

A SURVEY OF CARSHARING PREFERENCES

by

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ABSTRACT

A survey of attitudes to carsharing is described. Stated response techniques were used, with respondents asked to make various choices between hypothetical alternatives and to indicate how they would behave in hypothetical situations. This provided a rich but inexpensive set of data on the preferences and predicted behaviour of people in Calgary, Canada who generally had no prior experience with carsharing. The impacts of various service attributes on the overall attractiveness of carsharing are shown, allowing different service options to be compared as to their attractiveness. Various socio-economic and neighbourhood characteristics were found to strongly influence the choice of whether to car share. The survey results have already directly influenced an organization that plans to implement car sharing in Calgary.

KEY WORDS

car sharing; stated response; stated preference; Calgary, Canada

1. INTRODUCTION

A car sharing service makes vehicles available in a way that facilitates multiple users for each vehicle. Car sharing is often promoted as an alternative to vehicle ownership by providing the convenience normally associated with owning a vehicle. As an alternative to vehicle ownership, car sharing can be environmentally beneficial as it requires less parking and discourages inappropriate auto travel with a pay-per-use structure. To be commercially and environmentally successful, car sharing needs to offer a service that is seen as "better" than car ownership for a large enough number of people.

This paper describes a survey that was designed to answer two questions: 1) what kind of car sharing organization is most desirable?, and 2) which people would join a car sharing organization under different conditions?

2. SURVEY DESIGN

A stated preference survey was designed to force people to make choices in hypothetical situations. Four types of hypothetical choices were collected from each respondent:

- **Ranking Choice:** Respondents were presented with three different hypothetical car sharing organizations on a page and asked to rank them according to their attractiveness.
- **Joining Choice:** Respondents were asked whether they would join each hypothetical car sharing organization if it was the only car sharing service available.
- **Selling Choice:** For each hypothetical car sharing organization that a respondent indicated they would join, the respondent was asked whether they would sell one of their own vehicles as a response to joining that organization.
- **Usage Choice:** For the hypothetical car sharing organization that the respondent found most attractive, they were asked to indicate how much they would use the service.

The hypothetical car sharing organizations were described in terms of a number of attributes. These attributes were randomly computer generated for each survey using the INVIEW software (Hunt *et al*, 1995). Thus *each survey respondent* faced a unique set of alternatives, and no two surveys were alike. The attributes were:

- the type of car sharing organization ("Car Sharing Cooperative", "Car Club" or "Short Term Auto Rental")
- whether the cars were parked close to the respondent's home or whether they were parked close to some other attractive location (respondents were asked to identify one other attractive location for a car sharing service before they were asked to make any hypothetical choices)
- the walking distance to the vehicles
- the fee for joining the organization (in Canadian Dollars, with \$Can 1.00=\$US 0.67)
- whether the fee was a refundable deposit, a one-time (non-refundable) fee or an annual fee

- the type of reservation system (various combinations of "automated (touch tone) telephone", "24 hr live operator telephone" and "internet")
- the reliability guarantee ("xx% availability for yy bookings" where yy is either "24 hr advance" or "last minute")
- the hourly usage fee
- the per kilometre distance fee
- the age of the available vehicles (from "brand new" to "5 years old")
- the type of vehicles offered (compact or mid-sized cars, with or without a "minivan for special trips" or a "truck for special trips")

In addition, for every alternative it was specifically reiterated that "fuel and insurance are handled by the organization."

Figure 1 shows an example of one randomly generated hypothetical alternative. Three such alternatives were presented on a page, and two such pages were presented to each respondent. To the left of the alternative is the space where the Ranking Choice is indicated by the respondent. To the right of the alternative is the space where the Joining Choice and Selling Choice is indicated by the respondent.

Rank (1,2,3)		Would you join?	Would you sell your car?
	<p style="text-align: center;">"DAE Car Sharing Cooperative"</p> <ul style="list-style-type: none"> • cars are parked close to your home • 300m walking distance to vehicles (4 minutes at an average walking speed) • \$800 Membership Deposit (refunded within 1 month of withdrawing from the club) • Automated (Touch Tone) Telephone reservation system • reliability guarantee: 90% availability for last-minute bookings • \$1.50 per hour usage fee • \$0.15 per km distance fee • 1 year old mid-sized cars • Fuel and insurance are handled by the organization 		

Figure 1: Example of a hypothetical computer-generated carsharing alternative

To make the Ranking Choice easier (which makes responses more realistic - see Hunt *et al*, 1995), many attributes were held constant on a page. Those attributes that varied on one page were printed in **bold face**.

