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► **To cite this version:**

Sophie Dantan, Julie Bulteau, Isabelle Nicolai. Hurried or Risk-adverse Travelers: who will Pay More for Multimodal Information?. *Procedia Engineering*, 2015, Toward integrated modelling of urban systems, 115, pp.61-68. 10.1016/j.proeng.2015.07.355 . hal-01710058

HAL Id: hal-01710058

<https://hal.science/hal-01710058v1>

Submitted on 15 Feb 2018

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Symposium “Towards integrated modelling of urban systems”

Hurried or risk-adverse travelers: who will pay more for multimodal information?

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Abstract

By enabling the use of multimodal information by travelers, public policy can improve the use of soft travel modes and reduce the negative externalities of car use. However, such an eco-innovative multimodal information platform might only be efficient if travelers are willing to use it and pay for its development and update. To evaluate the relevance of the creation of a multimodal platform in the *Plateau de Saclay* – an area located 20 km south of Paris, very concerned by congestion – this paper measures workers' willingness to pay (WTP) for such a platform from a survey conducted in this area. A multinomial logit with unobserved heterogeneity is estimated to determine marginal WTP for the services that could potentially be provided by the platform. The respective effects of risk aversion and value of travel time on this marginal WTP are also investigated. Some gender differences in the evaluation of the platform and its trip planning are also apparent: men's WTP increases with their value of travel time and decreases with their risk aversion while women's WTP is mainly influenced by the constraints they may face when commuting

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Peer-review under responsibility of LET

Keywords: multimodal information; sustainable mobility; willingness to pay; stated preference modeling; risk aversion; value of travel time;

1. Introduction

The emergence of “big data” enables real-time information to be provided on the availability and frequency of several transport modes (public transportation, carpooling, electric car sharing) and thus new travel information systems to be built, enhancing the use of sustainable modes. In fact, previous research underlines that the provision

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of travel information can induce such changes when it is considered reliable by users ([9], [2]). The probability of mode or route change is also higher among young male travelers when the journey is long or subject to unexpected congestion (see [2],[3],[4],[11],[17]). Such an innovation is likely to enhance a modal shift from the car to sustainable modes. The provision of multimodal information constitutes an eco-innovation in the sense that it can increase changes in mode or route choice that reduce car use and/or the negative environmental externalities induced by traffic congestion. Moreover, a need for multimodal information has been highlighted by previous research ([14]). The perceived availability and quality of the alternative modes appear to be the main determinants of the potential modal shift ([9], [5]; [1]).

A multimodal platform would thus constitute an eco-innovation based on the provision of options. Building and updating such an information platform could then be funded not only by public and/or private investments but also by the potential users themselves, who could be asked to make a financial contribution for using the services. Thus, the present paper questions the relevance of providing such an innovation to travelers and of funding its services by the users. In particular, it measures the potential users' willingness to pay (WTP) and their motives for using multimodal travel information systems.

Previous research on WTP for transport information delivered by phone ([18], [20], [7], [22]) or by web-application ([13]) suggests that travelers' WTP for travel information is very low, particularly among public transport users. Transit users are less likely to pay for the provision of multimodal information since they consider it covered by their fare ([14]). However, this research also shows that WTP strongly increases when real-time and accurate information is provided or when some additional trip-planning options are offered. Some heterogeneity in WTP by gender and by age has also been pointed out: young travelers have a greater willingness to pay for travel information, which might reflect their stronger technology-oriented habits. Similarly, men have a higher WTP.

The originality of this paper is twofold: (i) the importance of real-time and trip-planning options regarding WTP was determined and tested on a sample of 398 commuters in the Plateau de Saclay, an area located 20 km south of Paris. Stated preference models were estimated to evaluate their WTP for an innovative multimodal information system; (ii) a detailed analysis was carried out using the travelers' value of travel time (VOT) and risk aversion and their effects on WTP.

Section 2 describes the data and presents the estimation strategies that were implemented to measure travelers' WTP for such a platform. Section 3 presents and discusses the results obtained from our estimations. Section 4 concludes about the relevant variables to take into account to help transport policy-makers implement a multimodal information platform.

