USING AN EARLY VEHICLE RETIREMENT PROGRAM TO SUPPORT A MODE SHIFT: CAR PURCHASE AND MODAL INTENTIONS FOLLOWING PROGRAM PARTICIPATION

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Paper submitted to the Word Conference on Transportation Research for publication

ABSTRACT

In order to stimulate the economy and reduce greenhouse gas emissions from older vehicles, most early vehicle retirement programs have provided participants with incentives to purchase a new, less polluting vehicle. Québec's "Adieu Bazou!", program additionally uses the program as a mode shift tool by providing alternative travel incentives to participants. Alternatives include public transit passes, rebates on bicycles and carsharing memberships. In the absence of post program information, the theory of planned behavior is used to assess participants' main travel mode intentions as well as their intention to purchase a new or used vehicle following program participation. A subset of program participants (2009-2011; n=9070, 22%) filled an optional survey about their future vehicle purchase and travel intentions, as well as reasons for entering the program. Age, gender, household income, incentive chosen, distance travelled in previous year and perceived access to public transit were used as independent variables in logistic and multinomial logistic regressions.

Car purchase intention and mainly travelling by vehicle was associated with greater distance travelled. Higher income participants were more likely to purchase new vehicles and lower income population more likely to purchase used vehicles or to refrain from any purchase. Intentions to use alternative travel modes were each associated with different socio-demographic characteristics and psychosocial factors. There was no association between chosen incentive and future travel intentions. Early vehicle retirement programs offer a promising incentive-based opportunity to influence mode shift. A post program survey is required to better understand actual long-term mode shift associated with program.

Keywords: Transit incentive, Theory of planned behavior, Scrappage, Transit access, Past behavior, Habit, Ecological concerns.

INTRODUCTION

Getting North Americans out of their vehicles and into alternative modes has proven to be a considerable challenge. One way to reduce vehicle emission without restricting vehicle use is to develop early vehicle retirement programs. In such schemes, older vehicles are scrapped in exchange for a rebate on a new vehicle. The efficiency of these programs with respect to reducing GHG emissions has been limited, context sensitive, and dependent on program characteristics (ITF, 2011). While vehicle scrappage program are typically designed to reduce Greenhouse Gas emissions (GHG), they typically support the purchase of a new vehicle through manufacturer rebates or government incentives. Many Travel Demand Management (TDM) tools implicitly attempt to reduce the negative impacts of transportation systems on GHG emissions. Promoting a mode shift to less polluting forms of travel is one of the most prominent means of achieving emission reductions. The *Association québécoise de lutte contre la pollution atmosphérique* (AQLPA) developed a series of partnerships to offer alternative travel incentives with the objective of using the program to promote a mode shift while making program participation more attractive for owners of older vehicles. Whether this innovative program characteristic influences travel intentions and results in an actual mode shift has not been studied in depth.

Using a travel behavior framework and the theory of planned behavior, this paper assesses reported travel intentions as well as vehicle purchase intention at the time of participation in the vehicle retirement program. This approach is used because of the lack of actual travel behavior data following program participation. The analysis is preceded by a presentation of the program's characteristics, the analytical framework and a description of available participant data. Results point to the challenges of breaking travel habits, especially in the context of limited travel alternatives for participants.

The "Adieu Bazou!" early vehicle retirement program as TDM

"Adieu Bazou!" (Literally Goodbye clunker), the Quebec component of the Canadian national early vehicle retirement program ("Retire Your Ride") was funded by Environment Canada and managed by the Clean Air Foundation (CAF). It allowed for owners of vehicles made during or before 1995 (a year where more stringent emissions restrictions were imposed on vehicles) to scrap their vehicles or light trucks in exchange for various incentives (Environment Canada, 2009). Some incentives favored a shift to alternative travel modes in an attempt to use the vehicle retirement program as a Travel Demand Management tool.

Participants of "Adieu Bazou!" could receive a 300$ incentive, rebates of up to 3000$ on a new vehicle (Ford, GM, Chevrolet and Hyundai joined the program), transit passes or a selection of alternative travel options that include registration to a car-sharing cooperative (Communauto), rebates on bicycles and electric scooters, as well as an interurban transit pass (AQLPA, 2011). The objective of such alternative transportation incentive programs is to ensure a temporary mode shift from automobile to other alternative modes. By incentivizing drivers to try out other modes, it is expected that some may decide to permanently reduce their driving in favor of alternative modes (Léger Marketing, 2010). For participating public transit agencies, such longer-term transit take-up would justify the cost of subsidizing free transit pass incentives. A year into the program, transit agencies agreed to expand the transit offer from 6 to 15 months of free unlimited basic transit pass. The transit pass incentive has since been restricted to 12 months.