The survey was conducted in Calgary, Canada, where no carsharing organization or short term auto rental service currently exists. The group planning on introducing carsharing (The Calgary Alternative Transportation Cooperative - CATCO) had experience in explaining carsharing, and had found that it took

some time before an average Calgarian understood the concept and how it might apply to them. Many people were initially opposed to the idea in principle, warming to the idea only as they considered how the service might be structured and how they might make individual trips. Other people immediately assumed that carpooling or ride-sharing was under discussion: some effort was necessary to convince them that they would be allowed to use the shared cars as solo drivers.

Given this experience, the idea of a short survey was abandoned because it would not allow enough time for respondents to comprehend the car sharing concept. The final survey was five pages long. The first page described car sharing, gave several typical examples of how different types of households can adapt when car sharing is available, and provided a space where respondents could provide contact information if they wished to be kept informed of CATCO's progress towards introducing car sharing in Calgary. The second page collected information on household composition and the types of automobiles owned by the household, asked respondents to indicate another location (other than near their home) where they might like to have access to shared cars, and gave instructions for the third and fourth page. The third and fourth pages were unique to each survey, and each described three computer generated hypothetical car sharing organizations (as described above.) These pages collected the Ranking Choices, the Joining Choices and the Selling Choices. The last page collected the Usage Choice, and then collected some of the more personal information on the household (income, ages, genders, etc.)

An example of a full survey instrument is available at <http://www.ucalgary.ca/~jabraham/CSSurvey.PDF>. A general overview of stated preference survey design is given in McMillan *et al*, 1997.

2. DATA COLLECTION

The Calgary Alternative Transportation Cooperative had not yet even officially formed when the survey was begun in March 1999 (Grenier, 1999). Part of the purpose of the survey was to provide the market research necessary to prove the concept to the firms or members that would provide the capital necessary to begin carsharing. Hence the budget for the survey was extremely limited. Four different approaches were used to collect survey data at a low money cost:

- Booths were rented at various community events. The purpose of CATCO and the concept of carsharing was presented in the booth, and a table was available where people could fill out a survey. Completed surveys earned a coupon for a free cappuccino or cafe latté. The length of the survey made it difficult to recruit respondents in this setting.
- Individuals were intercepted on public sidewalks and asked if they could take 10 minutes in the next "day or two" to fill out a survey. If they seemed receptive, the concept of carsharing was very briefly explained and they were offered the survey together with a stamped return envelope. Approximately 15% of surveys delivered in this manner were returned.
- Surveys were delivered to a selection of dwellings in a community, together with a covering letter specifically explaining how car sharing might be structured to benefit that very community. Again, a free specialty coffee was available by returning the survey to a cafe that was within 400 metres of the selected homes, but a stamped return envelope was also provided. Approximately 15% of the

surveys were returned, with about half of those returned by mail and the other half claiming their free coffee beverage.

- The people behind CATCO asked their friends and other associates to complete surveys.

As the organization progressed and local awareness grew, numerous individuals phoned CATCO and asked if they could complete a survey.

The cafe sponsorship fit well with the very local nature of carsharing that CATCO was envisioning. CATCO expected that most of the members would walk to pick up a vehicle, and that a critical mass of members would be required within a very small area before car sharing would be viable. This is very similar to the market of independent neighbourhood specialty coffee shops in Calgary.

Two hundred and forty-two surveys have been printed as of June 1999, and 50 have been returned.

All of the various collection methods obviously had a large potential for *self selection bias*, where individuals who are more likely to car share are also more likely to have responded to the survey. To allow for this to be investigated, a sample of homes in individual communities will be recruited *in person* to participate in a second wave of the survey.

