm, it correlated with a higher travel satisfaction. Presumably this is because the differences in the local culture in terms of expectation, perceptions and mood consequences. Further investigation on this matter would be a possible future research direction of this study.

There were tendencies showing that the public transport modes correlated with a lower reported travel satisfaction than with other travel modes, although this was not consistent throughout the different trial sites. Tourists/visitors seemed to report a higher travel satisfaction, compared with other groups of travellers, except for tourists/visitors in Rome.

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and Eluru, 2013) to the whole dataset. The estimated indicators, however, show that it is not advised to apply a Generalized Ordered response model for our rich model specification and to the city-specific models, M1 and M2, since the sample for each city-specific models are not large enough. Therefore we only refer to the ordered logit regression model estimation results.

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Table 5: Estimation results for M1 model *only significant variables at 95% CI are shown in the table

Variables	Bucharest		Coventry		Dublin		FIA		Grevena		Rome		Stockholm		Valencia		Vilnius	
	Estim.	Sig.	Estim	Sig.	Estim	Sig.	Estim.	Sig.	Estim.	Sig.	Estim.	Sig.	Estim.	Sig.	Estim.	Sig.	Estim.	Sig.
Very to rather Diss.	-3.590	0.003	-6.811	0.000	-4.358	0.000	-4.249	0.000	-2.619	.054	-5.484	0.000	-4.736	0.000	-2.834	.122	-2.899	.156
Rather to nor Sat/Diss.	-1.994	.090	-4.931	0.001	-2.904	0.019	-2.797	0.000	-.646	.633	-3.331	0.000	-3.489	0.000	-.958	.546	-1.099	.570
Nor Sat/Diss. to rather Sat	.886	.449	-3.067	0.030	-.846	.491	-.814	.135	2.769	0.046	-1.156	.131	-1.288	.142	1.675	.279	2.687	.158
Rather Sat. To very Sat.	4.293	.0.000	-.347	.803	1.369	.265	1.500	0.006	5.214	0.000	1.479	.056	1.127	.198	4.530	0.004	5.948	0.002
Male							-0.388	0.005										
<24							-1.172	0.014									-3.433	0.013
25-44							-1.198	0.008										
45-64							-1.307	0.004	2.655	0.002								
Income below					0.747	0.043												
Income average																		
Less than high school															2.791	0.003		
High school			1.492	0.002											2.420	0.008		
Bachelor			1.511	0.000											2.020	0.028		
<10 min			1.826	0.030			0.732	0.028	4.104	0.007							3.113	0.025
11-30 min					1.212	0.013												
31-60 min					0.868	0.048			2.116	0.005	-1.463	0.002						
61-90 min									1.935	0.019	-1.724	0.000						
91-120 min											-2.186	0.000						
2-3 hours			3.047	0.005														
Daily					-0.950	0.004	-0.574	0.002	-1.739	0.037	-1.046	0.000						
Weekly									-2.443	0.000	-0.895	0.001						
Monthly									-1.357	0.021								
Disruption-Yes	-1.790	0.000	-1.484	0.000	-1.841	0.000	-1.088	0.000			-0.886	0.000	-1.547	0.000	-1.708	0.003		
No car									-2.106	0.003	-1.159	0.000						
One car																		
Partner/married																		
Single with children			2.748	0.009					-4.141	0.001							-2.418	0.011
Partner/married children																		
Other							0.849	0.000			-0.730	0.007						
Unemployed															-1.044	0.006		
Student																		
Other																		
Terraced/Detached/ Semidet. House			-1.538	0.016					1.452	0.016			0.567	0.024				
Small/Med. Building			-1.660	0.034														

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Table 5: Estimation results for M1 model (continued)