By influencing owners of older vehicle to reduce the amount of driving they do through a shift to other modes of transportation, the objective is to reduce vehicle emissions by a greater factor than that achieved through vehicle replacement (AQLPA, 2011; Léger Marketing, 2010). There are reasons for trying to incentivize participants to adopt other travel modes as part of early vehicle retirement programs instead of promoting the purchase of a new car. As participants purchase a newer vehicle, they tend to increase the amount of driving they do thereby reducing the benefits achieved through the purchase of a less polluting vehicle (ITF, 2011; Dill, 2004; Van Wee et al., 2000). Improvements in fuel efficiency and associated reduced travel costs may be at the core of this change in behavior (Zolnik, 2012). Another issue with programs that do not restrict auto purchase to certain vehicle classes is the risk that participants upgrade their vehicle to a larger and relatively more polluting vehicle. This can also decrease expected benefits and was identified as a program drawback in Germany (ITF, 2011). They recommend restricting vehicle type or adjusting incentive to types of vehicle based on emissions.

Only a few other early vehicle retirement programs were designed with similar alternative travel incentive programs and mode shift objectives. Scotland (a one day program in the city of Glasgow) and Hungary were the only ones referred to in the literature with public transit incentives (Dill, 2001). British Columbia's SCRAP-IT program is the only one for which documentation is available (Antweiler and Gulati, 2011). An assessment of program success with respect to modes shift was not found in available literature.

Participating agencies that are providing incentives are interested in knowing if this is a useful strategy to seduce new riders or promote the use of public transit. A previous analysis of the dataset revealed that choice of incentive was associated with different socio-demographic characteristics and access variables (Lachapelle, 2013). The paper serves to show how future choices of participants may be shaped by their intentions, which are a product of external factors to the program such as perceived access as a barrier, participant's income and perceived benefits of participation, attitudes towards travel, and environmental concerns. Reducing vehicle use may be facilitated by interrupting habitual driving (through vehicle retirement), especially in cases where long travel distance can drive moral motivation to reduce driving (Eriksson et al., 2008).

Objectives

The paper is structured around two main objectives.

- Identify the determinants of the intention to purchase a new or used vehicle.
- Identify the determinants of modal intention once vehicle is recycled.

The next section provides three complementary frameworks and theories that can help structure the current analysis. Through the analysis, I show that these body of knowledge can contribute to analyzing this question but that ultimately, follow-up data is required to assess actual mode shift outcomes of the program during and after incentive period is over.

Theoretical Framework

Travel Demand Management

Different body of literature can help us understand vehicle purchase and travel intentions in the context of this study. Travel Demand Management evolved out of the need to mitigate the impact of the rapid motorization of developed countries. It refers to policies and urban planning

strategies to reduce the amount of single occupancy vehicle on the roads. This can be done by adapting infrastructure and investing in alternative forms of transportation, and in changing the pricing of different transportation alternatives through the use of incentives and disincentives. Meyer (1999) suggests that carrots are more efficient than sticks as demand management tools. This is because they promote certain travel behavior while not limiting the use of other. Furthermore, disincentives may often be perceived as an additional tax burden. The early vehicle retirement program being studied included alternative travel incentives that can reduce the cost of travel.

Travel behavior and choice models

Understanding the effect of policies on travel requires understanding how these policies contribute to shaping the behavior of individuals with respect to travel. The discrete choice model used in many transportation applications can provide insights into this question (Dommencich and McFadden, 1975; Ben-Akiva and Learman, 1985). Choice set made up of different travel modes, can be assessed at the level of individual trips or through measures of habitual travel patterns (e.g. most frequent commute mode). The discrete choice framework proposes that the utility of a travel option in certain circumstances can be compared against the utility of other modes. This utility can be a function of travel time, distance, convenience, cost of trip, overall cost of transportation options and may be influenced by socio-economics characteristics. Service quality, perceived value, and satisfaction (Lai and Chen, 2011) are some of the indicators of service convenience used to assess public transit use. Other land use measures representing the ease of use of various travel modes can also be integrated to the choice framework (Cervero, 2002). This behavioral model can also be used to understand other choice processes related to personal travel. Vehicle ownership has been analyzed using the discrete choice model. Potoglou and Kanaroglou (2008) found that household life-cycle stage, socio-economic factors, mixed density and land-use diversity influenced households decision to own a given number of vehicles. Choice models of vehicle ownership have also been developed using class and type of vehicle as well as cost and size (Nayum et al., in press).

Insights from psychology: intentions in the Theory of Planned Behavior

Gärling and colleagues (2002) developed a framework based on travel psychology and economics to identify the determinants of successful TDM policy adoption. In order to shift travel behavior, individuals are thought to go through a process of travel goal setting. These goals may involve for example reducing travel distance, shifting modes or reducing ecological impacts. They then explore “how travel is influenced by the impact various travel demand management (TDM) measures have on time, cost, and convenience of travel options” Gärling et al., 2002. p.59). Life changes are considered as important opportunities for mode shift (Gärling and Schuitema, 2007) as they may force to break travel habits (Eriksson et al., 2008).