3. MODEL

The choice data were analysed with *logit models* (see Ben-Akiva and Lerman, 1985, for a comprehensive discussion.) The models are based on *utility functions*, which provide a numerical measure of the attractiveness of an option. The logit model uses these utility functions to calculate the probability that a choice will be made, with a higher utility leading to a higher probability that the option will be chosen. The predicted probabilities are compared with the observed choices, and the *parameters* of the utility function are estimated to find the model that is most likely to predict the choices that were made by the survey respondents. The form of the utility function and structure of the logit model can be adjusted by the analyst in response to various theories and hypothesis, but the parameter values associated with that form are estimated by a strict mathematical procedure that analyses the choices made by the respondents.

This has several advantages:

- The individuality of each survey respondent is respected and can be investigated, allowing this type of survey where each respondent faces a unique set of choices;
- The modelling is based on strong theories of behaviour and not just on statistical correlations, allowing insight into the ways individuals make decisions;
- The same form of model can be used to predict the probability of any one individual responding in any particular way when faced with specific conditions, and these can be aggregated together in a computer simulation to predict the response of a particular market segment.

Some respondents indicated that it was difficult for them to predict how much they would use the vehicles of a car sharing organization (the Usage Choice). This was not unexpected, as anecdotal evidence from other car sharing organizations across Canada suggested that it takes some time for members to adjust their driving habits after choosing to join a car sharing organization. The choices between car sharing

organizations (the Ranking Choice) and the choice of whether or not to join (the Joining Choice) were easier for respondents. The remainder of this paper discusses an analysis of the Ranking Choices and the Joining Choices.

These choices were analysed by specifying that both should use the same utility function. This is an approximation, perhaps, because individuals might "sign up" with any organization that has very low minimum fees, even if the remaining attributes of service are unattractive. In other words, they might join an unattractive car sharing organization but not make use of the services. Certain statistical tests indicated that the same utility function was not inappropriate. In fact no respondent indicated they would join a car sharing organization that they rated less attractive than car sharing organizations they wouldn't join.

4. RESULTS

The resulting utility function is shown in figure 2. This figure indicates the coefficients of each attribute in a linear function. For instance, the coefficient of "\$500 annual fee" is approximately -2.0. This indicates that an additional annual fee of \$500.00 reduces the attractiveness of a car sharing organization by 2.0 "utils". The units of "utils" are a measure of the attractiveness of an alternative, so negative utils indicates a less attractive alternative. A difference of 3 utils between any two alternatives in the Ranking Choice gives a 95% probability that a respondent will choose the alternative with the higher utility.

Important results can be seen by comparing the lengths of various bars in figure 2. The "\$500 deposit" and "\$500 onetime" coefficients are smaller than the "\$500 annual" coefficient, indicating the predictable response that people would rather pay less often and get their money back. The "\$500 deposit" is still surprisingly large, however, suggesting that respondents demand a high rate of return on their investment, probably at least in part because they feel that investing in a car sharing organization is risky. This suggests that the average member would not be a good source of equity for CATCO. CATCO still intends to charge a membership deposit, but it will be designed to serve more as a damage deposit than as a source of equity. These characteristics reflect the average survey respondent; certain individual members may be willing to invest additional money into CATCO.

The relatively large size of the "\$500 onetime" coefficient (almost as large as the "\$500 annual" coefficient) suggests that the average respondent is not considering making a long-term commitment to carsharing.

The coefficient for "cooperative" was eliminated from the model (and figure 2) because it was found to be small both practically (the hatched bar was small) and statistically (the black bar was large in comparison to the hatched bar.) This indicates that there is no measurable preference for an organization calling itself a "Car Sharing Cooperative" over organizations called "Short Term Auto Rental" or "Car Club". This is possibly because no effort was made in the survey to explain the benefits of a cooperative. CATCO still believes that a cooperative offers substantial benefits for carsharing. (Grenier, 1999.)

