Motivating the Use of Real-Time Multimodal Travel Planners: The Role of Users Perceived Value, Technophile and Place Attachment

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1. Case study

A new advanced real-time multimodal travel planners, we called it here "iGo", is under investigation for Lisbon traffic management enhancement. The idea behind the system is to integrate traffic information and journey planning to include all modes of transport. This system will incorporate real-time information about traffic, public transport, congestion, available car parking spaces, as well as weather, air pollution etc. Furthermore, "iGo" provides the users with information about CO2 emissions produced/saved by taking different travel options and the amount of calories burnt by taking active modes. It is also possible to monitor CO2 savings and calorie performances over time. "iGo" enables its users for registration to an environmental friendly loyalty program: "the more environmental-friendly itinerary they take, the more bonus points they earn". The bonus points can be used to get some free services (through vouchers) or public transport tickets. Furthermore, the collected bonus points and travel information could be shared on social media. For the registration, people need to create a user account, provide the system with some personal information, and allow the system to record their travel behaviour. Table 1 presents and categorizes the functionalities of the new travel planner with regard to the travel mode. Those functionalities are accessible through a mobile application.

TABLE 1. The multimodal travel planner application functionalities

Travel mode	Functionalities
All modes	Travel time and cost of travel options
	Creating a customized personal account
	Navigation app
	Weather information
	CO2 emissions information on average based on distance and travel mode
	Loyalty program registration
Car	Traffic disruption alerts and proposed alternative routes
	Parking space availability, booking and payment
Public transport	Location of public transport stands and stations
	Available seats on public transport
	Booking seats for your trip by public transport
	Public transport ticket payment
	Public transport tracking (Find out when bus/train arrives at the bus stop/train station)
Active modes	Electric / conventional bike availability, booking and payment

The solution is envisioned to create a better transportation experience for users through intrinsic value. The value could be classified into three categories: "DO & FEEL BETTER" –by increasing the trip efficiency in terms of travel time and time/effort to look for information, "BE BETTER"- by promoting more environmental friendly travel behaviour and "LOOK BETTER" – by sharing travel information as symbols to communicate meanings about themselves to others and gaining social recognition. To the City of Lisbon, the new system will provide a better traffic and pollution monitoring and forecast information and a future possibility to implement traffic management rules to reduce congestion and pollution. The implementation of the new system is also anticipated to support a larger adoption of sustainable mobility choices by urban travellers.

2. Research objectives and theoretical framework

A deeper understanding of individual's tendency to use and consult with ATIS is a main contribution to develop these systems and consequently to promote change to sustainable mobility decisions, behaviourally. The present study aims at identifying the driving forces behind individual decision to use a travel planner in which nudge principals are integrated. We look through the lens of psychology and social science to understand individuals' attitudes, values or motivation towards the acceptance and usage of "iGo". We argue that individual motives including perceived values developed by using the system and technophile attitude as well as the social dynamic outside the system condition are important determinants for its acceptance and adoption. The main contribution of this study is to better explain user-sided heterogeneity observed in individual behaviour, and to effectively evaluate this technology for possible adoption. How ATIS have an influence is highly dependent on how users interface with the system. Noticeably, this process is not distinctly technological, but has a social dimension, which forces a socio-technical evaluation (Gotzenbrucker and Kohl, 2011). Specifically, we focus on the question "how do user's perceived values, affinity to information systems, and place attachment affect the use of the new advanced real-time multimodal information system?"

Past research ascribes the effectiveness of ATIS on mobility behaviour to user specific inclination to accessing travel information. Searching for and acquiring new information is inhibited by habits (Kenyon and Lyons, 2003; Verplanken and Woods, 2006), thereby counteracting individual use of ATIS. There is a lack of understanding about which support travellers need for information due to, for instance, user-sided heterogeneity observed in individual mobility behaviour. We address this issue by investigating individual perceived values associated with using "iGo" for daily commute. We hypothesized that there are different dimensions of perceived values for using "iGo" (i.e. "DO & FEEL BETTER", "BE BETTER" and "LOOK BETTER") and each of them uniquely contribute to the explanation of its adoption

Affinity for technology, hereafter technophile, can be critical for the marketing of the new information system and its future usage. Previous studies showed the potential target groups for technological innovations (e.g. electric bike and electric vehicles) are among people who are technophiles (Turrentine et al., 2011; Hackbarth and Madlener, 2016). Therefore, we examined how technology affinity predicts the adoption of "iGo".

Place attachment is another factor often assumed to have an effect on citizens' propensity to involve in cooperation action and positive change in local community. Place attachment is widely viewed as an important part of human identity and an affective bond between people and places. A greater understanding of people's emotional connections with place may provide a better understanding of people's motivations, reactions to, and participation in local community-based action (Manzo and Perkins, 2006; Amundsen, 2015). We hypothesized that place attachment plays a significant role in the adoption of the new information system. Figure 1 describes the conceptual model.