2. Survey data

In order to estimate travelers' WTP for multimodal travel information and to disentangle their motives for paying, a web-based survey of the staff of the University of Versailles-Saint-Quentin was conducted. An advantage of this choice of sample is that the university is located in four towns of the Plateau de Saclay area, so that the residences and workplaces of the respondents differ enough to ensure sufficient variability of the travel behaviors. By contrast, the levels of education and occupations vary less and are higher than in the average French population (40% of the respondents have a PhD) due to both the particular activity of a university and the fact that the Plateau-de-Saclay is an area devoted to research and industrial activity. This feature of our sample might enable the WTP of a rather educated population for a multimodal platform to be measured but may prevent the effect of education and occupation on WTP from being assessed (not enough variability). For this reason, our research focuses on the effect of other individual characteristics.

The first part of the survey collected individual characteristics such as gender, age, size of household, residential and work locations while the second part surveyed travel habits and preferences. In the third part of the survey, travelers' interest in a potential multimodal information platform was investigated.

To do so, a hypothetical platform was described to the respondents: it was assumed to provide itineraries for any origin-destination requested by users, with all available modes. Users would also be able to obtain reservations or real-time information on the availability of bicycle-sharing, car-sharing, car-pooling and parking solutions. The access to this platform would be available on a smartphone or a dedicated machine in train stations. After the description, respondents were asked to indicate their interest in the platform and, more accurately, in some benefits

that it could provide. The replies reveal that 52% of the sample are rather interested and 18% are very interested while only 18% are rather uninterested and 12% are not interested at all.

Obtaining real-time information appears the main motive for using this hypothetical platform since 80% of the sample are rather interested or very interested in such a benefit. 62% are interested in achieving savings thanks to the platform and 65% in preserving the environment. By contrast, less than 40% are interested in locating services along their itinerary. Then, respondents' WTP was measured directly by asking them to indicate the maximum amount they were willing to pay to fund the platform and thus obtain access to it. They answered by choosing from eight levels of WTP. Figure 1 **Erreur ! Source du renvoi introuvable.** shows that 60% of the sample are willing to pay for the platform: 45% would pay from 0.10€ to 5€ while 15% would be willing to pay more.

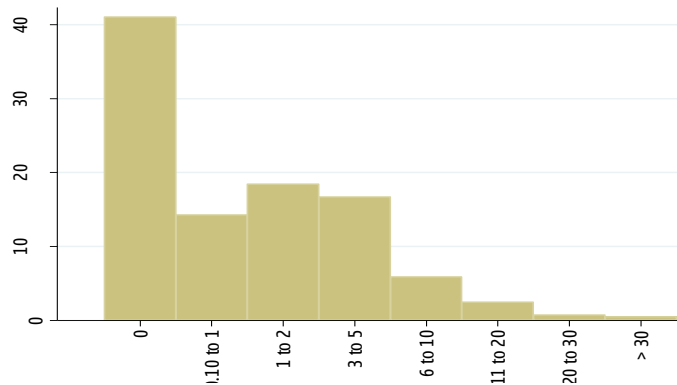


Figure 1 Willingness to pay for access to the multimodal platform (in €/month)

Respondents with a zero-willingness to pay were asked to indicate why (Figure 1 **Erreur ! Source du renvoi introuvable.**). Some of them chose several motives. The main motive for unwillingness to pay (25%) is that respondents do not feel concerned by such a platform. By contrast, less than 15% consider the platform useless or unaffordable, or need more information to judge.