The theory of planned behavior (TPB) explicitly refers to the concept of intentions as a predictor of behavior (Ajzen, 1991). According to this theory, in order to adopt a behavior, individuals need to have the intention to do so. Intentions capture the motivational factors that influence a behavior: how hard are people willing to try, and how determined they are to perform the behavior. A strong intention should result in a strong adoption of the desired behavior. This intention will be formed by attitudes towards travel, subjective norm and perceived behavioral

control. Attitudes towards travel by a certain mode consist in how favorable or unfavorable the evaluation of this behavior is. Behavioral beliefs, “what with actually occur” and outcome evaluation, “is this a good or a bad thing” are the two components of attitudes and are not available in this study. Subjective norm refers to the personal and social pressures to comply with a behavior. Travel related subjective norms include the social image associated with driving and the perception that certain travel behaviors are more environmentally responsible than others. Normative beliefs, “What my mother/other important person wants” provide a social pressure to perform certain behavior, which is moderated by motivation to comply, whether a person is actually concerned about acting according to these norms.

Behavioral control refers to the ability to actually complete a certain behavior. The resource and opportunities available to a person will help determine if the behavior is adopted. The perception of the ease or difficulty of completing a behavior will be of varying accuracy, depending on knowledge about the behavior. With only limited information about the behavior, perceptions may be flawed. Actual behavioral control can hence provide additional information, especially when perceptions are flawed by lack of knowledge. Perceptions may come from second hand information, such as the experience of friends. As such, they may be misleading. Actual information, although theoretically clearer, may sometimes be difficult to access. In order to adopt a certain behavior, individuals must have volitional control over this behavior: they must actually be able to complete the behavior. Perceived behavioral control is more important when volitional control declines. Transit is one such situation in which individuals have varying levels of volitional control since service is not systematically and broadly available to individuals. For example, Pushkarev and Zupan,(1977) and Rogalsky (2010) found considerable discrepancies in access to public transit across metropolitan areas of various sizes. Availability of requisite opportunities and resources such as time, money and skills (Ajzen, 1991) may also influence perceived control over the ability to travel. Hence household income can, in the case of travel choices, confer a certain volitional control.

Finally, the TPB is open to the inclusion of additional variables, provided that they capture a portion of the variance in intention. An important role is attributed to past behavior in setting up future behavior. “Repeated performance of a behavior results in the establishment of a habit” (Ajzen, 1991 p. 203). Past behavior is considered the residual effect not accounted for in the theoretical model because of missing information or incomplete theory. (Ajzen, 1991). While it is used to test the theory’s sufficiency, it can provide additional explanatory power in shaping intentions and behaviors. The TPB has been used to directly elicit mode choice through past behavior, habit, and reasoned action (Bamberg et al., 2003). Dill and Mohr (2010) used the theory of planned behavior to test the effect of individual marketing programs on TDM. While intention is notoriously different from behavior it is nonetheless considered a useful marker of behavior (Gärling and Schuitema, 2007; Jakobsson, 2004). Weather, illness, and unspecified unexpected event may all cause discrepancies between intentions and actual use of different modes (Jakobsson, 2004). Varying degrees of ability to complete a behavior (perceived behavioral control) can also cause a discrepancy between intentions and behavior (Ajzen, 1991).

Travel intentions have particularly been studied in tourism, as it is difficult to survey respondents at the time of a specific vacation trip. As a result, intentions are often used to estimate demand for tourism travel (Weaver and Lawton, 2007). The TPB and additional measures of past behavior have been used in assessing intentions to choose a travel destination (Lam and Hsu, 2006). Nonetheless, numerous examples exist in the urban travel literature (e.g. Chen and Chao, 2011; Jakobsson, 2004; Bamberg et al., 2003).

Analysing "Adieu Bazou!"

Many of these theoretical frameworks share common features. They refer to enablers, which make a travel behavior more likely, and disablers, which prevent or inhibit certain behaviors. Using these frameworks, models of vehicle purchase intention and travel mode intentions of participants to a scrappage program that includes alternative travel incentives can be developed (Figure 1). As in Potoglou and Kanaroglou's (2008) analysis, choice models are used to assess vehicle ownership. Other examples of studies using the theory of planned behavior to assess travel choices also exist (Bamberg et al., 2003; Klöckner and Blöbaum, 2010). The models are specified using the available and relevant information described below.

