**Title:** Revealed choice of a new generation: travel behaviour of older drivers in rural New Brunswick, Canada

**Submission date:** July 23, 2010
Revision date: October 19, 2010
**Word count: 4436 + nine (9) tables**
**Author name:** Trevor R. Hanson, Postdoctoral fellow, Department of Civil Engineering, University of New Brunswick
Eric D. Hildebrand, Professor, Department of Civil Engineering, University of New Brunswick

**Mailing address and contact information**
University of New Brunswick Transportation Group
Department of Civil Engineering
P.O. Box 4400
University of New Brunswick
Fredericton, Canada, E3B 5A3
506 453-4521
506 453-3568 fax
thanson@unb.ca

**ABSTRACT**

The effects of aging, in concert with high automobile dependence due to limited alternatives, means rural older people are particularly vulnerable to losing automobile-related mobility with age. The development of successful alternatives requires replicating the conditions that make car use attractive which begins with enhancing the understanding of how current rural older drivers use their cars. Detailed travel information from Global Positioning System (GPS)-based travel diaries, supported by participant stated responses can lead to a better understanding of these conditions at a level not typically explored for this group.

This paper profiles the travel behaviour of a convenience sample of 60 drivers (average age 69.6 years) in rural New Brunswick, Canada collected through GPS-based travel diaries and participant-supplied contextual information. Participants completed an average of 4.29 driving trips per day and 1.06 passenger trips per day in their own vehicles, while travelling in 81% of all eligible survey days. The proportion of passenger trips taken in one's own vehicle increased with age for men and decreased for women, and was equivalent for men and women aged 75 years and older. "Higher Order/Serving Others" and "Life Maintenance" trip purposes comprised 55% and 45% of all trips, respectively. Participants completed 67% of "shopping" trips and 72% of "medical" trips in urban areas with 76% of "social" trips in rural areas. Rural participants were able to meet many of their life maintenance and higher order needs in rural areas, suggesting that transportation access to urban areas cannot be the sole impetus of transportation policy for non-drivers.

## INTRODUCTION

The study of the travel behaviour of rural older drivers has been limited to large self-reported surveys, such as the National Household Transportation Survey or small focus groups. Global Positioning System (GPS)-based travel diaries have emerged as a popular tool for collecting revealed data (what drivers actually did as opposed to relying solely on stated information), however, few if any studies have specifically employed them in the study of rural older drivers. There are several emerging older driver research areas that would benefit from being explored with travel data from a rural perspective: self-regulation among drivers; low-mileage bias; and the travel behaviour of the current and next generation of older drivers. Each of these research areas requires a base of detailed exposure data for effective analysis which is only possible to obtain through GPS data collection. These data for older drivers in the rural context are not known to exist.

This paper describes the findings from a GPS travel diary survey of 60 participants in rural New Brunswick, Canada (29 men, 31 women, average age: 69.6 years) in terms of revealed travel behaviour. It presents a summary of the survey methodology, major findings in terms of vehicle usage by age and gender, discussion of survey issues (including a commentary on the potential for use in a better understanding of self-regulation and low-mileage bias), and conclusions. The results presented offer a baseline of revealed trip making data not known to exist in this level of detail for this particular group and can provide support to the development of driving alternatives in rural areas.

### Literature Review

The impetus for older driver research is rooted in two realities: North American society is (for the most part) structurally dependent on the automobile; the process of aging can make driving difficult or impossible over time. Factor in the expected growth in the population of older people (doubling in Canada to 23% of the total population by 2031 (*1*)), and the shift in driver composition (the next generation of older drivers will include life long drivers and many more women (*2*)), this suggests challenges involving older driver safety and mobility could have system-wide impacts over time.

Often overlooked in this paradigm are the travel needs of older people in rural areas. While most North Americans live in urban areas, 19 of 50 U.S. states and 4 of 10 Canadian provinces, have rural populations nearing 40% or more of the total population of the jurisdiction (*3*, *4*). Rural older drivers, by virtue of geography, drive farther, and (for those over the age of 80) more frequently that their urban counterparts (*5*), suggesting a higher reliance on their vehicle to meet their needs. Since many drivers will likely outlive their ability to drive (*6*) and have limited alternatives available (*7*, *8*, *9*), it raises questions about how this group will be able to meet their needs without driving.

Cobb and Coughlin indicate that the first alternative transportation mode of choice for older people is riding in a car with friends and family (*10*). They argue that the attributes that make travelling with friends and family the preferred choice "must be studied further and replicated in any transportation option that is likely to serve as a true transportation alternative to driving." By extension, a better understanding of how rural older people that *currently* drive meet their needs with their own vehicle could provide a necessary baseline to assist in that replication.