Table 1: Stated motives for unwillingness to pay

I'm not willing to pay because	% of "Yes"
"I don't feel concerned"	27.0
"Some similar free information already exists"	24.6
"I already have a season ticket for transport"	20.4
"I'm not the one who should pay"	19.2
"I don't want to pay for an application"	19.2
"I don't want to pay for information"	16.8
"This platform is useless"	15.0
"I don't have enough information to judge"	13.2
"I can't afford paying"	12.6

Other stated motives indicate that unwilling respondents consider that multimodal information must be provided free or be paid for by someone else. Consistently, when asked who should pay for the provision of the multimodal platform (Table 2), less than 18% of the unwilling respondents designate private car users, against 29% of those who are willing to pay for the platform. Similarly, 13.5% of the former think that public transport users should pay, against 21.1% of the latter. Divergences also appear concerning the possibility of funding the platform by advertising: 57% of unwilling travelers would accept advertisements being displayed on the platform to fund it against 69% of the willing respondents. Institutional funding is more consensual: about 50% of the sample agrees

that transport or public organizations should pay for a multimodal platform and about 30% think that private firms should also contribute to funding it. Once again, respondents could choose several motives.

Table 2: Opinions on potential contributions to the funding

		WTP=0 (%)	WTP>0 (%)
Who should pay?	Transport organizations	50.9	54.9
	Public organizations	46.0	52.3
	Private firms	27.6	31.2
	Public transport users	13.5	21.1
	Private car users	17.78	29.5
Would you accept advertisements?	Yes	57.1	69.6

3. Estimation results

3.1. Willingness to pay for trip-planning options

Asking commuters directly how much they are willing to pay for a multimodal information platform may not however be the best way to measure their actual WTP for such a platform. This is all the more true that similar information by mode may be available for free, which creates a so-called cognitive dissonance bias which might make users unable to indicate their willingness to pay. Moreover, a strategic bias could lead respondents to over- or under-estimate their willingness to pay if they think that a multimodal platform could effectively be provided to them. That is why, in addition to the direct measure of WTP, we implement the stated preferences strategy described above.

We consider two potential prices of the platform and 4 trip-planning options: provision of real-time information, multiple-proposals of itinerary, a travel time computation option and the location of services (shopping, gas station...) along itinerary. We assumed that the interactions between these 5 two-level attributes do not have any effect on the utility provided and thus consider only 9 profiles of the platform (a fraction of 8 would have been sufficient) and placed into three choice sets of three profiles, to which one opt-out alternative was added.

Table 3 presents the attributes of the alternative configurations of the platform proposed in each choice set. The attribute of the opt-out alternative is not presented in Table 3 since its attributes are constant: it offers no option and its price equals zero. To maximize the sincerity of the respondents, the two values of the price proposed to a respondent were anchored to the WTP he/she previously stated (Table 4).

Table 3: Attributes of the configurations proposed by question

Attribute/vary in:	Choice set 1			Choice set 2			Choice set 3		
	Alt 1	Alt 2	Alt 3	Alt 1	Alt 2	Alt 3	Alt 1	Alt 2	Alt 3
price	P1	P1	P2	P1	P2	P2	P1	P2	P2
Real-time information	X		X	X	X	X			
Multiple itinerary proposal		X	X	X	X	X	X	X	X
Travel cost computation						X			X
Location of services					X			X	

Table 4: Proposed prices of configurations by stated willingness to pay

Stated WTP=	0-1€	1-5€	6-20€	20-30€
P1	0.10€	1€	6€	20€
P2	0.50€	2€	10€	29€

Thus, after indicating how much they were willing to pay for such a platform, respondents were asked in three questions (corresponding to the three choice sets) to choose one alternative from a choice set composed of:

- three different configurations of the platform, denoted k ($k=1$ to 3), each one varying in its characteristics (information on real-time events, services, and travel costs) and in its price (proposed prices being anchored to the previously stated WTP).
- a free opt-out alternative denoted “no platform” consisting of obtaining information in another way.