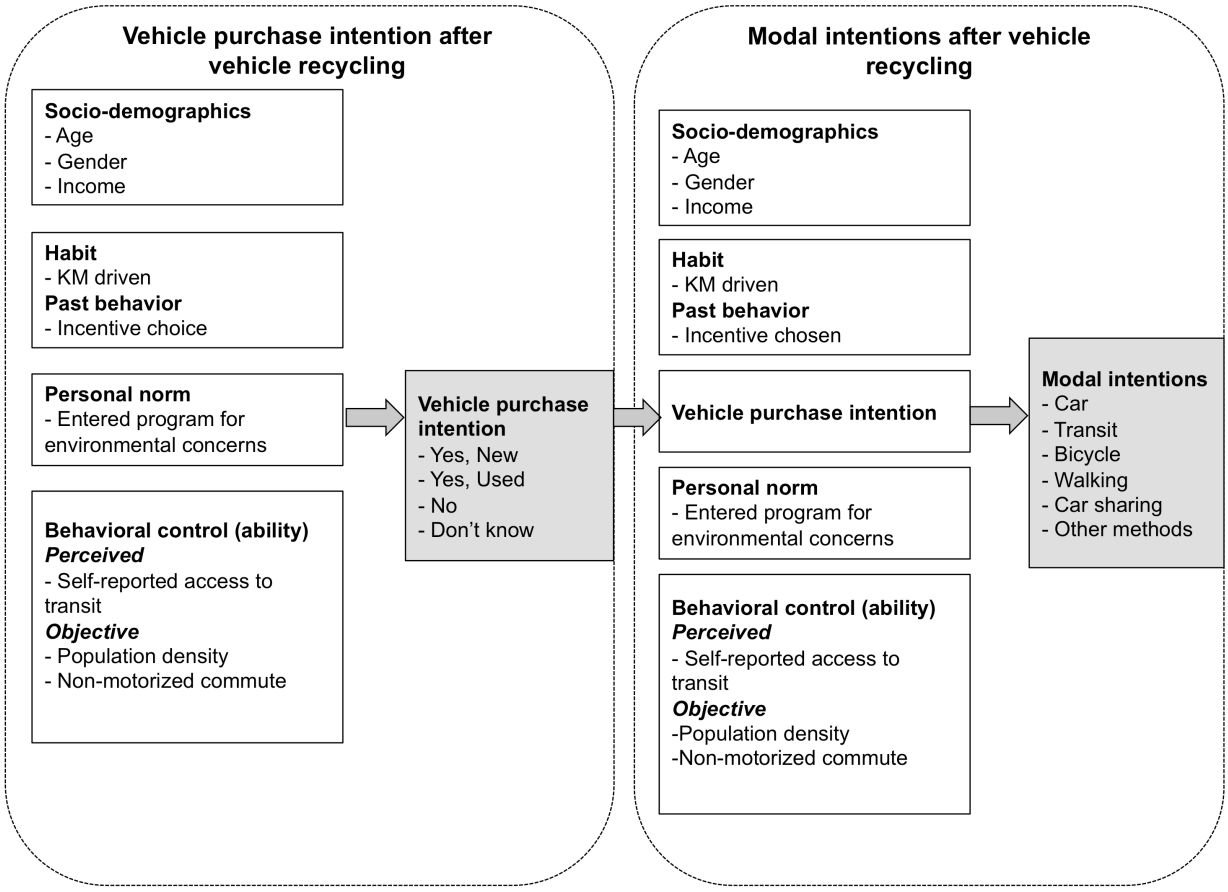

Figure 1: Analytical framework

Socio-demographic characteristics were expected to have an influence on intentions by shaping tastes, preferences, financial ability, and physical ability. Gender, age and income were identified in other studies as influencing travel mode choice and intentions (Scheiner and Holz-Rau, 2012; Rogalsky, 2010; Jakobsson, 2004; Cervero, 2002; Boarnet and Crane, 2001). Personal norm was expressed through perceiving environmental concern as important in entering the program. Flamm (2009) found lower vehicle ownership and use in households with pro-environmental behavior. Eriksson and Forward (2011) also found associations between pro-environmental travel behavior and travel intentions.

As users develop strong travel choice habits, changing their behavior becomes more difficult (Gardner, 2009). In a study of intention to switch to transit use, habitual behavior of drivers strongly hindered intentions (Chen and Chao, 2011). Habit was here expressed through a self-reported measure of kilometers driven in previous year. A form of previous travel behavior, the incentive chosen as part of the program is also expected to be associated with travel intentions.

Indicators of behavioral control (ability), relevant to this analysis are the perceived quality of transit service as well as characteristics of the built environment associated with alternative travel (TRB, 2001; TRB-IOM, 2005). Measures of ability to travel by alternative modes were found to be salient factors in influencing travel intentions (Eriksson and Forward, 2011).

The same framework is applied to the choice of individual travel modes with the exception that the intention to purchase a vehicle is also included. Vehicle purchase intention is undoubtedly an enabler of automobile travel and a deterrent to alternative travel. While the questions asked in the optional survey of participants do not completely reflect the theory of planned behavior and other psychological concepts presented, they are used here to explore the individual roles of environmental concerns, travel habits, past behavior and measures of ability to switch travel mode in shaping travel intentions. Such analysis can clarify under what circumstances mode shift incentives obtained through participation in an early vehicle retirement program can influence travel behavior.

METHOD

All data used in this analysis was retrieved from three sources of data: participant records for the early vehicle retirement program, an optional survey of participants and the most recent Canadian Census data from 2006.

