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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 mixed logit is estimated to determine marginal WTP for the services that could potentially be provided by the platform. The willingness to pay for the multimodal platform is found to depend on the provision of real-time information and on gender-specific motives.

Keywords: multimodal information, willingness to pay, stated preference modelling

Introduction

The emergence of "big data" enables real time information to be provided on the availability and the frequency of several transport modes (public transportation, car-pooling, electric car-sharing) and thus new travel information systems to be built. Such intelligent mobility systems are likely to enhance the use of sustainable modes and, consequently, to reduce the negative environmental and economic impact of traffic congestion

In fact, previous research underlines that the provision of travel information can induce such changes when it is considered reliable by users (Khattak *et al.* 1993a, Abdel-Aty 1995). 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 Abdel-Aty *et al.* 1995, 1996, 1997,

Khattak *et al.* 1995, 1996, Polydoropoulou *et al.* 1996). 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 (Polak and Jones 1993).

The perceived availability and quality of the alternative modes appear to be the main determinants of the potential modal shift (Khattak *et al.* 1993b, Chen *et al.* 1999; Abdel-Aty and Abdalla 2004). However, building and updating such a system is expensive so that users might be asked to contribute to its funding. The present paper questions the relevance of funding this innovation by users' contributions. In particular, it measures potential users' willingness to pay (WTP) and motives for using multimodal travel information systems.

Previous research on WTP for transport information delivered by phone (Polydoropoulou *et al.* 1997, Wolinetz *et al.* 2001, Khattak *et al.* 2003, Zhang and Levinson 2008) or by web-application (Molin and Timmermans, 2006) 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 (Neuherz *et al.* 2000). 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.

We determined and tested for the importance of real-time and trip-planning options on the WTP of a sample of 398 commuters in the *Plateau de Saclay*, an area located 20 km south from Paris. We estimated stated preference models to evaluate their WTP for an innovative multimodal information system. Section 2 describes the data and presents some descriptive statistics about travelers' interest for such a platform. Section 3 presents the results obtained from our estimations. We conclude about the relevant variables to take into account to help the transport policies to implement a multimodal information platform.

Data

Survey sample

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.

Descriptive statistics

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 1shows 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.

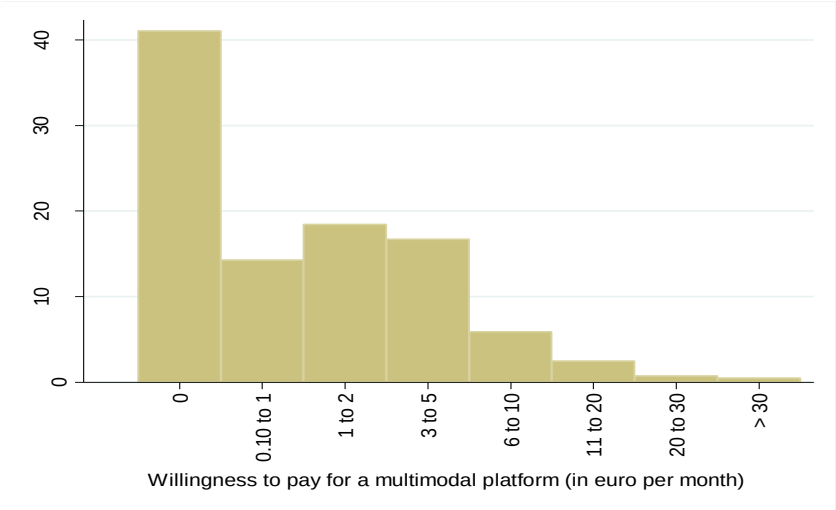

Figure 1– Willingness to pay for a multimodal information platform

Respondents with a zero-willingness to pay were asked to indicate why (Table 1). They were allowed to select 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 as 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"	26.95%
"Some similar free information already exist"	24.55%
"I already have a subscription for transport"	20.36%
"I'm not the one who should pay"	19.16%
"I don't want to pay for an application"	19.16%
"I don't want to pay for information"	16.77%
"This platform is useless"	14.97%
"I don't have enough information to judge"	13.17%
"I can't afford paying"	12.57%

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 agree that transport or public organizations should pay for a multimodal platform and about 30% think that private firms should also contribute to funding it.