The challenge is that the current understanding of rural older driver behaviour is based on large-scale self-reported datasets which include limited contextual information, or from small focus group studies. The National Household Travel Survey has been considered to be limited in "the level of detail required to inform decisions about location-specific issues" (*11*). The Canadian Vehicle Survey (*12*) is also limited in specific details on rural people, including women and those over the age of 85 years and has tended to present aggregate information of primary benefit for national policy discussions. Since rural older drivers have the attributes typically associated with underreporting on surveys (between 50-69 years of age, men, people who are unemployed, those who travel long distances (> 32 km) on an average trip, and those who trip chain) (*13*), a dataset based on actual vehicular travel (including other contextual information such as passenger travel and adaptive behaviour) would be integral to alternative development.

The use of Global Positioning System (GPS)-based travel data, which can provide a complete record of travel, has been discussed in several research efforts (*14*, *15*, *16*, *17*, *18*). GPS-based travel data collection has also been employed to study older drivers through the Candrive initiative (Canadian Driving Research Initiative for Vehicular Safety in the Elderly) (*19*), though the initiative is primarily medically-related and draws volunteers from seven Canadian urban centres. Hildebrand et al. (*7*) first demonstrated the benefits of using this technology (including the prompted recall method) to reduce respondent burden and incidence of missed trips for rural older drivers. Applying this method to a larger sample group for a longer period of time would result in a travel database that fills gaps known to exist in the knowledge base regarding the travel needs of rural older drivers.

## METHODOLOGY AND DATA SOURCES

This study employed passive GPS units installed in participant vehicles, with passenger, trip purpose and other contextual information collected through interviews including prompted recall and stated adaptation methods. Participants were recruited through convenience sampling methods, an accepted non-probability method when dealing with a sensitive issue (such as driver's licensing issues) (*20*). A threshold of 60 years of age was used for inclusion, though two participants (one aged 54 years and the other 56 years) were permitted by virtue of being retired or working from home, where it was not expected that their travel patterns would differ from inclusion with those 60 – 64 years of age.

An initial meeting was held with participants to review the study and consent forms and to collect some basic demographic information. A ShadowTracker J2 device (with battery pack) was placed in participant vehicles for up to 7 days, upon which a meeting was arranged with the participant to collect the unit and conduct a post-survey interview. The GPS data from the ShadowTracker J2 was immediately loaded into a laptop for display on the proprietary Geographic Information System (GIS) that accompanied the unit. The participant's travel was displayed on a digital map of the local area with "stops" (a user-defined time threshold of non-movement, in this case, 1 minute), organized by day of the week. "Stops" typically signalled the end of a trip, but in some cases the "stops" involved waiting at stoplights or traffic. The interviewer worked with the participant to review the GPS data on the GIS to assign trip purposes and

passenger information to each "stop", in turn identifying which "stops" actually corresponded to the end of a trip. This interview process took approximately 1 hour. Trip purposes were assigned in 1351 of 1362 participant driving trips, with only 11 trips unable to be recalled by participants.

"Rural" was considered anything outside of an "urban" area as defined by Statistics Canada *(21)*, which is an area with a minimum population of 1000 and minimum population density of 400 people per square kilometre. Some exceptions were made for including "urban" areas of a couple thousand people if they appeared to share a common transportation experience (a single traffic light in the community, for example) with a similar sized rural community not meeting the population density threshold.

A trip was defined as a travel activity from one origin to one destination. A new trip began where the destination point of the old trip becomes the origin for a new trip. A journey from a participant's home to a gas station, then to the mall and directly back home again was considered a "trip chain" and consists of three separate trips. Trip making as a metric describes the frequency of daily use of transportation. The "trip" is the fundamental unit for measuring travel (in traditional travel demand modelling). In traditional travel demand modelling, each "trip" is assigned a "mode" (such as car or transit). In this research, since only participant vehicles were instrumented, only the automobile "mode" was studied.

## RESULTS

Participant data were organized into a participant and trip database developed by the University of New Brunswick. The database consisted of 320 days of travel, 1494 trips, 12449 km of travel for 60 rural participants (29 men, 31 women) aged 54-92 years old (average 69.6 years), recruited through convenience sampling, snowball sampling, and advertisements. Participants completed 1362 trips as driver, 58 trips as passenger in their own vehicles (with a non-participant as driver), with the remaining 74 trips involved exclusive use of the participant's vehicle by a non-participant. The data in TABLE 1 show the breakdown of participant attributes by age and gender in terms of total count, average household size, number of vehicles per household, distance to the nearest urban area and average annual self-reported kilometres.