Program Administrative Data and survey of participants

Between February 2009 and April 2011, over 40 000 vehicle owners participated to the program and recycled their vehicle. Participant registration to the “Adieu Bazou!” program required information on home location, sex and age in addition to the incentive selected. A subset of 9070 (22.4%) participants filled an optional survey that included questions on intentions:

- “Will you purchase another vehicle?” (Yes, no, don’t know/not sure) and if yes, “Will it be new or used” (New, used, don’t know/not sure). These two variables were used to develop four categories of vehicle purchase intentions (New, used, no intentions, don’t know/not sure).
- “What mode of transportation will you use now that you have retired your vehicle?” Participants could check more than one of the following: car, bicycle, public transit, walking, carpooling, and vehicle sharing.

The survey also included questions on attitudes, norms, and behavioral control.

- Habit: Self-reported average km travelled in a year (6 distance categories)
- Previous behavior: Incentive chosen
- Subjective norm: Entered program for environmental concerns (Yes, no)
- Perceived behavioral control (ability to travel by alternative modes). “The transit system is accessible to me” (5 point scale from totally agree to do not agree at all).

Five categories of combined household income are also included in the optional survey and a sixth category states “None, I am a student”. (This category also includes students with part-time jobs).

Census data

Using participant’s home location, additional information was collected on the characteristics favoring alternative travel mode use where participants live. The province of Quebec includes 13,409 dissemination areas (DA). Each participant was assigned to its home location’s DA to calculate population density near each respondent’s home using aggregated data from the 2006 Census. Our expectation was that lower density would be associated with more use of personal vehicles, and that higher densities would be associated with more use of alternative travel options, and lower intentions to purchase a vehicle. The proportion of the population commuting by public transit and the proportion of the population commuting by non-motorized transportation were used as proxies for an area where alternative transportation options are more feasible. These variables were expected to have a positive association with the use of alternative transportation and a negative association with the choice to purchase a car. An Indicator variable for living in one of the 6 Census Metropolitan Areas of the province of Quebec (CMAs vs. not) was computed to account for the presence of broader transit service in such areas.

Statistical analyses

Intention to purchase a new vehicle

After registration to a vehicle retirement program, what are participant’s intentions with respect to the purchase of a new vehicle? The four possible answers to this question (New, used, no, don’t know/not sure) were modeled as choices using a multinomial logit model (MNL). Socio-demographic variables, the chosen incentive, previous distance travelled, environmental concern as a reason for recycling vehicle, population density, the proportion of transit commuters, non-motorized commuters and a self-reported measure of transit accessibility are included in the model. MNL was used, as answers are exclusive. Having no intention to buy a replacement vehicle was used as a reference category.

Modal intention

Modal intention was studied using a series of six binary logistic regressions because more than one response was accepted (answers were non-exclusive). As in the case of vehicle purchase intention, modal intention was estimated using the same variables. Additionally, intention to purchase a vehicle was added to this model, because owning a vehicle would be expected to influence modal intention. Vehicle ownership and availability are strong predictors of vehicle travel. All analyses were carried out using Stata 11.

RESULTS

A description of variables for the study sample is presented in Table 1. A first column includes variable description for all variables included in analyses. The second column presents the values that were available for the entire participating population to compare them to the

subsample used in this analysis. With respect to age and gender the subsample is quite similar to the population of program participants. With respect to program incentive choice, more participants chose other modes than the car in the analytical sample. Transit passes were also chosen more frequently in the overall population.

Table 1: Sample description and comparison to population

	Analytical sample	Program participants
	Proportion or mean	**Proportion or mean**
Observations	**9070**	**40321**
Women	0.34	0.36
Participant age		
16-24 [ref.]	0.13	0.13
25-34	0.16	0.16
35-44	0.16	0.17
45-54	0.25	0.25
55-64	0.18	0.18
65+	0.11	0.11
Incentive choice		
Cash (300$) [ref.]	0.92	0.82
Car rebate	0.03	0.06
Transit pass	0.04	0.09
Bicycle, carshare, carpool	0.01	0.03
Area characteristics		
Lives in Metropolitan Census Region	0.65	0.60
Population density (mean of ln)	6.75	6.60
Non-motorized commute	0.08	0.08
Environmental concerns was important reason for program participation	0.11	0.21
Car purchase intention		
New	0.21	
Used	0.41	
No [ref.]	0.25	
Not sure	0.13	
Modal intention		
Car	0.82	
Public transit	0.27	
Bicycling	0.26	
Walking	0.19	
Carshare program	0.04	
Other methods	0.03	
Household income		
Less than 25 000 $ [ref.]	0.21	
$25 001-$35 000	0.16	
$35 001-$50 000	0.21	
$50 001-$75 000	0.19	
More than 75 000 $	0.15	
None, I am a student	0.08	

	Analytical sample	Program participants
	Proportion or mean	**Proportion or mean**
Distance travelled in previous years		
Less than 10 000 km [ref.]	0.32	
10 000-15 000 km	0.30	
15 000-20 000 km	0.20	
20 000-25 000 km	0.10	
Over 25 000 km	0.05	
Don't know	0.03	
The transit system is accessible to me		
Totally agree	0.30	
Somewhat agree	0.13	
No opinion	0.13	
Somewhat disagree	0.12	
Totally disagree [ref.]	0.31	