Table 2– Opinions on potential contributions to the funding

		WTP=0	***WTP>0***	***Total***
Who should pay?	Transport organizations	50.92%	54.85%	53.25%
	Public organizations	46.01%	52.32%	49.75%
	Private firms	27.61%	31.22%	29.75%
	Transport public users	13.50%	21.10%	18.00%
	Private car users	17.79%	29.54%	24.75%
Would you accept advertisement?	Yes	57.06%	69.62%	64.50%

Results

Willingness to pay for acceding the platform

In order to explain the differences in the stated WTP, an OLS (Table 5 in Appendix) and then an interval regression of the WTP on individual characteristics were estimated alternately. The results of both estimations are very similar. Table 3 presents the results of an interval regression of the WTP on individual characteristics. In order to account for potential gender differences in WTP, the gender-specific effects of these characteristics were estimated.
In a first interval regression, log income and the log of family size were excluded from the explanatory variables in order to maximize the sample size (and not exclude individuals who refused to indicate their income). They were then re-included (see the two right-hand columns) in order to measure the effect of income on WTP.

Table 3 – Interval regression of the willingness to pay

	man	***woman***	***man***	***woman***
intercept	2.760***		2.810***	
		-1.586**		-1.858**
(age-40)/10	-0.041	0.513*	0.155	0.248
# children	0.100	0.741***	0.039	0.635*
log(household monthly income)- 7.74	-	-	-1.299**	1.050*
log(family size)	-	-	0.743	0.091
car-use	-1.184**	-0.022	-1.199**	-0.266
travel info media ="none" (reference)	-	-	-	-
"internet on a computer"	-1.727**	-0.367	-2.008***	-0.370
"internet on a smartphone"	1.453**	0.473	1.788**	0.307
"offline media (talk, radio, maps)"	2.264*	0.401	1.865	0.935
Std. error of random term	3.603		3.564	
# observations	397		347	
(Pseudo-)R^2	0.015		0.022	

In the first estimation, the reference individual is a 40-year-old man without children, who does not use a car to go to work and does not obtain travel information. His WTP is found to be 2.76 euros per month. A similar woman's WTP is about 1.6 euros lower. Turning to the effects of individual characteristics, a woman's WTP increases slightly with her age (0.50€ per decade) and significantly with the number of her children (0.74€ per child) while a man's WTP is not affected by these variables.

The fact that women's travel behavior is more affected by the presence of children is a standard finding in transport economics, which reflects the fact that, in heterosexual couples, women are in charge of dropping off children at school in the morning and picking them up in the evening (see, for instance, Picard *et al.* 2013 for gender differences in transport behavior within couples).

By contrast, while a woman's WTP is not impacted by her travel habits, a man's WTP decreases when the car is one of his travel modes to go to work (-1.18€) and when he is used to obtaining travel information online on a computer (1.72€). When he is used to obtaining it on a smartphone or by old-fashioned modes, his WTP is higher than when he is not informed (+2.26€ and +1.45€, respectively).

In the second estimation, the log income is included in the explanatory variables of the WTP. To obtain the monthly income, we proxied it by the middle of the interval in which the respondent located his/her household income (when given). To control for the effect of family size on this income, we did not divide the household income by the square root of the family

size to obtain an income per capita, but rather included the log of family size in the regression. However, we centered the log income on the average log income per capita, i.e. 7.74 (which corresponds to an income per capita of around 2300€).

In this second regression, the reference individuals are the same as previously but they live alone and earn the average income per capita. While the inclusion of these variables does not change significantly the estimates of the previous coefficients in the men's WTP equation, those of women are significantly modified. In particular, women's age no longer affects the WTP, which suggests that an older woman is willing to pay more for a multimodal platform because she earns more. By contrast, men's WTP decreases with their income (-0.12€ for a 10% increase in monthly income).

Marginal willingness to pay for trip-planning services

After indicating how much they were willing to pay for such a platform, respondents were asked several times to choose one alternative from a choice set composed of:

- three different configurations of the platform, each one varying in its characteristics (information on real-time events, services, and travel costs) and in its price (proposed prices being correlated to the previously stated WTP).
- an opt-out alternative consisting of obtaining information in another way.