Variables	Bucharest		Coventry		Dublin		FIA		Grevena		Rome		Stockholm		Valencia	
	Estim.	Sig.	Esti.	Sig.	Estim	Sig.	Estim.	Sig.	Estim.	Sig.	Estim.	Sig.	Estim.	Sig.	Estim.	Sig.
Happy	1.543	0.000			0.674	0.014	0.710	0.000			0.846	0.000			0.733	0.050
Satisfied					1.255	0.000	0.550	0.000			0.917	0.000	0.681	0.006		
Active			1.430	0.000			0.292	0.027			0.500	0.009				
Alert							0.361	0.005	1.491	0.007						
Joyful	-0.974	0.003							1.480	0.028					0.813	0.028
Awake	0.643	0.043	-0.894	0.026					-1.130	0.039			0.495	0.031		
Start- Workplaces					0.498	0.042	0.315	0.023								
Finish- Workplaces			-0.839	0.024			0.407	0.001							-0.773	0.001
Area Live- Urban	1.267	0.021					0.458	0.000	1.865	0.009					1.096	0.018
TM Soft modes					-1.595	0.041										
TM PT Rail							-0.406	0.004			-0.651	0.002	-0.780	0.009		
TM PT Road					-1.286	0.017	-0.448	0.004			-1.088	0.000			-0.727	0.019
TM Other	-1.306	0.010													-3.138	0.038
UG Comm.Imp																
UG Low income																
UG Over 64									2.611	0.009						
UG Rural Dwellers									2.932	0.001	-0.869	0.019				
UG Visitors	2.277	0.001	1.241	0.036							-0.894	0.039			1.078	0.048
UG Commuters															-0.788	0.033
UG Under 24																
UG Other																
-2 Log Likelihood	**617.10**		**480.81**		**916.76**		**3051.35**		**390.42**		**1593.39**		**1099.89**		**812.84**	
Df	**51**		**51**		**51**		**51**		**51**		**51**		**51**		**51**	
Pearson Chi-square	**1422.76**		**940.27**		**1412.63**		**6202.54**		**785.08**		**4403.89**		**2129.70**		**1321.72**	
McFadden Ps. R2	**0.230**		**0.274**		**0.262**		**0.143**		**0.283**		**0.187**		**0.132**		**0.125**	
N	**320**		**243**		**398**		**1324**		**220**		**678**		**489**		**452**	

*Only significant variables at 95% CI are shown in the table

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Table 6: Estimation results for M2 model

Variables	Bucharest		Coventry		Dublin		Grevena		Rome		Stockholm		Valencia		Vilnius	
	Estim.	Sig.	Estim	Sig.	Estim	Sig.	Estim.	Sig.	Estim.	Sig.	Estim.	Sig.	Estim.	Sig.	Estim.	Sig.
Very to rather Diss.	-5.664	0.000	-7.008	0.000	-4.348	0.000	-4.468	0.001	-4.770	0.000	-4.621	0.000	-4.215	0.009	-1.394	0.373
Rather to nor Sat/Diss.	-3.989	0.000	-4.679	0.000	-2.856	0.003	-2.734	0.044	-2.553	0.000	-3.232	0.000	-2.072	0.139	0.105	0.943
Nor Sat/Diss. to rather Sat	-1.002	0.324	-2.713	0.024	-0.825	0.379	0.370	0.783	-0.432	0.532	-0.700	0.358	0.665	0.629	3.546	0.015
Rather to very Sat. Male	2.167	0.035	0.162	0.891	1.343	0.153	2.677	0.048	2.139	0.002	1.728	0.024	3.411	0.014	6.605	0.000
<24			-1.871	0.016												
25-44			-1.821	0.014	-1.228	0.046										
45-64			-1.557	0.038												
Income below							-1.393	0.046								
Income average																
< high school									0.747	0.045						
High school			1.190	0.008												
Bachelor			1.140	0.004												
<10 min			2.061	0.004			2.749	0.006							2.576	0.022
11-30 min					0.976	0.037										
31-60 min									-1.370	0.003						
61-90 min									-1.692	0.000	-1.132	0.039				
91-120 min									-2.244	0.000						
2-3 hours			2.907	0.005												
Daily					-0.819	0.012			-0.905	0.000						
Weekly							-1.571	0.011	-0.716	0.006						
Monthly			-1.324	0.035			-1.176	0.028								
Disruption-Yes	-1.752	0.000	-1.599	0.000	-1.964	0.000			-1.196	0.000	-1.596	0.000	-1.672	0.003		
No car			-0.915	0.027			-2.003	0.002	-1.469	0.000						
One car																
Partner/married																
Single with children			2.249	0.024	-1.769	0.039	-3.228	0.008								
Partner/married children																
Other									-0.887	0.001						
Unemployed													-0.643	0.049		
Student																
Other									0.408	0.047						
Terraced/Detached/ Semidet. House			-1.564	0.012			1.236	0.030			0.799	0.001				
Small/Med Building			-1.822	0.015												

*Only significant variables at 95% CI are shown in the table

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Table 6: Estimation results for M2 model (continued)