The preference for shorter walking distance was initially found to be quite low, which could indicate that respondents are willing to walk a long distance to pick up the vehicles. When this was further investigated, however, it was found that this could be broken into two different effects. First, there is some suggestion that people in households with no automobiles were not that sensitive to walking distance, (indicated by the

small size of the "each 400m walk (no car)" coefficient in figure 2) perhaps because they are accustomed to walking longer distances or because they have a lower income and hence are more willing to walk further to save money. Second, those households that owned cars found the first 400m of walking distance to be quite unattractive ("first 400m walk"), but beyond 400m they had little aversion to longer distances ("each add. 400m walk"). A hypothesis that could explain this is that these people imagine themselves being dropped off at the car sharing parking location by another household member using a household car when the shared cars are more than 400m away. The second wave of the survey will test this hypothesis directly by asking respondents how they would pick up the shared vehicle.

The suggestion that a significant number of their potential members are willing to drive longer distances to pick up their vehicles has direct relevance to CATCO. First, CATCO is concerned that the environmental objectives of carsharing will be more difficult to accomplish if members drive long distances to pick up vehicles. Second, CATCO realizes that a critical mass in one particular neighbourhood might not be necessary for car sharing to be viable in Calgary. Related to both of these, CATCO realizes that a city-wide (instead of local neighbourhood) marketing effort could help it achieve financial viability but could hinder its achievement of various environmental objectives.

Respondents had a measurable preference for carsharing near their home instead of the other location they identified as being attractive to carsharing ("not home" in figure 2). (This is further reinforced by the fact that some respondents could not identify any other attractive location.) Workplaces, LRT stations and shopping centres were most commonly listed as other locations. The sheer number of potential customers at these sites might make them viable as car sharing locations in spite of the greater preference for neighbourhood based car sharing.

There was no measurable preference for either a 24 hour live operator reservation system or an automated touch-tone reservation system, so these were dropped from the model and from figure 2. There is some indication that an Internet reservation system would be preferred either by itself ("internet reservation") or in combination with one of the telephone systems ("+internet reservation").

The availability guarantee was fairly important, with an additional 10% unreliability being as bad as approximately \$75 annual fee (comparing the length of the "each 10% of unreliability" bar with the length of the "\$500 annual" bar). However, offering a last-minute reliability guarantee ("last min reliability") instead of a 24 hour advance guarantee improves the attractiveness of the car sharing organization by about the same amount as reducing the annual fees by \$175. The actual reliability that can be guaranteed depends on the amount the vehicles are used and the number of vehicles that are provided. The ability to provide vehicles depends on the amount of money that is collected from members, which depends on the number of members that join and how much they use the vehicles. Thus there is a circular relationship between reliability, attractiveness, and costs (revenue), and none of these can be predicted without considering the other two. This emphasizes that the demand model developed from this survey needs to be combined with a model of the carsharing organization itself before complete predictions can be made.

The per kilometre fee and the per hour fee were not seen to be too onerous: One dollar per hour was only as onerous as \$140 per year, and \$0.10 per km was only as onerous as \$65 per year. There are different possible reasons for this. One is that respondents imagine themselves using the vehicles very little (as little as 12 hours per month and 55 kilometre per month if inelastic usage and cost minimizing is assumed). A

second is that respondents are not minimizing their predicted cost, but instead choose options that preserve flexibility. This is a common type of behaviour, and it is exploited by airlines when they charge substantially more for cancellable tickets. These survey results have prompted CATCO to consider these per-use fees as its main revenue source, as such a fee structure could encourage membership, provide flexibility to members, and help to achieve the reliability guarantee and the environmental objectives of the organization. A third possible reason is that respondents did not calculate how much they would be paying in usage fees. When faced with a real decision instead of a hypothetical decision respondents may take more time to calculate the full impact of usage fees and be more sensitive to them.

In the lower part of figure 2 (under the legend), various respondent characteristics are shown. The Ranking Choices do not inform these parameter values at all -- they are based entirely on the Joining Choices. The Joining Choices were significantly harder to predict. A utility difference of 8.4 utils is necessary before the model can predict a choice with 95% accuracy.

It was assumed that households with no drivers at all would not join a car sharing organization. Households with two or more drivers were more likely to indicate they would join because they obviously have a greater need for vehicles. Similarly, households who own more private vehicles are less likely to join.