From the responses, we model the probability to choose a configuration j and the opt-out option as follows:

$$P_i(\text{choice} = j) = \frac{\exp(U_i^j)}{1 + \sum_{k=1 \text{ to } 3} \exp(U_i^k)} \quad \text{and} \quad P_i(\text{choice} = \text{"no platform"}) = \frac{1}{1 + \sum_{k=1 \text{ to } 3} \exp(U_i^k)} \quad (2)$$

where $U_i^j = \rho_i - \alpha_i \cdot p_j + \sum_s \beta_i^s \cdot X_j^s$ is the utility provided by the configuration j ($j=1$ to 3). The utility of the opt-

out alternative is normalized to 0. X_j^s equals 1 if the option s is provided by the configuration j and 0 otherwise. β_i^s denotes the marginal utility of the option s and α_i the disutility of the price p_j . The utilities of the three configurations are assumed to have a common intercept randomly distributed among individuals. Including this platform-specific error term allows that error terms between the three configurations of the platform to be correlated. Since the survey provided three answers per respondent, we are able to estimate such a random individual-specific term to account for unobserved heterogeneity in WTP. This term aims to capture the unobserved heterogeneity in users' interest in a multimodal information platform. Moreover, as already said, it enables to correct for the potential endogeneity issue which might arise when the proposed price is anchored to individual stated willingness to pay.

We assume that this random term take two discrete values denoted μ_j , $j=1$ to 2 . The estimates of the corresponding mixed logit model are obtained by the GLLAMM procedure on Stata ([19]). This procedure implements the method developed by [7] and estimate simultaneously the values μ_j and their prior probabilities. Table 5 presents the estimation of the multinomial logit of trip-planning options corresponding to Equation 2. The sign of each coefficient indicates the effect of the corresponding variable on the propensity to prefer the platform to another information source.

Thus, the effect of price on the choice probability is negative until the price is lower than 1€ and becomes insignificant above this threshold. This is consistent with the finding of [13] that the negative effect of price on the probability of using a travel information platform decreases with price.

In a first estimation, trip-planning option dummies are interacted with age, number of children and a dummy variable indicating whether a car is used to go to work (when insignificant for both genders, the interactions are excluded from the explanatory variables). Estimates of the effect of trip-planning options and their interactions are gender-specific.

Thus, the reference man (woman) - who is 40-year-old, lives without children and does not use a car to go to work - is willing to pay 1.85€ (2.14€) for real-time information and 1.17€ (1.15€) for multiple itineraries but would not pay to locate services along each itinerary or for a computation of travel cost (non-significant marginal WTP). Women would even pay less if a service-location option was displayed on the platform. The importance of real-time information is consistent with previous studies on the WTP for travel information.

The number of children decreases women's WTP for real-time information without affecting men's. This may be because women who are in charge of children's travel between home and school have a tighter schedule and might be more aware of travel information so that they do not need to pay for it. By contrast, the number of children increases the men's WTP for the location of services along an itinerary without affecting that of women, potentially because they are less aware of the location of services than women are. Men who go to work by car are willing to pay less to obtain the location of services. Older men are also willing to pay less for a computation of travel cost service. Such a gender difference in the importance of children in mode choice decision has been highlighted by previous literature (see for instance the review of gender differences by [20] or more recently . [15] on couple mode choice). The introduction of log income in the explanatory variables highlights some of these results. For example, WTP for service-location along itineraries is higher among poor women, which suggests that they are most likely to use these services than richer women and men. The poorest women also appear to have a higher marginal WTP for computation of travel cost. The fact that the effect of age on men's WTP for cost-computation decreases when log income is included suggests that both variables are correlated. Thus, the negative (although less significant) effect of age on men's demand for cost-computation might be explained by the fact that they care less about travel costs as their income increases.