Variables	Bucharest		Coventry		Dublin		Grevena		Rome		Stockholm		Valencia		Vilnius	
	Estim.	Sig.	Estim	Sig.	Estim	Sig.	Estim.	Sig.	Estim.	Sig.	Estim.	Sig.	Estim.	Sig.	Estim.	Sig.
Happy	**1.424**	0			**0.654**	0.015			**0.953**	0	**0.48**	0.047	**0.81**	0.022	**0.753**	0.039
Satisfied					**1.173**	0			**0.861**	0	**0.729**	0.002			**1.673**	0
Active			**1.162**	0.002					**0.419**	0.027						
Alert							**1.405**	0.007							**0.818**	0.032
Joyful	**-0.817**	0.009											**0.789**	0.028		
Awake			**-0.878**	0.019			**-1.161**	0.023			**0.456**	0.032			**1.12**	0.003
Start_Workplaces																
Finish_Workplaces	**-0.624**	0.035	**-0.613**	0.08	**0.458**	0.039	**0.436**	0.3			**-0.348**	0.045	**-0.823**	0		
Area Live Urban													**0.891**	0.025	**0.965**	0.023
SatNav					**3.076**	0.012					**-0.556**	0.014				
Game app	**-1.901**	0.014	**-1.893**	0.005					**-2.844**	0	**-1.296**	0	**-2.622**	0		
Paper-based	**0.77**	0.045	**1.849**	0	**0.771**	0.003										
Focus groups	**-1.915**	0.002							**-1.274**	0						
-2 Log Likelihood	645.09		504.51		948.73		418.55		1639.96		1275.07		871.14		374.47	
Df	43		43		42		42		42		43		42		41	
Pearson Chi-square	1270.01		870.11		1416.36		736.25		4267.71		2401.62		1646.41		609.86	
McFadden Pseudo R-square	0.213		0.305		0.251		0.237		0.188		0.158		0.126		0.276	
N	329		261		406		220		697		575		472		212	

*Only significant variables at 95% CI are shown in the table

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In terms of survey methods, only Stockholm, Bucharest and Coventry had valid samples for all five survey methods (see Table 6). Overall, responses collected via the game app (and sbNavi in Stockholm) reported a significantly lower travel satisfaction than other survey methods. At the same time, paper-and-pencil methods responses reported higher travel satisfaction in Bucharest, Coventry, Dublin, and Rome. Survey methods were not found significant in influencing the reported travel satisfaction in Vilnius and Grevena. This may be due to the small sample size from these two sites. Focus group participants in Rome and Bucharest, however, reported a lower travel satisfaction than their fellow respondents.

5. Discussion and conclusion

Using 5,275 valid responses from eight European cities and five FIA national networks, this study examined factors that underlie travellers' door-to-door travel satisfaction and how different survey methods may influence the reported level of satisfaction among diverse groups of travellers. The travel satisfaction measurement survey tools tested consisted of two types of smartphone applications (a satellite navigation app and a game app), an on-line survey, a paper-based semi-structured questionnaire and a focus group.

The results showed that the travel satisfaction reported by different survey methods and different 'travel mode users' correlate with different key determinants. The relationship between and within these key determinants, however, was far from straight forward. For example, many policy makers believe that parking provision is important for the satisfaction of the door-to-door journey of car travellers. But the results show that private car users' overall travel satisfaction was more directly correlated with the availability and visibility of travel related information. Thus, the most frequently discussed issues, such as parking availability, security, and disruption-related information correlated with the availability and visibility of travel related information, but not directly with the car users' overall travel satisfaction.

The results also showed that the chosen survey method does influence the reported level of travel satisfaction. Furthermore, the satisfaction that was gathered on the main trip leg does not necessarily correspond with overall satisfaction of the door-to-door journey. This highlights the need for more consideration when using national journey travel satisfaction (e.g. Swedish public transport annual barometer, Passenger Focus' annual satisfaction report, etc.) which mostly focus on specific (often single) travel modes and trip legs. In the age of privatisation, these reports were used to evaluate the performance of the public transport provider, thus an incomplete picture of the passenger travel satisfaction may lead to unfair judgment of the operator's performances. The results also showed that travellers' experience in interchanges and with infrastructure systems, in most cases, matter more than the ride quality on the main trip leg.

Surveying door-to-door travel satisfaction with different survey methods, however, was not without concerns. In addition to the complexity of measuring and analysing dynamic, door-to-door, multimodal, travel satisfaction, without asking the travellers to validate their data, it became hard to define the ground of truth (which devices/methods would be referred as the truth). On the other hand, using various different methods opened up different opportunities, e.g. measuring the impacts of multimodal and interchanges planning and design, in real time, towards the users' appreciations and needs, which would be very difficult with traditional paper-and-pencil surveys. Nevertheless, special needs travellers were more receptive towards focus group-like methods. Real-time measurements, such as those provided by the game app and sbNavi, require a consistent data connection and high end technology which for some countries are still luxuries. It was apparent from the survey feedback that - despite a surge in technology adoption and penetration in Europe in terms of smartphones in the last several years - the acceptance of a smartphone app as a survey tool is still very low and uneven between user groups and countries. There were also significant privacy and data protection concerns among

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potential respondents (e.g. in Rome) in terms of installing an app coming from an unknown source.