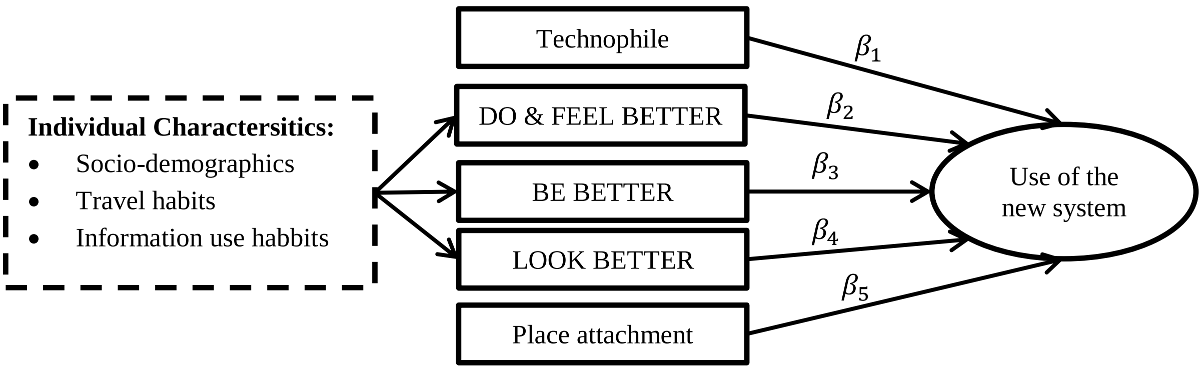

FIGURE 1. Conceptual model on motivations to adopt the information system

3. Data collection

A technology-use preference survey was designed to collect data for the analysis while translate the behavioural framework into a concrete framework that can be empirically validated. We collected the data in Lisbon via academic and social networks targeting 227 people. The survey elicits various groups of explanatory variables. The first group consists of socio-economic information (e.g., age, gender, income, education, family status, and, place of residence) and current travel habits (e.g., habitual travel mode and travel information use habit). The second group comprises of the three distinct perceived values that motivate travellers to use "iGo" as well as technology-related self-concepts of technophile. The last groups contain the items corresponds to place attachment construct in the context of transport-related projects. Table 2 lists the items related to attitudinal constructs including their means and standard deviations as well as the internal consistencies of the constructs.

TABLE 2. Psychological constructs and their indicators

Latent variables		Indicators	M	SD	Alpha
Technophile	TPH1	I usually like to install interesting new apps	3.92	0.85	0.8
	TPH2	I regularly use apps for payments, reservations, errands etc.	3.42	1.17	
	TPH3	I am enthusiastic about GPS and travel apps	3.72	1.05	
	TPH4	I think it is exciting to try new apps	3.47	0.94	
Using the new travel information system will help me to …			M	SD	Alpha
DO & FEEL BETTER	DFB1	reduce my travel time	3.48	1.04	0.89
	DFB2	be on time	3.53	0.99	
	DFB3	be faster and more efficient trip	3.74	0.95	
	DFB4	get customized information about my preferred trips	3.69	0.91	
	DFB5	reduce time spend /difficulty for travel information search	3.67	0.95	
	DFB6	choose my travel mode according to departure/arrival time	3.47	1.18	
BE BETTER	BB1	cycle more	2.27	1.08	0.80
	BB2	use car-sharing more	2.24	1.03	
	BB3	make healthier/greener choices	2.93	1.10	
LOOK BETTER	LB1	be rewarded with bonus points for eco-friendly behaviour	3.28	0.98	0.77
	LB2	monitor amount of calories burnt while travelling	2.97	1.053	
	LB3	share information with other users	3.19	1.067	
	LB4	share my saved CO2 emissions because of my environmentally friendly behaviour on the social media	2.45	1.13	
Interaction between authorities and residents in Lisbon area			M	SD	Alpha
Place Attachment	PA1	Participating in transport-related test projects in my city is important to me	3.84	0.79	0.84
	PA2	Knowing more about new travel apps in my city is important to me	3.99	0.75	
	PA3	Knowing more about how to make my city sustainable is important to me	4.07	0.74	

Notes: All indicator statements were measured based on a 5-point Likert scale (1 = strongly disagree; 5 = strongly agree).