**TABLE 1: Summary Of Participant Attributes**

| | Male | | | | Female | | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | **54-64** | **65-74** | **>75** | **Total** | **54-64** | **65-74** | **>75** | **Total** | |
| Count | 9 | 13 | 7 | 29 | 11 | 14 | 6 | 31 | 60 |
| Avg. household size (people) | 2.1 | 2.0 | 1.9 | 2.0 | 2.0 | 1.9 | 1.8 | 1.9 | 2.0 |
| Avg. number of household vehicles | 2.0 | 1.6 | 1.1 | 1.6 | 1.6 | 1.8 | 1.2 | 1.6 | 1.6 |
| Avg. distance to urban area (km) | 19.7 | 38.9 | 18.4 | 28.0 | 27.8 | 37.0 | 19.8 | 30.4 | 29.3 |
| Avg. years in current home | 24.2 | 19.6 | 31.6 | 23.9 | 25.4 | 21.6 | 50.2 | 28.7 | 26.4 |
| Avg. km driven per year (x 1000) | 26.0 | 21.1 | 18.7 | 22.0 | 10.5 | 9.7 | 5.7 | 9.2 | 15.4 |

Chi-squared tests showed that the distributed attributes of the sampled participants (in terms of age, gender, labour force characteristics, annual kilometres driven, days per week sampled, etc) did not differ significantly from the population from which they were drawn.

Data from the University of New Brunswick 2010 study show in TABLE 2 that the average daily trip-making trends between men and women and by age were consistent with previous findings (such as *22*) where number of trips taken decreases with age and between the sexes.

**TABLE 2: Average Number Of Trips Per Day By Participants In A Household Vehicle**

| | Male | | | | Female | | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | **54-64** | **65-74** | **>75** | **Total** | **54-64** | **65-74** | **>75** | **Total** | |
| Driver | 6.83 | 5.83 | 2.98 | 5.46 | 3.60 | 3.15 | 2.57 | 3.20 | 4.29 |
| *StdDev* | *2.06* | *2.40* | *2.57* | *2.70* | *2.33* | *2.78* | *1.65* | *2.40* | *2.77* |
| Passenger | 0.10 | 0.00 | 0.93 | 0.26 | 2.03 | 2.13 | 0.63 | 1.81 | 1.06 |
| *StdDev* | *0.25* | *0.00* | *1.48* | *0.80* | *1.78* | *2.24* | *0.71* | *1.91* | *1.67* |
| Avg. Total | 6.93 | 5.83 | 3.91 | 5.72 | 5.63 | 5.28 | 3.20 | 5.01 | 5.35 |

Interestingly, the number of trips per day taken as a passenger in a household vehicle decreased for women aged 75 years and older, while for the men 75 years and older, it increased. When passenger trips in a household vehicle are included in total participant trip-making, the difference between the trip-making of men and women is far less dramatic than considering driving trips exclusively.

**Passenger travel behaviour in household vehicle**

Data in TABLE 3 show that male participants younger than 75 years made nearly all of their trips as a driver, while male participants over 75 years made only 71% of their trips as a driver. Female participants aged 65-74 made fewer trips as a driver than those younger than 65 years (56% vs. 64%), however those over the age of 75 made proportionally more trips as a driver than men aged 75 years and older.

**TABLE 3: Proportion of trips taken in household vehicle as driver and passenger**

| | Male | | | | Female | | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | **54-64** | **65-74** | **>75** | **Total** | **54-64** | **65-74** | **>75** | **Total** | |
| **Driver** | 0.99 | 1.00 | 0.78 | 0.96 | 0.67 | 0.63 | 0.79 | 0.67 | 0.81 |
| **Passenger** | 0.01 | 0.00 | 0.22 | 0.04 | 0.33 | 0.37 | 0.21 | 0.33 | 0.19 |

It appeared that the female participants were more likely to be a passenger in their own vehicles and that the driver was generally male (their partner). Male participants over the age of 75 appeared more likely to be a passenger than their younger counterparts and that it was the female participants that were driving more.

The fact that female participants aged 75 years and older conducted a higher proportion of their trips as driver was surprising for the majority (4 of 6) were in two person

households. The observed decrease in the number of driving trips by men aged 75 years and older appeared to be offset by an increase in the number of driving trips by their spouses.

Travel behaviour between male and female participants appears to be noticeably different in terms of the percentage of their driving trips made with their spouse (or other household member). Data in TABLE 4 show male participants younger than 65 years completed 62% of their trips without the presence of a household member, compared to 100% of female participants 65 years of age and younger. For men, 38% to 48% of all trips were taken with a female household member as passenger, compared to 0 – 24% of all trips for women with male household passengers. It should be noted that these values also contain information on "non-participants" as household passengers.