Table 5: Mixed logit model of the choice of trip-planning options

	w/o income		with income	
	man	woman	man	woman
Min(price, 1€)	-0.858*		-0.940**	
Max(price-1€,0)	0.007		0.045	
“real-time information” option	1.794***	2.144***	1.673***	2.246***
*(# children)	0.173	-0.417**	0.217	-0.510**
*log(monthly income per capita)	-	-	-0.362	0.359
“services along itineraries” option	0.004	-0.761**	0.010	-0.965***
*car use	-1.104***	0.417	-1.155***	0.594
*(# children)	0.385**	0.106	0.390**	0.148
*log(monthly income per capita)	-	-	-0.154	-1.074***
“cost-computation” option	-0.054	-0.141	0.041	-0.103
*(age-40)/10	-0.301**	-0.120	-0.257*	-0.014
log(monthly income per capita)	-	-	-0.510	-0.671
“multiple itineraries” option	1.169***	1.154***	1.124***	1.185***
*log(monthly income per capita)	-	-	-0.333	-0.028
$\bar{\rho}$	-2.425***		-2.655***	
		+0.146		+0.395
$\mu_1; \mu_2$	-5.4652; 2.8777		-6.068; 2.9795	
p1; p2	33.68%; 68.32%		32.52%; 67.48%	
# observations	388		339	
Pseudo-R ²	0.271		0.366	

3.2. Willingness to pay, risk aversion and Value of travel time

In order to measure the effect of individual risk aversion (RA) and value of travel time (VOT) on marginal willingness to pay, we estimate these variables from the replies to specific questions of the survey. VOT, first, was measured by estimating a discrete mode choice model whose explanatory variables are the respondents' stated travel time and cost per mode. Indeed, respondents were asked to indicate their travel time and cost for their current mode and to give an approximation of these values if they used an alternative mode. Individuals who stated that they only traveled from home to work by car were asked to approximate the duration and cost of this travel if carried out by public transport and vice versa. Respondents might underestimate or overestimate their travel time with the mode they never use. Nevertheless, their mode choice depends on their perceived travel time, not on the travel time they would actually achieve. So using perceived travel time instead of actual ones (obtained from traffic-simulation for instance) might not bias the mode choice estimation. Thus, our estimation sample was restricted to individuals who use only a car or only public transport and a binary logit mode choice model was estimated between the following modes: “public transport (PT)”, “private car (PC)”. In this model, the utility of each mode is assumed to depend on the corresponding cost and travel time with the disutility of time being mode- and individual-specific (it depends on gender, age and diploma) while the disutility of cost is assumed constant across modes and individual. The ratio of the estimated disutility of time by the estimated disutility of travel cost correspond the individual specific VOT. For instance, according to our estimations, a 40-year-old individual with an average income per capita and with less than five years of tertiary education has a VOT by public transport of 7.1€/h when this individual is a man against 10€/h for a woman. By contrast, this individual's VOT by car is about 12€/h whatever the gender.

To estimate risk aversion, the method developed by [6] was implemented for the responses to two lottery-type questions. Individuals were asked to consider their usual journey from home to work and to choose between two alternatives to achieve it: a safe journey with a fixed duration t_{safe} and a risky journey with a travel time that has a 50% chance of being longer (with a duration t_{max}) and a 50% chance of being shorter (with a duration t_{min}). To be realistic, the proposed travel times were anchored to the stated one. From the proposed travel times, and assuming that the utility of each journey is a Constant Relative Risk Aversion (CRRA) function of its duration, we computed the threshold of risk aversion above which an individual chooses the safe journey. This threshold is to the value θ

($\neq -1$) which equalizes the utility of the safe alternative $-\frac{t_{safe}^{1+\theta}}{1+\theta}$ and the utility of the risky one $-\frac{1}{2} \cdot \frac{t_{min}^{1+\theta}}{1+\theta} - \frac{1}{2} \cdot \frac{t_{max}^{1+\theta}}{1+\theta}$.

If an individual chose the safe journey (and thus had a risk aversion over the threshold), in the second question, a

choice between the same safe journey and a less risky one was offered, in order to compare the individual risk aversion with a lower threshold. By contrast, if the individual chose the risky alternative (means that risk aversion is below the threshold), in the second question, he/she was asked to choose between the same safe journey and a riskier one, in order to compare the individual aversion to a higher threshold. From answers to the lottery-type questions, the individual risk aversion, denoted θ_i , was located among different intervals. An increasing transformation $\psi(\theta_i) = \log(\theta_i + \eta)$ of the risk aversion was considered and assumed to be a linear function of age, travel time, current information media, travel mode, diploma, gender and number of children plus an error term. Assuming that this error term is logistically-distributed, an ordered logit model was estimated to explain the choice between risky and safe alternatives and to recover simultaneously the parameter η and the coefficient of the individual characteristics in the linear function.