4. Methodological approach

The questionnaire items and the observed individual characteristics lead to the formulation of a Bayesian structural equation model (BSEM) to test the hypothesized behavioural framework. Since Bayesian methods are better equipped to model data with small sample sizes (McNeish, 2016), we used this approach to analyse the dataset and address the small sample problem. We also compared two different BSEMs .In the first model there are zero cross-loadings and the residual covariance matrix is assumed to be diagonal while in the second model, we consider a prior with mean zero and a normal distribution with small variance for cross-loadings. Furthermore, the residual covariance matrix is not diagonal. To evaluate model quality, Posterior Predictive P-Value (PPP) for model assessment, and Deviance Information Criterion (DIC) for model choice were used. Model fit in the Bayesian context relates to assessing the predictive accuracy of a model, and is referred to as posterior predictive checking (Gelman et al., 2014). The general idea behind posterior predictive checking is that there should be little, if any, discrepancy between data generated by the model and the actual data itself. An excellent fit is characterized by a PPP of 0.5. However, Muthen and Asparouhov (2012) suggest that a PPP of 0.05 is a reasonable indicator of acceptable fit. DIC is a Bayesian generalization of the Maximum Likelihood AIC and BIC. The goal of the DIC is to compare candidate models with respect to their ability to predict new data of the same kind. DIC does not provide an absolute criterion for model fit but it is used to compare competing models. The model with the lower DIC should be preferred. In this study, the models were estimated using the BAYES estimator in MPlus.

4. Results

Table 3 shows the fit results of the two BSEMs mentioned above. Model 2 is preferred since it provides an acceptable PPP of 0.051 and a lower DIC. CI stands for confidence interval. The remaining tables are based on the estimate of Model 2.

TABLE 3. Model fit statistics

Model	95% Confidence Interval for the difference between the observed and the replicated Chi-Square values		PPP value	DIC
	Lower CI	Upper CI		
Model 1: BSEM with zero cross loadings	350.817	486.521	0.000	11676
Model 2: BSEM with cross loadings and residual covariance	-13.918	131.978	0.051	11434

Table 4 displays the estimates of the measurement equations of the latent variables plus the latent variables correlation matrix from Model 2. In Table 4, values in bold indicate major loadings which freely estimated using the uninformative priors i.e. the Default priors in Mplus. Asterisks indicate 95% credibility interval does not contain zero.

TABLE 4. Estimates of the measurement equations and the latent variables correlation matrix

	Technophile	DO & FEEL BETTER	BE BETTER	LOOK BETTER	Place attachment
TPH1	1	0.073	0.010	-0.013	-0.004
TPH2	**0.998***	0.077	-0.037	0.004	0.005
TPH3	**1.046***	0.180*	0.051	-0.059	0.035
TPH4	**0.97***	0.150	0.071	0.075	-0.025
DFB1	0.102	1	-0.001	-0.077	0.019
DFB2	-0.002	**1.063***	-0.004	-0.058	-0.036
DFB3	-0.054	**1.086***	0.000	-0.042	-0.026
DFB4	0.132	**0.732***	-0.03	0.153	0.113
DFB5	-0.045	**0.836***	-0.022	0.180*	-0.004
DFB6	-0.092	**0.847***	0.157*	-0.021	-0.045
BB1	0.032	-0.117	1	-0.022	-0.013
BB2	0.044	-0.004	**0.785***	-0.094	0.063
BB3	-0.074	0.224*	**0.461***	0.150	-0.007
LB1	-0.024	0.006	-0.008	1	0.081
LB2	0.069	0.032	0.072	**1.036***	-0.093
LB3	-0.016	0.226*	-0.041	**0.651***	0.019
LB4	0.003	-0.102	0.139	**0.786***	0.013
PA1	-0.043	-0.017	0.065	-0.009	1
PA2	0.122	0.164	-0.04	-0.081	**1.032***
PA3	-0.105	-0.052	0.083	0.136	**0.812***
Latent variable correlation matrix					
Technophile	----				
DO & FEEL BETTER	0.016	----			
BE BETTER	0.100	0.321*	----		
LOOK BETTER	0.126	0.259*	0.251*	----	
Place Attachment	0.138	0.123	0.229*	0.212*	----

Table 5 displays the relationship between the perceived value dimensions and respondents characteristics. In this table, PPI stands for posterior probability interval.

TABLE 5. Estimates of the structural equation linking the perceived values to individual and commute characteristics

DO & FEEL BETTER	Estimate	Posterior S.D.	95% PPI
Car use frequency	0.096	0.032	(0.035)-(0.160)
Transit use frequency	0.057	0.033	(0.001)-(0.120)
Frequency of information acquisition for traveling by car	0.142	0.045	(0.058)-(0.233)
Frequency of information acquisition for traveling by transit	0.117	0.045	(0.031)-(0.208)
BE BETTER	Estimate	Posterior S.D.	95% PPI
Active mode use frequency	0.109	0.037	(0.037)-(0.183)
Frequency of information acquisition for traveling by active modes	0.415	0.098	(0.225)-(0.610)
LOOK BETTER	Estimate	Posterior S.D.	95% PPI
Male	-0.211	0.101	(-0.414)-(-0.017)

"DO & FEEL BETTER" relates positively to higher transit and car use, while "BE BETTER" is associated positively with higher cycling and walking frequency. Individuals who commute more often with public transit value the usefulness of "iGo" to improve their daily trip efficiency. It therefore appears that the supply oriented nature of public transit induces a lack of knowledge for trips, for instance, due to the problems with reliability and punctuality performance. Regular active mode users, who are already taking eco-friendly travel option, appear to value the system usefulness to promote environmental friendly travel behavior. Whereas, it is not favorable to frequent car commuters which "iGo" is meant to target in order to promote more sustainable mobility behavior.