**TABLE 4: Number and percentage of driving trips taken by participants with a household member as passenger**

| | Male | | | | Female | | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | **54-64** | **65-74** | **>75** | **Total** | **54-64** | **65-74** | **>75** | **Total** | |
| **Drive alone** | 173 | 213 | 68 | **454** | 201 | 229 | 68 | 498 | **952** |
| **Female pax.** | 106 | 196 | 43 | **345** | 0 | 0 | 0 | 0 | **345** |
| **Male pax.** | 0 | 0 | 0 | **0** | 0 | 16 | 21 | 37 | **37** |
| **Total trips** | **279** | **409** | **111** | **799** | **201** | **245** | **89** | **535** | **1334*** |
| **% drive alone** | **62** | **52** | **61** | **57** | **100** | **93** | **76** | **93** | **71** |

*Pax. = Passenger*

** An additional 28 driving trips were not included due to lack of passenger information*

These results suggest that there is a higher reliance by the female participants and household members on the male participants for trip-making, though the proportion of male household members as passengers is highest for women older than 75 years. Male participants were more likely to drive with their female household member as a passenger than the converse.

## Travel survey immobility

An important measure of travel behaviour is the probability that a participant will travel in any given day. This is an important consideration for the development of any transportation alternative since it provides an indication of how many days per week travel demand exists. Since information on driving and passenger behaviour was recorded, it was possible to develop proportions in a participant's survey period where travel took place as a driver, passenger in a household vehicle and as both.

The data in TABLE 5 describe the probability of travel in any given day by participants, organized by age and gender. The probability of "travelling in any given day" consists of the proportion of the days in the survey period where participants travelled as a driver or a passenger in their household vehicle. In some cases, participants were only drivers and were only passengers, and in some days, both, which is why the sum of the probabilities of driving in any given day and being a passenger do not total the probability of travelling in any given day.

**TABLE 5: Probability Of A Participant Travelling In Any Given Day**

| | Male | | | | Female | | | | Grand Total |
|---|---|---|---|---|---|---|---|---|---|
| | <65 | 65-74 | >75 | Total | <65 | 65-74 | >75 | Total | |
| Driving in any given day | 0.89 | 0.84 | 0.45 | 0.78 | 0.58 | 0.54 | 0.65 | 0.58 | 0.67 |
| Passenger in any given day | 0.05 | 0.00 | 0.24 | 0.06 | 0.44 | 0.36 | 0.11 | 0.34 | 0.21 |
| Travelling in any given day | 0.89 | 0.84 | 0.67 | 0.82 | 0.87 | 0.80 | 0.71 | 0.81 | 0.81 |

The probability of women aged 75 years and older travelling as a passenger in their household vehicle in any given day was approximately half that of men of the same age. This does not appear to be a function of household size, as only one female and one male participant over the age of 75 years lived in a one-person household. One possible explanation is that in a two-person household (consisting of a married couple), the younger female participants often accompanied their partners as a passenger, while more of the driving was shared between men and women aged 75 years and older.

On average, participants did not travel in their vehicle in 19% of study days. This is lower than the non-travel rate of 31% found by Schmöcker, et al.(22) in their study of London seniors and by Madre, et al. (*23*) who found immobility rates above 30% in rural areas outside of Paris. Madre, et al. argued that surveys where immobility was greater than 8-12% (based on their estimates) may be due in part to "soft refusal" by participants (i.e., not driving as a means to not respond to surveys). It is highly unlikely this "soft refusal" took place in this research since the GPS provided a complete record of vehicular travel. It was possible for drivers to have made walking trips from their home, or to have travelled with another person outside of their home. Knowledge of this may have been interesting, but not critical in this research given that dependence on one's own automobile for trip-making was the focus of the study.

**Trip purposes**

Another critical component of travel behaviour (in addition to the frequency of travel) is the purpose for the travel. Participants were asked the purpose of each trip during the prompted recall interview. Trip purposes as defined by Carp (*24*) and employed by Hanson (*25*) are typically organized into two categories, *Life Maintenance* and *Higher Order*, and each category includes trip purposes in support of each category. Life Maintenance trips are associated with maintaining quality of life, and are generally considered to be trips that are obligatory. These trips include:

- Shopping (groceries, clothes, convenience items, household maintenance, etc);
- Personal errands (banking, mailing a letter, etc);
- Vehicle errands (fuelling, vehicle maintenance);
- Work (part-time or full-time paid labour);
- Medical related (doctor or hospital visits, pharmacy visits for doctor-prescribed medication).

