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Transportation
Print ISSN: 0049-4488
Online ISSN: 1572-9435
DOI: 10.1007/s11116-011-9323-3
Publisher: Springer
Published Article URL: https://doi.org/10.1007/s11116-011-9323-3

This paper appears in: Transportation, Print ISSN: 0049-4488 Online ISSN: 1572-9435 Digital Object Identifier: 10.1007/s11116-011-9323-3

Springer Author Posting Policy: https://v2.sherpa.ac.uk/id/publication/16198

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http://www.springerlink.com/content/p578420317343064/

The final publication is available at www.springerlink.com

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Rural seniors are highly dependent on their automobile to meet their trip making needs, yet the effects of aging can make access to the vehicle difficult or impossible over time. The anticipated growth in the older person population, in concert with limited travel data available to support rural transportation planning in Canada suggests a disconnect between what rural older people may require for transportation and the availability of formal alternatives. Many will seek informal alternatives to driving, such as depending on friends and family, to meet their travel needs, but the degree is not well understood in the context of their actual vehicle usage and stated ability to adapt.

This paper draws from a Global Positioning System (GPS)-based multi-day travel diary survey of a convenience sample of 60 rural older drivers (29 men, 31 women, average age of 69.6 years) from New Brunswick, Canada. Participants would rely on "friends and family" for 52% of all trips they undertook as driver in the survey, "walk or bike" for 14% of trips, and "not take the trip" in 34% of trips if they did not have access to a vehicle. "Medical trips", "Shopping" and "Personal Errands" were the least discretionary of all trip types, yet the most difficult for participants to find alternate arrangements. Most participants (70%) believed a solution is needed in rural areas that does not involve depending on friends and family. These findings suggest the need for transportation policies that encourage the development and sustainability of rural alternatives.

Rural, seniors, stated adaptation, travel survey, policy

1.0 Introduction

Answering the question “can rural older drivers meet their needs without a car?” requires understanding three key things: how growing older (and doing so in a rural area) impacts ones ability to meet needs independently with a car; the relationship between service provision, data availability and the rural transportation planning process; how rural older drivers currently meet their needs with a car and how they would adapt to not having a car. The first two can be understood through a review of existing literature and traditional surveys. Understanding the third requires the collection of detailed revealed travel data and contextual responses not known to exist for rural older drivers.

This paper incorporates detailed revealed and stated travel behaviour from a Global Positioning Systems (GPS) based multi-day travel diary survey of 60 rural older drivers (29 men, 31 women, average age 69.6 years) from New Brunswick, a province of 750,000 (50% rural) in eastern Canada. The GPS travel diaries were complemented by participant stated responses, including how they would complete each recorded trip if they did not have access to a vehicle. These responses were organized to determine the frequency, destination, and purposes of those trips for which participants would require alternative transportation, and are presented in concert with participant views on alternatives. The revealed data are discussed in terms of state of rural transportation planning practice to answer the question “can rural older drivers meet their needs without a car?”

2.0 Background

2.1 Aging and impacts on transportation

North America's population is aging. The proportion of the population aged 65 years or older has been increasing for many years, representing over 13% of the total population in 2005 in Canada (Statistics Canada 2005), and just over 12% in the United States in 2008 (U.S. Census Bureau, 2008). Driven by the baby boom population (those born between 1946 and 1964) population projection estimates indicate that by 2031, the number of Canadians aged 65 years and older will double to over 9 million and represent 23% of the total population (Statistics Canada 2006). The population of those 80 years and older in Canada has been growing at the fastest rate of all age groups: 41% increase between 1991 and 2001, and an expected 43% increase between 2001 and 2011 (Statistics Canada, 2010). The structural need in North American society to access facilities by private automobile, in concert with the growth in a population where health affects of aging can compromise access to the automobile, highlights a service and policy gap that can be expected to widen over time.

An aging population will impact the use of medical services, recreational facilities, shopping facilities, and many other public and private services. The aging process itself can have varied impacts on personal health, but generally result in mobility and cognitive impairments over time (TRB 1988). These impairments can negatively affect a person's ability to control and operate an automobile (Taylor and Tripodes 2001). The issue of transportation for older people who do not or cannot drive has been a research area for the last 40 years, but as described by Coughlin (2009) while there have always been older people, "Old age is new". The composition and driving experience of the "baby boom" older person cohort will likely be different than previous cohorts due to universal

licensing between the sexes and lifelong driving experience (Rosenbloom and Morris 1998). Coughlin (2009) also highlighted six key differences between aging "baby boomers" to previous generations of older people: larger incomes; propensity to maintain demand for transportation with age; increased activity of older women; caregiving for children and elders; working retirement; a shift in the type of fun and leisure activities.