The perceived value of "iGo" adoption is influenced by travel information use habits. "DO & FEEL BETTER" positively relates to individuals who use travel information frequently for car and public transit commute trip, while "BE BETTER" associates positively to higher frequency of information acquisition for travelling by active modes. It suggests that the former group already uses available travel information sources for the sake of trip efficiency improvement. It is an important travel need, and therefore, they perceived "iGo" as a new source to satisfy such need. On the other hand, the latter group does not see it as an important need as the former group does for daily commute.

In opposite to male, female show favourable evaluations about the system attributes reflecting "LOOK BETTER", indicating a gender difference in the perceived advantages of the symbolic attributes of the system, whereas the result dos not show any difference in terms of "DO & FEEL BETTER" as well as "BE BETTER". Although there is no straightforward answer, the intuition behind this result can be explained by gender differences in reflected appraisal. It is a source of self-esteem describing a person's perception of how others see and evaluate him or her. Since females attach greater importance to reflected appraisals than do males (Schwalbe and Staples, 1991), the symbolic attributes of "iGo" such as receiving feedback, being rewarded and showing off their quality for eco-friendly behaviour are perceived more importantly.

Table 6 shows the relationship between technophile, three dimensions of perceived values and place attachment constructs and the adoption of "iGo" according to Figure1. The results show that using "iGo" relates positively with participants, who are technophile, put more value and importance on the quality of the system for trip efficiency and show responsible behaviour to involve in transport related local issues and community planning (i.e. place attachment).

TABLE 6. Estimates of the structural equations relating the adoption of "iGo" with the latent constructs

Using "iGo"	Estimate	Posterior S.D.	95% PPI
Technophile (β_1)	0.240*	0.110	(0.025)-(0.455)
DO & FEEL BETTER (β_2)	0.437*	0.106	(0.240)-(0.656)
BE BETTER (β_3)	0.038	0.084	(-0.126)-(0.204)
LOOK BETTER (β_4)	-0.203	0.121	(-0.450)-(0.029)
Place attachment (β_5)	0.158*	0.096	(0.006)-(0.310)

Greater use of “iGo” correlates positively with stronger technophile. It indicates that the system attributes and functionalities should be designed aligned to the needs of both groups of technophiles and technophobes. On one hand, the entry threshold for unwilling users should be lowered and on the other hand, tech-lovers should be appealed. The system features should be simple, easily understandable and accessible by everyone, irrespective of the technology affinity. In order to attract technophiles, the system can either offer sophisticated services or provide them with the possibility of participatory design.

The results show that search time/effort and travel time savings are the motivational factors driving commuters to use “iGo”. This result is compatible with previous studies presenting that the information attributes which increase trip efficiency in terms of time and effort are the most desired since those type of information make traveling ‘easier’ (Grotenhuis et al., 2007; Wirtz and Jakobs, 2013). The implementation of the system does not promote sustainable travel behaviour in a daily basis by means of modal shift and the selection of greener travel modes. The ineffectiveness of “iGo” to support modal shift can be attributed to strong habitual mobility behaviour which hider modal shift. The information can play a role in shifting modes only if it becomes meaningful enough to provide users with significant reasons to break away from their routine. Furthermore, the symbolic attributes of “iGo” i.e. information sharing and being rewarded do not encourage the participants to use the system. The reasons could be several; arguably travel information sharing features of the system did not match the expectations of the participants (e.g. collected bonus points or CO2 saved are not of importance to others), the offered incentives are not of interest and, the perceived difficulties of using the system outweigh its perceived value (e.g. battery consumption due to running the app, loyalty program registration, privacy concern etc.).

Higher “Place attachment” relates positively to the adoption of “iGo”, suggesting that individuals, who have higher feeling of place attachment, put more value and importance on the new travel information system. For people with higher “Place attachment”, the city is significant and their identity and values are connected with the place. Therefore their affective bonds with the place develop a positive evaluation of the usefulness of the new information system, which in its future implementation will improve the city's quality of life. This result indicates the importance of the public engagement to achieve the goals of implementing the new information system.

5. References

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