Higher Order trips are associated with personal well-being and have historically been considered discretionary. These trips include:

- Social trips (visiting friends and relatives, organized social activities);

- Dining out/entertainment (having dinner, coffee, going to the movies, going bowling);
- Church/educational (attending faith-based, spiritual events).

The approach by Carp for Life Maintenance and Higher Order-based trips assumes that vehicular use by older drivers is by nature self-serving, which is not always the case (*26*).

A third category of trip-making *Serving Others* seemed appropriate given the observed use of vehicles explicitly for someone else's benefit.

- Picking up/dropping off passengers;
- Errands for others;
- Volunteer work.

Hanson (*25*) included the Serving Others trips as part of Higher Order trip-making. It is the Serving Others trips taken by rural older drivers that present added value to the community by virtue of their transportation service provision. These trips could also be considered discretionary by the vehicle owner, but may actually be an obligatory trip for a passenger (if they are being shuttled to a medical appointment, for example).

Data in TABLE 6 show most of the travel undertaken by participants was in support of Life Maintenance needs, ranging from 29-37% of all trips. In terms of ages, the lowest proportion of Life Maintenance trips was for the 65-74 age range of both sexes. The proportion of Higher Order trip-making was lowest for the youngest men and highest for the oldest men, while this was the opposite for the women. In each case, Higher Order trip-making represented 20- 24% of all trip-making. "Serving Others" was highest for the youngest men and lowest for the oldest men, while women 65-74 had the highest proportion of Serving Others trips. Trips "Home" were the highest for the oldest participants of both sexes.

**TABLE 6: Proportion Of Driving Trips By Trip Purpose By Age and Gender**

| | Male | | | | Female | | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | 54-64 | 65-74 | >75 | Total | 54-64 | 65-74 | >75 | Total | |
| Life Maintenance | 0.35 | 0.32 | 0.37 | 0.34 | 0.33 | 0.29 | 0.33 | 0.31 | 0.33 |
| Higher Order | 0.20 | 0.22 | 0.24 | 0.22 | 0.23 | 0.21 | 0.20 | 0.22 | 0.22 |
| Serving Others | 0.20 | 0.18 | 0.12 | 0.18 | 0.18 | 0.23 | 0.15 | 0.20 | 0.19 |
| Return Home | 0.22 | 0.25 | 0.28 | 0.24 | 0.24 | 0.24 | 0.30 | 0.25 | 0.25 |
| Misc | 0.03 | 0.03 | 0.00 | 0.02 | 0.02 | 0.03 | 0.01 | 0.02 | 0.02 |
| Total | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

When the results are compared to previous studies in the 1970's in Lawrence, MA that included information on Life Maintenance and Higher Order trip purposes, participants in this study completed proportionally more Higher Order trips than Life Maintenance trips while completing proportionally fewer trips home (TABLE 7) (*25*). The results are consistent with a study of non-urban Kentucky communities (*27*) where Higher Order trips were the predominate trip purpose, though it does suggest there is some variability between jurisdictions. It should be noted that while the Lawrence study did not use the terms "Life Maintenance" or "Higher Order", the trip types recorded were similar enough to those employed in this research to permit categorizing them as such. The results of

this study are also consistent with the results of Hildebrand, et al. (*7*) though that was a pilot study that only had 17 participants sampled on average for 2 – 3 days apiece.

**TABLE 7: Distribution Of Trip Purposes Between Life Maintenance And Higher Order Trips By Study Location**

| | Lawrence (1978) | Kentucky (1994) | University of New Brunswick (2004) | University of New Brunswick (2010) |
|---|---|---|---|---|
| Life Maintenance | 61.9% | 38% | 48.4% | 44.6% |
| Higher Order* | 38.1% | 62% | 51.6% | 55.4% |

**Includes Serving Others*

**Trip making location**

Equally important is the knowledge of the proportion of specific trip types and where participants travelled (urban or rural destination) to make that trip. The closure of local businesses and services in rural areas with consolidation in urban areas raises questions about access, especially if one has health issues (*28*). In one community for this research, participants were lamenting the closure of the local credit union resulting in the accounts being consolidated to another community 70 km away. It also has an impact on driver safety as research has shown the oldest rural drivers (aged 81+) had most of their collisions in urban areas those they drive mostly in rural areas (*29*)

The most popular Life Maintenance trip type was "shopping", which comprised 20% of all trips, and with 67% of all "shopping" trips having a destination in an urban area (TABLE 8). It was expected that participants would be taking the greatest proportion of Life Maintenance trips to urban areas, however, participants made the majority of "personal errands" and "vehicle errands" trips in rural areas. Based on trip-making data, it was interesting to find that many participants were able to meet certain needs in rural areas. Some participants appeared able to access some medical services locally as well.