The services under consideration in the different configurations of the platform are:

- the provision of real-time information on the traffic and on the availability of shared bicycle, car or parking place
- the provision of multiple itineraries with several modes
- the computation of travel cost for each itinerary
- the location of services and shops along each itinerary

From the obtained replies, we estimate a mixed logit with unobserved heterogeneity in the platform mean utility. We model this unobserved heterogeneity as the sum of an average platform utility h and a random term with zero mean.

We first assume that this random term is randomly distributed and can take two discrete values denoted u_1 and u_2. The estimates of the corresponding model are obtained by the GLLAMM procedure on Stata (Rabe-Hesketh *et al.* 2001). Table 4 presents the estimation of the corresponding mixed logit of trip-planning options. This second estimation strategy enables to determine the valuation of the different trip-planning options.

The sign of each coefficient indicates the effect of the corresponding variable on the propensity to prefer the platform to another information source.

Table 4 –Mixed logit, discrete random term

	man	***woman***	***man***	***woman***
Min(price, 1€)	-0.858**		-0.940**	
Max(price-1€,0)	0.007		0.045	
"real-time information" service	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" service	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-computing" service	-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" service	1.169***	1.154***	1.124***	1.185***
***log(monthly income per capita)**	-	-	-0.333	-0.028
h	-2.425***		-2.655***	
		+0.146		+0.395
u_1 ; u_2	-5.4652 ; 2.8777		-6.068 ; 2.9795	
# observations	388		339	
Pseudo-R^2	0.271		0.366	

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 Molin and Timmermans (2006) 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 services and their interactions are gender-specific.
Thus, the reference man (woman) - who is 40-years-old, lives without children and does not use a car to go to work - is willing to pay 1.8€ (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 cost-computing service (non-significant marginal WTP). Women would even pay less if a service-location service 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 cost-computing service.

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 cost-computing services. 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.

Very similar results are obtained when assuming that the random term μ_i is normally distributed with a zero-mean and a standard error σ (Table 6).

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 service 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 services must be adapted to their potential users.

A man's WTP depends on the means of access to the platform: 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.). 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 particular, women with high income are less interested in a service-locating option and multiple-itinerary proposal.

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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Appendix

Table 5 – OLS regression of WTP on individual characteristics

	man	***woman***	***man***	***woman***
intercept	3.034***		3.043***	
		-1.818**		-2.115*
(age-40)/10	-0.055	0.617*	0.172	0.320
# children	0.083	0.861***	-0.071	0.758
log(household monthly income)- 7.74	-	-	-1.583**	1.132
log(family size)	-	-	1.066	0.161
car-use	-1.324*	0.026	-1.375*	-0.295
travel info media ="none"	-	-	-	
"internet on a computer"	-2.210***	-0.456	-2.547***	-0.456
"internet on a smartphone"	1.818**	0.513	2.198**	0.366
"offline media (talk, radio, maps)"	3.197**	0.452	2.714*	1.041
# observations	397		347	
(Pseudo-)R^2	0.015		0.022	

Table 6 – Mixed logit, normal random term

	man	***woman***	***man***	***woman***
Min(price, 1€)	-0.978***		-1.182***	
Max(price-1€,0)	0.0002		0.028	
"real-time information" service	1.843***	2.166***	1.750***	2.227***
***(# children)**	0.166	-0.411**	0.243	-0.468**
***log(household monthly income)**	-	-	-0.209	0.313
"services along itineraries" service	0.031	-0.738**	0.068	-0.921***
*** car-use**	-1.108***	0.416	-1.165***	0.592
***(# children)**	0.383**	0.107	0.387**	0.156
***log(household monthly income)**	-	-	-0.133	-1.095***
"cost-computing" service	-0.031	-0.117	0.091	-0.053
***(age-40)/10**	-0.301**	-0.123	-0.258*	-0.016
***log(household monthly income)**	-	-	-0.492	-0.686**
"multiple itineraries" service	1.195***	1.179***	1.177***	1.233***
***log(household monthly income)**	-	-	-0.254	-0.082
h	-3.604***		-3.746***	
		+0.103		+0.305
σ	7.098		7.352	
# observations	388		339	
Pseudo-R2	0.259		0 .353	