A surprising result was that respondents who lived on streets with "restrictions or controls on street parking" ("neigh. parking controls" in figure 2) were much more likely to say they would join a car sharing organization. Three related hypothesis have been developed to explain this. First, the restrictions on parking could make vehicle ownership much less attractive and encourage people to find alternatives. Second, it could be that people who are very attached to vehicle ownership would not choose to live in areas where they may not be able to park their vehicles in front of their homes. Third, the areas of parking restrictions in Calgary are where the demand for parking is very high -- because they are within walking distance to major employment centres, major transit routes (including Light Rail Transit) or important shopping districts. Those people living in these communities could obviously meet more of their needs on foot than those people who live in homes that are not close enough to anything to be high demand parking spaces. The error in this coefficient (black bar in figure 2) is still quite large, however, cautioning that this result may not hold when more data is collected.

Other results include:

- There is very little preference for newer cars (hence this was dropped from the model and does not appear on figure 2.)
- There is significant desire for having a "minivan available for special trips", equivalent to about \$150 per year. Once a minivan is available there is no measureable additional desire for a "truck for special trips" (and the availability of trucks was dropped from the model and from figure 2.)
- People with lower incomes are more likely to consider car sharing, lending support to the hypothesis that car sharing is an attractive alternative for poorer people who find car ownership too expensive.
- There are initial indications that men, younger people and people with less children are more attracted to car sharing. But there are not enough data to conclude that these indications are statistically significant.

CONCLUSIONS

The model predicts the Ranking Choices made by respondents comparing hypothetical car sharing organizations much better than it predicts the Joining Choices where respondents indicate whether or not they would join a particular car sharing organization. This is partly due to the structure of the survey (which was initially designed to determine what type of service to offer) and partly because it is always easier to compare more similar alternatives because there are less sources of randomness.

The coefficients estimated from the Joining Choice data (in the lower portion of figure 2 below the legend) are larger than most of the characteristics of the car sharing organization (in the upper portion of figure 2). This indicates that the person and their situation is more important than most of the details of the car sharing organization when making a prediction as to whether he or she will join. In the absence of direct competition, it might be more important to focus on reaching the right market than on fine tuning the details of the service. Fortunately, the survey provides information to commence both tasks.

The biases in the sampling methods and the fairly large uncertainties on many of the coefficients suggest that more data should be collected with a more controlled sample. This would correct the sampling bias, which could lead to sizeable changes in the coefficients of the respondent characteristics for two main reasons:

- Individuals who are less likely to carshare (and hence less likely to have responded to the survey) probably have similar relative preferences for the various attributes of carsharing but obviously have significantly different preference towards carsharing in general.
- The standard errors on many of these coefficients are quite large. More data should allow these to be estimated more precisely.

The survey has provided important data to understand attitudes towards car sharing and has helped CATCO in its strategic planning. The use of stated response methods, where respondents were asked how they would behave in hypothetical situations, provided a rich and useful data set with only 50 completed surveys. This points to the overall power of stated preference technique. Certain findings (e.g. the unimportance of access distance beyond 400m) suggested changes in survey design, highlighting the value of ongoing (concurrent) data collection and data analysis.

Many of the attributes of car sharing service can not be arbitrarily set by a carsharing organization, because the carsharing organization's budget is constrained by the amount of revenue it can generate. This is substantially different than modelling for government transportation planning, where the availability of tax revenue makes any reasonable scenario theoretically possible. Hence, in car sharing a demand model such as the one presented here needs to be used together with a supply model that describes the business of car sharing. There are numerous ways to do this, and CATCO is currently working on a simple (spreadsheet-based) supply-demand model that would allow it to investigate various carsharing scenarios for Calgary.

Important findings include the large implied aversion to membership deposits, the relatively small sensitivity to per kilometre fees and the support from those who lived on streets with "restrictions or controls on street parking". Further research should be designed to investigate these aspects more fully.

Reliability was defined in terms of a "reliability guarantee" in the survey. One easy way to achieve a 100% reliability guarantee is to keep one car with usage fees so high that no-one ever uses it. This suggests that varying prices according to predicted demand could provide the reliability that respondents desire while still offering reasonable prices when demand is low. This is akin to congestion pricing for roads (Mohring) or yield management by airlines. Yield management theory may be directly applicable to car sharing, except airlines are profit motivated while CATCO is a democratic cooperative with an environmental mandate.

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