**TABLE 8: Proportion Of Trips By Rural And Urban Destinations**

| | Life Maintenance | | | | | Higher Order | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Proportion*** | Shop | Pers Err. | Veh Err. | Work | Med | Social * | Din | Pick up pax | Vol | Err. for others | All trips |
| All trips | 0.20 | 0.13 | 0.04 | 0.05 | 0.03 | 0.19 | 0.11 | 0.12 | 0.08 | 0.05 | 1.00 |
| Rural destination | 0.33 | 0.65 | 0.63 | 0.40 | 0.28 | 0.76 | 0.44 | 0.79 | 0.81 | 0.82 | 0.60 |
| Urban destination | 0.67 | 0.35 | 0.37 | 0.60 | 0.72 | 0.24 | 0.56 | 0.21 | 0.19 | 0.18 | 0.40 |

**Includes "Church/Educational" trips*

*Shop = Shopping, Pers Err = Personal Errands, Veh Err = Vehicle Errands, Med = Medical, Din = Dining out/Entertainment, pax = Passenger, Vol = Volunteer, Err. for others = Errands for others*

The most common Higher Order trip purpose for male and female participants was "Social Visits", comprising 19% of all trip types. Participants actually completed over 75% of their "Social" trips within rural areas, while 44% of their "Dining out/Entertainment" trips were in rural areas. The value for the number of "Dining out" trips in rural areas was actually higher than anticipated since it is often assumed such facilities are generally only available in urban areas. Not unexpectedly, the participants who "served others" did so in rural areas.

**Trip discretion**

A stated adaptation survey was completed based on the participant's busiest travel day to find out how they would modify their trip making if they did not have access to a vehicle, including whether they would still take the trip. The data in TABLE 9 show the proportion of participants that would still want to take the trip even without a vehicle. "Medical visits", though a small proportion of overall trip making, were highly valued by participants, as were "work", "shopping" and "personal errands".

**TABLE 9: Estimated Trip Purpose Discretion By Trip Type**

| Trip purpose | Proportion of participants would still take trip | Trip type |
|---|---|---|
| Medical visits | 0.89 | Life Maintenance |
| Work | 0.86 | Life Maintenance |
| Social visits | 0.75 | Higher Order |
| Shopping | 0.68 | Life Maintenance |
| Personal errands | 0.67 | Life Maintenance |
| Volunteering | 0.56 | Higher Order |
| Errands for others | 0.55 | Higher Order |
| Dining/Entertainment | 0.54 | Higher Order |

It is interesting to note that 75% of participants would still want to undertake "social visits" and over 50% would want to continue "volunteering" and running "errands for others".

## DISCUSSION

This paper presents some very interesting findings that warrant consideration by others in this field, though the sampling methods (convenience, snowball, quota sampling) employed can subject this study to the biases normally associated with volunteer-based travel surveys. It also limits the applicability of the conclusions to the participant group, though Chi-squared tests on the expected and observed distribution of participant attributes show no significant differences between the distribution of attributes and the population from where they were drawn. The collection of revealed travel behaviour (through GPS) also provided a complete record of travel, unlike pen and paper surveys which can result in omitted trips and other details. This should provide confidence that the data are useful for policy analysis given the general absence of revealed travel data on this population.

There are other limitations to the study as well. Participants may have travelled with another outside of his or her household, but it was not considered a factor in this research since it is the maintenance of the personal automobile for household travel that remains of paramount importance. The trip purposes were obtained through a prompted recall survey which depended on a participant's ability to recall their travel. Since each individual trip was reviewed by the researcher in concert with the participant, and participant travel often included instances of having multiple days of common destinations within an area familiar to the researcher, and 99.1% of all trips were assigned a purpose. It should also be noted that this was a study of individual travel behaviour, and not a household transportation study. In light of the study limitations, when compared to existing methods for travel data collection (primarily self-reported pen and paper survey) that typically overlook rural older drivers (and those that do participate underreport), the methods employed in this study offer a far clearer picture of the travel behaviour of this group of older drivers than possible under random sampling or pen and paper surveys.