Intention to purchase a new vehicle

Vehicle purchase intention may be used to assess the program's potential in fulfilling its mode shift objective. A multinomial logistic regression of intention to purchase a new or used vehicle is presented in Table 2. Gender and age were not significantly associated with the intention to purchase a new or used vehicle. As income increased, the propensity to purchase a new vehicle increased and the propensity to purchase a used vehicle decreased. Students were more likely to have the intention to purchase a vehicle than the lowest income group (reference category). The lower income groups are also more frequently undecided about vehicle purchase. In comparison with those having travelled less than 10 000 km last year, those that drove between 10 000 km and 25 000 km were more likely to have the intention of purchasing a new vehicle, and to a lesser extent, a used one. This variable was not associated with uncertainty about vehicle purchase. There was a negative relationship between environmental concerns and the purchase of a new vehicle. As perceive access to public transit increased, participants were less likely to have the intention to purchase a new vehicle. The relationship with the purchase of a used vehicle was weaker and only influenced purchase intention when access was high. There was no significant association with any of the area characteristics.

Modal intention

The second group of models assesses modal intentions once vehicle is recycled using a series of binary logistic regression (Table 3). The same independent variables used in the vehicle purchase model are included with the addition of vehicle purchase intention. Significant associations were found for key socio-demographic variables.

Being a woman had no relationship with travel intention for any mode. Age also was poorly associated with travel intentions, save for three instances: participants aged between 35 and 44 were more likely to have the intention of using public transportation than participants aged 16 to 24; most age groups that were older that the reference category were more likely to have the intention to travel using vehicle sharing systems; and participants over 65 were less likely that the youngest ones to choose carpooling or other means (unspecified). Household income was associated with all travel intention outcomes. As income increased, intention to travel by vehicle

increased. This relationship was inversed for other incentives. Participants earning between 25 000$ and 35 000$ were less likely to have the intention to use transit than those earning Less than 25 000$. All groups were less likely than the lowest income group to walk and carshare and two of the wealthier groups were less likely to choose carpooling or other travel modes. Students were more likely to have the intention to use public transit and bicycling, and were less likely to have the intention to carpool or use other modes. The incentive chosen by participants was not associated with any travel intention.

Table 2: Car purchase intentions

Base: No	**New**	**Used**	**Don't know**
	Coef.	**Coef.**	**Coef.**
Women	0.039	0.002	-0.018
Participant age			
16-24 [ref.]			
25-34	0.062	-0.111	-0.136
35-44	-0.107	-0.038	-0.089
45-54	-0.117	-0.103	-0.145
55-64	-0.12	-0.08	-0.079
65+	-0.195	0.019	-0.171
Household income			
Less than 25 000 $[ref.]			
$25 001-$35 000	0.721***	0.012	-0.084
$35 001-$50 000	0.756***	-0.224**	-0.071
$50 001-$75 000	0.697***	-0.470***	-0.432***
More than 75 000 $	0.876***	-0.560***	-0.542***
None, I am a student	-0.131	0.321**	0.216
Incentive choice			
Cash (300$) [ref.]			
Car rebate	-0.469*	-0.18	-0.228
Transit pass	0.037	0.028	-0.114
Bicycle, carshare, carpool	0.253	-0.535	-0.048
Distance travelled in previous years			
Less than 10 000 km [ref.]			
10 000-15 000 km	0.523***	0.294***	0.056
15 000-20 000 km	0.634***	0.237**	0.092
20 000-25 000 km	0.560***	0.267**	-0.135
Over 25 000 km	0.066	0.092	-0.085
Don't know	-0.377	-0.15	0.208
Environmental concerns was important reason for program participation	-0.204*	-0.028	-0.143
The transit system is accessible to me			
Totally agree	-0.857***	-0.458***	0.118
Somewhat agree	-0.466***	-0.184*	0.218
No opinion	-0.389***	-0.046	0.017
Somewhat disagree	-0.319**	0.094	0.179
Totally disagree [ref.]			

Base: No	**New**	**Used**	**Don't know**
	Coef.	**Coef.**	**Coef.**
Area characteristics			
Lives in census metropolitan area	0.031	-0.045	0.012
Population density (ln)	0.031	0.019	0.001
Non-motorized commute (proportion)	-0.359	-0.471	-0.168
Constant	-0.806***	0.711***	-0.483**
Observations	9070		
ll (base)	-11816		
ll (model)	-11418.5		
Chi-square	795.1		
Significance	0.000		
Pseudo r2	0.034		

Note: ll = Log likelihood of empty and full model
Coef.=Coefficient; ref.=reference category
* p<0.05, ** p<0.01, *** p<0.001

Participants' travel habit was strongly associated with travel intentions. As reported distance travelled in previous year increased, participants were more likely to have the intention to travel by vehicle. They were also significantly less likely to travel by public transit and walking. The intention to purchase a vehicle was, as expected, strongly and positively associated with the intention to travel by vehicle and negatively associated with the intention to use public transit, bicycling, vehicle sharing, carpooling and other modes. Being undecided about the purchase of a vehicle was negatively associated with the intention to travel by vehicle and positively associated with the intention to travel by public transit, bicycling, walking and vehicle sharing. Having entered the program because of environmental concern was not associated with any of the travel intentions.