The next step will involve further detailed examination of the impact of trip leg complexity, and an investigation of familiarity and uncertainty in relation to trip satisfaction. Structural equation modelling will be used to examine traveller satisfaction for each trip leg, the nature of the trip purpose and also the experience of access and egress during trip legs. Further analyses on the focus groups results, especially among various groups of travellers with special needs, will also be a future step of this study.

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References

Abenoza R.F., Cats O. and Susilo Y.O. (2017) Travel satisfaction with public transport: determinants, user classes, regional disparities and their evolution. *Transportation Research Part A: Policy and Practice*, 95, 64-84.

Alfonzo, M.A., (2005) To Walk or Not to Walk? The Hierarchy of Walking Needs. *Environment and Behavior*, 37 (6), 808-836.

Andrews, G., Parkhurst, G., Susilo, Y.O. and Shaw, J. (2012) 'The Grey Escape': How and why are older people using their free bus passes? *Journal of Transport Planning and Technology*, 35 (1), 3-15.

Banister, D. and Bowling, A. (2004) Quality of life for the elderly: the transport dimension. *Transport Policy*, 11, 105–115.

Belisario, M., Jamsek, J., Huckvale, K., O´Donoghe, J., Morrison, C.P., Car, J. (2015) Comparison of self-administered survey questionnaire responses collected using mobile apps versus other methods. Cochrane database of systematic reviews, Vol 7: MR000042.

BMRB Social Research (2004) Department for Transport Omnibus Survey - October 2003. Department for Transport.

Cantwell, M., Caulfield, B. and O'Mahony, M. (2009) Examining the Factors that Impact upon Public Transport Commuting Satisfaction. *Journal of Public Transportation*, 12 (2), 1-22.

Cats, O., Abenoza, R.F., Liu, C. and Susilo, Y.O. (2015) Evolution of Satisfaction with Public Transport and Its Determinants in Sweden: Identifying Priority Areas. *Transportation Research Record*, 2538, 86–95.

Cats, O., Susilo, Y.O., Hrin, R., Woodcock, A., Diana, M., Speicytee, E., O'Connell, E., Di Majo, C., Tolio, V., Bellver, P. and Hoppe, M. (2014) An Integrated Approach to Measuring the Whole Journey Traveller Experience. *Transport Research Arena* 2014, Paris.

Clifton, K.J. (2003) Examining Travel Choices Of Low-Income Populations: Issues, Methods, and New Approaches, paper presented at the *10th International Conference on Travel Behaviour Research*, Lucerne, August 2003.

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Findings from measuring door-to-door travellers' travel satisfaction with traditional and smartphone app survey methods in eight European cities

DfT. Department for Transport (2011) Personal Travel Factsheet: Commuting and Business Travel. UK Department for Transport, London.

Diana, M. (2008) Making the "primary utility of travel" concept operational: a measurement model for the assessment of the intrinsic utility of reported trips, *Transportation Research Part A*, 42, 455-474.

Ettema, D.F., Friman, M., Gärling, T., Olsson, L.E. and Fujii, S. (2012) How in-vehicle activities affect work commuters' satisfaction with public transport. *Journal of Transport Geography,* 24, 215-222.

Eurobarometer (2013) Europeans' Satisfaction with Rail Services, Flash Eurobarometer 382a, TNS Political and Social, European Commission, December 2013.

Farquhar, M. (1995) Elderly people's definitions of quality of life. *Social Science and Medicine*, 41, 1439–1446.

Fillenbaum, J.E. (1985) Screening the elderly: a brief instrumental activities of daily living measure. *Journal of the American Geriatrics*, 33, 698-706.

Friman, M., Fujii, S., Ettema, D., Gärling, T., and Olsson L. E. (2013) Psychometric analysis of the satisfaction with travel scale. *Transportation Research Part A*, 48, 132-145.

Friman, M., Gärling, T. (2001) Frequency of negative critical incidents and satisfaction with public transport services. II. *Journal of Retailing and Consumer Services*, 8, 105–114.

Giuliano, G. and Narayan, D. (2003). *Another look at travel patterns and urban form: The US and Great Britain.* Carfax Publishing.

Hine, J. and Mitchell F. (2003) *Transport Disadvantage and Social Exclusion, Exclusionary Mechanisms, in Transport in Urban Scotland*, Ashgate Publishing Limited, England.