**Other potential uses of the GPS data**

This paper explored the trip making behaviour of rural older drivers through the collection of GPS travel data; however, the GPS data have many other uses to support the study of rural older drivers. Data can be used in concert with a digital road network to obtain detailed and exact exposure information with greater precision that available for this group previously. Exposure information can contribute to a better understanding of rural older driver safety, including whether rural older drivers are subject to "low mileage bias". Detailed time of day travel and road class information can help evaluate the potential effectiveness of restrictive licensing policies for rural older drivers (such as driving after dark or on four-lane highways). Participant speed information by road class provides an additional element to study safety, including speed differential with other road users. Trip making behaviour can also be used in concert with Stated Adaptation responses to better understand how rural older drivers anticipate meeting their needs without a car, and to what degree they would need assistance. Each of these potentially uses are currently being explored using the University of New Brunswick dataset.

The data collection method is replicable and provides useful results that would benefit governmental agencies and transportation planning; however, it is unclear whether it is wise for these agencies to undertake this type of research themselves. Involving a third party, such as a university, to collect, maintain and analyze the data can provide additional assurance to potential participants that this is not a "government assessment" of driving ability nor a "big brother" exercise. While there were 60 participants, there were an additional 19 individuals who used the participants' vehicles, some of whom would have been eligible for the study but did not want to participate. Some of this refusal may be attributable to an aversion to the level of detail garnered from their travel; others may have felt the respondent burden was still too high. A better understanding of refusal to participate in GPS studies by the older non-participants in this study could assist in better crafting future research efforts.

## CONCLUSIONS

The travel behaviour of the 60 rural older drivers in this study was studied by analyzing data collected using passive GPS, complemented with prompted recall survey data, GIS analysis and results from a stated adaptation survey. Though data were not randomly sampled, Chi-squared tests show no significant difference between expected and observed distributions of participant attributes, which provides additional confidence of the usefulness of the data for policy analysis and alternative development. Jurisdictions with substantial older rural populations could develop better alternatives (or better tailor existing services) by developing a better understanding of how older drivers in rural areas use their vehicles since it is the primary travel mode.

The revealed travel data suggest the rural participants are active drivers who use their vehicles to undertake trips with many different purposes, but mostly to meet their "Higher Order" needs, which includes a sizeable proportion of trips to "serve others". The proportion of trips taken as a passenger in one's own vehicle increased with age for men and decreased for women, and was equivalent between the sexes for ages 75 years and older. While trip frequency and probability of travelling in any given day generally decreased with age, the proportion of "Life Maintenance" and "Higher Order" trips changed little. Rural participants were, in fact, able to meet many of their life maintenance and higher order needs in rural areas which suggests that transportation access to urban areas cannot be the sole impetus of transportation policy for non-drivers.

## ACKNOWLEDGEMENTS

The authors acknowledge the financial support of Prof. Albert and Ena Stevens and the National Sciences and Engineering Research Council (NSERC). The authors also acknowledge the helpful comments from the anonymous reviewers.

## REFERENCES

*1* Statistics Canada. *Projected population by age group and sex according to a medium growth scenario for 2006, 2011, 2016, 2021, 2026 and 2031, at July 1*. www40.statcan.ca/l01/cst01/demo23c.htm.. Accessed May 18, 2007.

*2* Rosenbloom, S. The Mobility Needs of the Elderly. In *Transportation in an Aging Society, Vol. 2, Special Report 218*, Transportation Research Board, National Research Council, Washington D.C., 1988, pp. 30

*3 U.S. Census Bureau urban and rural population counts by state,* U.S. Department of Commerce. www.census.gov/population/www/censusdata/files/urpop0090.txt. Accessed July 23, 2010.

*4 2006 Census of Canada, Statistics Canada.* www12.statcan.gc.ca/census-recensement/index-eng.cfm. Accessed July 23, 2010.

*5* Pucher, J. and J. Renne. Rural mobility and mode choice: Evidence from the 2001 National Household Travel Survey. *Transportation* Vol 32., 2005, pp. 165–186

*6* Foley, D. J., H.K. Heimovitz, J. M. Guralnik, and D. B. Brock. Driving Life Expectancy of Persons Aged 70 Years and Older in the United States. A*merican Journal of Public Health* Vol. 92, No. 8, 2002.

*7* Hildebrand, E.D. M. Gordon, and T. Hanson. Understanding the Travel Behaviour of the Rural Elderly. In *Proceedings of the 39th Annual Conference of the Canadian Transportation Research Forum: Revolutions in Transportation*, ISSN #1183-2770, Calgary, May 9-12, 2004, pp. 236-252

*8* Hanson, T.R. Transportation alternatives for rural seniors in New Brunswick, Canada: Issues, policy implications and research needs. CD-ROM, In *Proceedings of the Transportation Research Board 88th Annual Meeting*, Transportation Research Board of the National Academies, Washington D.C., 2009.