The strongest and most consistent relationship found in travel intention models was perceived access to transit. As perceived access to the transit system increased, participants were less likely to have the intention to travel by car, and were more likely to have the intention to travel by public transit, bicycling and walking. Only those that totally or somewhat agreed with the statement were more likely to have the intention to vehicle share. Objective characteristics of the area showed limited relationships. Living in a CMA increased the probability of carsharing and population density increased the probability of using a personal vehicle. The percentage of non-motorized commuters in a population' DA was negatively associated with the intention to travel by vehicle and by bicycle.

DISCUSSION

Household income, habit, in terms of kilometer driven, and perceived access to transit presented the most consistent relationships across analyses. Intentions to drive and purchase a vehicle stood in stark contrast with all other modes. The lowest income group was more likely to have the intention to purchase a used car while the wealthier ones showed interest in new vehicles. Students participating in the program either had the intention to buy a used vehicle or had the

intention of switching to public transit. Higher income was also associated with less uncertainty about the purchase of a car.

Table 3: Travel intention models

	Car	Public transit	Bicycle	Walking	Carshare	Carpool and others
	Coef.	**Coef.**	**Coef.**	**Coef.**	**Coef.**	**Coef.**
Women	0.072	0.043	0	0.061	0.06	0.121
Participant age						
16-24 [ref.]						
25-34	0.034	0.031	0.08	-0.042	0.560**	-0.225
35-44	0.052	0.166	0.142	0.037	0.267	-0.166
45-54	-0.059	0.168	0.064	-0.008	0.634**	-0.021
55-64	0.112	0.072	-0.082	-0.125	0.497*	-0.235
65+	-0.059	0.158	-0.047	-0.149	0.662**	-0.784**
Household income						
Less than 25 000 $[ref.]						
$25 001-$35 000	0.377***	-0.156	0.025	-0.214*	-0.347*	-0.041
$35 001-$50 000	0.650***	-0.099	0.021	-0.285***	-0.469**	-0.476*
$50 001-$75 000	0.580***	0	0.112	-0.337***	-0.548**	-0.510*
More than 75 000 $	0.647***	0.260**	0.163	-0.221*	-0.31	-0.36
None, I am a student	-0.064	0.812***	0.349***	0.083	-0.333	-0.867**
Incentive choice						
Cash (300$) [ref.]						
Car rebate	0.037	0.088	0.126	0.145	-0.333	-0.488
Transit pass	0.28	-0.015	-0.033	-0.162	-0.641	-0.396
Bicycle, carshare, carpool	-0.046	0.544	0.106	0.214	0.804	0.607
Distance travelled						
Less than 10 000 km [ref.]						
10 000-15 000 km	0.302***	-0.005	0.135*	-0.006	-0.038	-0.108
15 000-20 000 km	0.463***	-0.214**	0.002	-0.239**	-0.169	0.009
20 000-25 000 km	0.493***	-0.300**	-0.016	-0.335**	-0.451*	-0.227
Over 25 000 km	0.847***	-0.544***	0.018	-0.289*	0.12	-0.129
Don't know	-0.019	0.106	-0.266	-0.114	0.281	0.342
Car purchase intention						
New	1.504***	-0.878***	-0.576***	-0.542***	-0.959***	-0.526**
Used	1.539***	-0.468***	0.026	0.025	-0.643***	-0.737***
No [ref.]						
Not sure	-0.162*	0.395***	0.226**	0.279**	0.329*	0.137
Environmental concerns was important reason for program participation	-0.149	0.145	0.055	0.135	-0.006	-0.078
The transit system is accessible to me						
Totally agree	-1.384***	2.984***	0.710***	1.011***	0.467***	0.069
Somewhat agree	-1.093***	2.577***	0.614***	0.722***	0.360*	-0.095
No opinion	-0.539***	1.901***	0.373***	0.620***	0.16	-0.126
Somewhat disagree	-0.115	1.294***	0.565***	0.582***	0.284	-0.142

	Car	Public transit	Bicycle	Walking	Carshare	Carpool and others
Totally disagree [ref.]						
Area characteristics						
Lives in CMA	-0.152	0	-0.073	-0.001	0.282*	-0.048
Population density (ln)	0.035*	-0.007	0.001	0	-0.042	-0.007
Non-motorized commute (proportion)	-0.54	-0.678*	-0.751*	-0.356	-0.17	0.377
Constant	0.793***	-2.715***	-1.501***	-1.686***	-3.034***	-2.599***
Observations	9070	9070	9070	9070	9070	9070
ll (base)	-4301.81	-5325.7	-5160.45	-4461.35	-1614.86	-1200.84
ll (model)	-3560.46	-4175.26	-5000.03	-4254.33	-1536.02	-1163.35
Chi-square	1482.7	2300.9	320.8	414	157.7	75
Significance	0.000	0.000	0.000	0.000	0.000	0.000
Pseudo r2	0.172	0.216	0.031	0.046	0.049	0.031