Iseki, H., Ringler, A., Taylor, B.D., Miller, M., and Smart, M. (2007) Evaluating Transit Stops and Stations from the Perspective of Transit Users. Report to California Department of Transportation, Division of Research and Innovation, Sacramento, CA.

Jakobsson-Bergstad, C., Gamble, A., Hagman, O., Polk, M., Gärling, T. and Olsson, L.E. (2011) Affective-symbolic and instrumental-independence psychological motives mediating effects of socio-demographic variables on daily car use. *Journal of Transport Geography*, 19, 33-38.

Marottoli, R.A., Mendes, C.F., Glass, T.A., Williams, C.S., Cooney, L.M., Berkman, L.F. and Tinetti, M.E. (1997) Driving cessation and increased depressive symptoms: prospective evidence from the new haven EPESE. *Journal of American Geriatrics Society*, 45, 202-206.

METPEX (2013) Identification of user requirements concerning the definition of variables to be measured by the METPEX tool (Deliverable 2.3 of the METPEX project), EU Commissions.

METPEX (2014) Report on survey and data collection processes at each location (Deliverable 4.1 of the METPEX project), EU Commissions.

Muconsult (2003) De Kwaliteitsbeleving van de Reis Met de Trein. Fase 2: Kwantitatief Onderzoek (Quality Experience of a Train Journey. Phase 2: Quantitative Research (Stated Preference). Netherlands: Internal Publication Netherlands Railways.

Ory, D.T., Mokhtarian, P.L. When is getting there half the fun? Modeling the liking for travel. *Transportation Research Part A*, 39 (2), 97-123.

Páez A. and Whalen, K. (2010) Enjoyment of commute: A comparison of different modes, *Transportation Research: Part A*, 44, 537-549.

Pedersen, T., Friman, M. and Kristensson, P. (2011) The role of predicted, on-line experienced and remembered satisfaction in current choice to use public transport services. *Journal of Retailing and Consumer Services*, 18, 471-475.

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Steg, L. (2005) Car use: lust and must. Instrumental, symbolic and affective motives for car use. *Transportation Research Part A*, 39, 147-162.

Stradling, S., Anable, J., Carreno, M. (2007) Performance, importance and user disgruntlement: a six-step method for measuring satisfaction with travel modes. *Transportation Research Part A*, 41, 98–106.

Susilo, Y.O. and Cats, O. (2014) Exploring Key Determinants of Travel Satisfaction for Multi-Modal Trips by Different Travellers' Groups. *Transportation Research A*, 67, 366-380.

Susilo, Y.O., Cats, O., Diana, M., Hrin, G.R., Woodcock, A. (2015) Implementing a behavioural pilot survey for the stage-based study of the whole journey traveller experience. Transportation Research Procedia, 11, 172 – 184.

Susilo, Y.O., Lyons, G., Jain, J. and Atkins, S. (2012) Great Britain Rail Passengers' Time Use and Journey Satisfaction: 2010 findings with multivariate analysis. *Transportation Research Record*, 2323, 99-109.

Susilo, Y.O., Woodcock, A., Liotopoulos, F., Duarte, A., Osmond, J., Abenoza, R.F., Anghel, L.E., Herrero, D., Fornari, F., Tolio, V., O'Connell, E., Markucevičiūtė, I., Kritharioti, C. and Pirra, M. (2017) Deploying traditional and smartphone app survey methods in measuring door-to-door travel satisfaction in eight European cities. Forthcoming at the Transportation Research Procedia.

Tovey, M. Woodcock, A. and Osmond, J (eds) (2017). *Designing mobility and transport services: Developing traveller experience tools*, Routledge, London

Tranter, P. (1995) Behind closed doors: women, girls and mobility. Paper presented at the *Women and Transport Conference*, Adelaide.

Van de Looij-Jansen, P.M. and De Wilde, E.J. (2008) Comparison of Web-Based versus Paper-and-Pencil Self-Administered Questionnaire: Effects on Health Indicators in Dutch Adolescents. *Health services research,* 43 (5), 1708-1721.

Van Hagen, M. (2015) Effect of Station Improvement Measures on Customer Satisfaction. *Journal of Traffic and Transportation Engineering,* 3, 7-18.

Wells, T., Bailey, J.T., Link, M.W. (2014) Comparison of smartphone and online computer survey administration. *Social Science Computer Review*, Vol. 32, 2, 238-55.

Wiersma, W. (2013). *The validity of surveys: Online and offline*. Oxford Internet Institute.

Yasmin, S. and Eluru, N. (2013). Evaluating alternate discrete outcome frameworks for modeling crash injury severity. *Accident Analysis and Prevention*, 59, 506-521.