*9* Burkhardt, J. Economic impact of Rural Transit Services. In *Transportation Research Record No. 1666*, Transportation Research Board of the National Academies, Washington D.C., 1999, pp. 55-64.

*10* Cobb, R.W., Coughlin, J.F. Transportation Policy for an Aging Society: Keeping Older Americans on the Move. In *Transportation for an Aging Society, a decade of experience*, *Conference Proceedings 27*, Transportation Research Board of the National Academies, Washington D.C., 2004, pp 275-289.

*11* Transportation Research Board. Measuring Personal Travel and Goods Movement: A review of the Bureau of Transportation Statistics' Surveys. In *Special Report 277*, Transportation Research Board, National Research Council, Washington D.C.,2003, pp.18 -19.

*12 Canadian Vehicle Survey Quarter 4, 2006*. Catalogue no. 53F0004XIE, Statistics Canada, 2007

*13* Bricka, S, and C. Bhat. Comparative analysis of Global Positioning System-Based and Travel Survey-Based Data. In *Transportation Research Record No. 1972*, Transportation Research Board, National Research Council, Washington D.C, 2006,. pp. 9 – 20.

*14* Murakami, Wagner, and Neumeister. Using Global Positioning Systems and Personal Digital Assistants for Personal Travel Surveys in the United States – In *Session Paper in TRB Transportation Research Circular E-C008: Transport Surveys: Raising the Standard*, 1997

*15* Doherty, S. T., and E. J. Miller, A Computerized Household Activity Scheduling Survey. *Transportation*, Vol. 27, No. 1, 2000, pp. 75–97

*16* Draijer, G., M. Kalfs, and J. Perdok. Global Positioning System as Data Collection Method for Travel Research. *Transportation Research Record No. 1719*, Transportation Research Board, National Research Council, Washington D.C., 2000

*17* Wolf, J., R. Guensler, and W. Bachman. Elimination of the travel diary. In *Transportation Research Record No. 1768*, Transportation Research Board, National Research Council, Washington D.C., 2001, pp.125-134

*18* Bachu, P.K., T. Dudala, Sand .M. Kothuri. Prompted recall in Global Positioning Systems survey – Proof of Concept study. In *Transportation Research Record No. 1768*, Transportation Research Board, National Research Council, Washington D.C., 2001, pp. 106-113

*19* Candrive. Driving Research for Older Adults. http://www.candrive.ca, 2010

*20* Blaxter, L., Hughes, C., and M. Tight. How to Research (3rd Edition) Open University Press, 2006, pp.164-165

*21 2006 Census Dictionary*, Statistics Canada. Available from: www12.statcan.ca/english/census06/reference/dictionary/geo049.cfm. Accessed July 31, 2007.

*22* Schmöcker, J.D., M. A. Quddus, R. B. Noland, M. G. H. Bell. Estimating Trip Generation of Elderly and Disabled People: Analysis of London Data. In *Transportation Research Record No. 1924*. Transportation Research Board of the National Academies, Washington D.C., 2005.

*23* Madre, J., K. Axhausen, and W. Brög. Immobility in travel diary surveys. *Transportation* Vol.34, 2007, pp. 107–128.

*24* Carp, F.M. Significance of mobility for the well-being of the elderly. In *Transportation in an Aging Society*, Vol. 2, Special Report 218, Transportation Research Board of the National Academies, Washington D.C., 1988, pp. 1-20.

*25* Hanson, T. Using GPS and GIS to study the travel habits of elderly drivers. In *MScE Thesis No. 7161*, Department of Civil Engineering, University of New Brunswick, 2004.

*26* Goulias, K., and K. Henson. On altruists and egoists in activity participation and travel: who are they and do they live together? In *Transportation*, Vol. 33, 2006, pp. 447–462.

*27* Stamatiadis, N. Leinbach, T, Watkins, J. 1996. Travel Among Non-Urban Elderly. Eno Transportation Foundation Transportation Quarterly, Vol. 50 No. 3, 1996, pp 113-121.

*28* Herold, M, T. Gordon, K Kaye, E Brockie and T. Fuller. *Elderly and Disabled Rural Residents: A Continuing Transportation Issue.* Rural Transportation Series No. 4. Available from Agriculture and Agri-Food Canada, Ottawa ON, Publication Number 33798E, 2002.

*29* Hildebrand, E.D. and B. Myrick. Collision Experience and Mobility Concerns of the Rural Elderly. In *Proceedings of the Canadian Multidisciplinary Road Safety Conference XII; June 10-13, 2001; London, Ontario*, 2000.