Note: ll = Log likelihood of empty and full model

Coef. = Coefficient

* p<0.05, ** p<0.01, *** p<0.001

Previous travel behavior, in the form of average yearly distance travelled in the previous years was associated with intentions to purchase and use a vehicle. Travelling longer distances may make public transit and cycling incentives much less feasible than continuing to drive. Unless life situations have changed, past behavior can have a strong influence on intentions. People that travel longer distances, because they enjoy it, or be cause they live far from their place of work or leisure may be harder to incentivize to shift to alternative modes of transportation.
Perhaps because of the strong influence of the self-reported transit accessibility variable, relationships with objective environmental variables were weak or non-existent. Perceived accessibility may be more important at the time of setting goals and intentions that actual access. In any case, perceived access to transit service, a measure of behavioral control, had a strong influence on purchase and travel intentions. These results are consistent with Eriksson and Forward' (2011) analysis of modal intention. A synergy between low driving habit and high transit access may be crucial factors in shaping mode shift intention Eriksson and colleagues (2008) suggest that interruptions in car use such as the one caused by this program may facilitate a reduction in car use. In order to have the intention to shift travel modes, a synergy between these factors seems required.

Unsurprisingly wanting to purchase a vehicle was also strongly associated with the intention to drive, and not with the intention to use other modes. Previous research suggests that when a new vehicle is purchased, distance travelled is likely to increase due to novelty and fuel economy. It is on the other hand somewhat surprising that the incentive chosen was not associated with any travel or purchase intentions. One would expect to the contrary that the chosen incentive would largely drive future intention. The only possible explanation is that the choice of a 300$ incentive (the most popular) has no influence on travel choice, and alternative travel incentives are often chosen for other purpose than travel (purchasing a bicycle for leisure), or were given to other members of the family (this may be the case for public transit passes or rebates on bicycles). A number of other environmental and social variables were tested without success. With a few exceptions, results are plausible and follow expected and existing evidence. These exceptions are the influence of area characteristics on driving, walking and bicycling.

Limitation

Limitations to this study include the cross-sectional and optional nature of the survey and the use of intentions instead of actual self-reported behavior. Intentions can be shifted as a result of unforeseen circumstances and may not always accurately represent actual behavior. Existing data limits our ability to understand mode shift associated with the program. A survey of behavior after vehicle is recycled would help confirm the modal transfer caused or supported by the program. The studied sample was dependent upon participants' willingness to participate and therefore may not accurately represent the entire participating population or future program. However, given the data comparing all program participants to the studied sample, this subgroup of the population seems to partly represent program participants.

In light of the result of this analysis, information on additional vehicles available in households would be crucial in explaining intended travel behavior. Not knowing whether a participant gave up his only vehicle, or a second one, would likely clarify discrepancies between expected and obtained results. Because objective public transit, car share and bike path data was not available province wide, these were not included in analyses. Finally, the theory of planned behavior, the mode choice framework and travel demand management concepts were used, yet available data was not designed with this specific purpose.

CONCLUSION

This paper reported on the travel and vehicle purchase intentions of participants to an early vehicle retirement program. Economic and psychological theories were applied to this transportation problem. There are many factors external to the program that reduce the ability to change habit and shift modes. For both purchase and travel intentions, travel habits (distance travelled in previous year), income and perceived access to transit had inverse associations with intentions to use alternative travel modes (especially transit and bicycling) and with vehicle travel and purchase intentions. Where a positive relationship was found for alternative travel, a negative association was found for automobile travel and purchase. Program managers and participating agencies must be cognizant of the difficulties associated with breaking habits, dealing with households' pecuniary constraints and with limited real or perceived access to alternative travel as barrier to behavioral intention. Intentions to travel using alternative mode were strongly associated with how feasible this mode of travel effectively was perceived. With changing social norms, incentive-based TDM programs such as this one may generate greater benefits (Gärling and Schuitema, 2007) by attracting more convinced mode shifters. Changing social norms is an integral part of the program itself, and so is creating a break in habit. Targeting markets of users that typically travel short distances will ensure greater take-up of alternative travel incentive, and may have a stronger impact on permanent mode shift. Broader sustainable travel objectives include the objective of reducing overall travel distances to reduce emissions from the vehicle fleet. If successful, this objective could potentially have the indirect effect of making alternative travel take-up more popular with program participants. Without a clear pre-post design to assess post-program behavior, the modal shift attained with this program cannot be confidently asserted.

Acknowledgments

The author thanks AQLPA for sharing their program data and providing insights on their use throughout the project. The *Service aux collectivités* of the Université du Québec à Montréal as well as the *Villes, régions monde* network are also thanked for funding the project and

supporting this University-Community Partnership. Finally, Alexis Pelletier Audette is acknowledged for help with data gathering and literature review.

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