From these preliminary estimations (whose details are available upon request to the authors), the VOT and risk aversion of each individual were computed, centered on their average value and used instead of the individual characteristics in the multinomial logit. Table 6 presents the estimates obtained by including these variables at the same time and separately. The obtained estimates are very similar in both case which may be due to the weak correlation between risk-aversion and VOT (about -0.2). While both risk aversion and VOT have a significant effect on men’s WTP, women’s WTP is influenced, to a lesser extent, only by their VOT. Risk aversion and VOT decrease significantly men’s marginal WTP for service-location along itineraries and computation of travel cost. Risk aversion also decreases men’s desire for real-time information. This finding that risk-averse men and men in a hurry are less likely to acquire multimodal information is consistent with a previous finding that travelers with flexible schedules are more likely to acquire information about modes other than their usual one (see [11]). Interactions of the intercept with risk aversion and VOT suggest that women’s interest in the platform slightly increases with their VOT while men’s interest increases with their risk aversion.

Table 6: Mixed logit with RA and VOT

	man	woman	man	woman	man	woman
Min(price, 1€)		-0.742*		-0.807**		-0.807**
Max(price-1€,0)		0.003		0.004		0.006
“real-time information” option	1.521**	1.825***	1.346**	1.825***	1.872***	1.744***
(RA-2.8)	-0.364	-0.067			-0.382**	-0.076
*(VOT-8)	-0.107	0.031	-0.171	0.036		
“services along itineraries” option	-1.211***	-0.260	-1.262***	-0.264	-0.231	-0.356**
*(RA-2.8)	-0.262**	0.035			-0.294**	0.022
*(VOT-8)	-0.302***	0.052	-0.331***	0.047		
“cost-computation” option	-0.897**	-0.161	-0.896**	-0.174	-0.131	-0.174
*(RA-2.8)	-0.353***	0.079			-0.382***	0.077
*(VOT-8)	-0.240**	0.009	-0.268**	-0.002		
“multiple itineraries” option	0.557	0.886**	0.584	0.914***	1.129***	1.139***
*(RA-2.8)	-0.044	-0.120			-0.062	-0.081
(VOT-8)	-0.182	-0.138	-0.180	-0.123*		
$\bar{\rho}$		-1.819***		-1.577*		-2.499***
		-0.178		-0.340		+0.191
*(RA-2.8)	0.198	0.005			0.247	-0.046
(VOT-8)	0.257	0.194	0.287	0.193*		
$\mu_1; \mu_2$	-5.599, 2.9428		-5.3968, 2.8795		-5.5085, 2.9046	
p1; p2	34.45%; 65.55%		34.80%; 65.20%		34.52%; 65.48%	
# observations	384		385		384	
Pseudo-R ²	0.273		0.266		0.267	

4. Conclusion

We estimated workers’ willingness to pay for accessing a multimodal information platform and then estimated more precisely their WTP for its potential trip-planning options. We found that there is a demand for such a platform and that the most valued option is the provision of real-time information. Some gender differences in the evaluation of the platform and its trip planning are also apparent, suggesting that the provision of such options must be adapted to

their potential users. A man's WTP depends on the means of access to the platform and his level of risk aversion: men who are used to obtaining pre-trip information are less willing to use the multimodal platform than men who usually acquire en-route information on a smartphone or from offline modes (radio, paper maps, etc.). Consistently, risk-averse men or men in a hurry are less likely to use such a platform. Women's WTP depends more on their travel habits and, in particular, on the travel constraints they face when they have children. They have a greater WTP for real-time information than men. In order to improve the use of a multimodal information platform, public incentive policies should account for these gender differences in WTP and motives so as to target accurately the potential users of the platform. Identifying the users who are willing to pay the most for such a platform is all the more relevant when users may be asked to contribute to its funding.

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