The issue with aging drivers appears deceivingly simple: if the effects of aging result in someone no longer being competent to drive, they should no longer have the privilege to drive. In practice, this is complicated by "current policies and procedures [that] are ineffective in identifying high-risk older drivers" (Dobbs 2008) and negative "consequences of mobility changes associated with reducing or ceasing driving…" (Burkhardt 1999). The negative impacts of loss of mobility appear to factor in how many physicians deal with potentially unsafe drivers: a survey of Canadian physicians found 75% felt that reporting a patient as an unsafe driver would place them in a conflict of interest and negatively impact the patient and the physician–patient relationship (Jang, et al., 2007).

Driving cessation is a reality many people will face. Foley et al. (2002) estimated that the driving life expectancy for those at the age of 70 was 11 years, while those 85 years and older who were still driving had an estimated driving life expectancy of 2 years. Rosenbloom (2001) states; however, that it is "probably wrong to assume that mobility problems begin with driving cessation" rather that it is a gradual process that begins "long before the final indignity of losing the ability to drive." In that case, better understanding is needed of this process, in particular, how it manifests itself in the trip making behaviour of older drivers.

The heterogeneity within the driver population has meant recognizing the need for a demographic component to analysis and the need for disaggregate data. Hildebrand (1998) argued that most studies on older drivers have been deficient because of the tendency to aggregate of all the elderly into a single group among themselves or combined with those with disabilities. Siren (2005) indicated that older studies typically combine the driver pool, which has been predominately male, and that data sets often combined the results of men and women. Travel behaviour and approach to driving has been found to be different between the sexes, with older women more likely than older men to be a passenger in a vehicle (Kostyniuk and Shope, 2003) and to give up their licenses earlier (Foley et al. 2002, Burkhardt and McGavock 1999). Mollenkopf et al. (2004) found that "older persons living singly, women, persons with impaired health and low economic resources, and the rural elderly tend to be particularly at risk of losing their abilities to move about." Coughlin and Tompkins (2009) point out that in the United States, the highway system had generally been developed to support home to work trips of men, but "…tomorrow's traveler is likely to be older, female, racially and ethnically more diverse…". These findings suggest that further research that can provide additional context to age in travel surveys such as gender and geography would be beneficial in a better understanding of these travel issues and contribute to a solution.

2.2 The challenge of transportation for an aging rural population

In some provinces in Canada, including New Brunswick, over 40% of older people live in rural areas (Statistics Canada, 2007). Transportation challenges facing older people in rural areas are exacerbated by virtue of centralization of necessary services in urban areas and few if any alternatives to the private automobile. Hildebrand et al. (2000) studied the differences between accident involvement of urban and rural older drivers in New Brunswick, Canada. Rural

older drivers over the age of 81 years actually had a higher collision rate than their urban counterparts. Hildebrand and Myrick (2001) also reported that the majority of accidents experienced by the rural elderly were in urban areas, even though they drove more kilometres in rural areas. This, in concert with the finding that rural drivers also held on to their licenses longer than their urban counterparts, suggests that a higher dependence on the automobile due to a lack of automobile alternatives can manifest itself in terms of negative safety impacts.

Coughlin (2009) states it is unclear whether aging "baby boomers" (most of who live in suburban or rural areas) will age in place like their parents did, but if they do, "major transit investments will be necessary to provide alternatives to the car" and that friends and family will be called upon to provide most trips. This can be particularly challenging in the future for rural areas as smaller family sizes, outmigration of young people to urban centres, limited transit, and regionalization of services are all factors that make driving often the only option for rural seniors to meet their needs, even if potentially unsafe for some to do so. Coughlin (2009) concludes that there is a need to identify data gaps in transportation forecasting.

2.3 The relationship between data gaps and transportation service gaps in rural areas

One of the largest data gaps for transportation forecasting relates to transportation in rural areas. The preeminent source of data for use in determining travel trends in the United States has been the NHTS and its predecessors the National Personal Travel Survey (NPTS) of 1995 and the American Travel Survey (ATS). Last conducted in 2009, it is a "personal travel survey of the civilian, noninstitutionalized population of the United States" (TRB 2003). In its Special Report 277, the TRB Committee to Review the Bureau of

Transportation Statistics' (BTS) Survey Programs found that while these national surveys were useful, the surveys did not meet the needs of all users, in particular, at a local level. Hough (2007) argued "the studies that have been conducted using NHTS data do not adequately address the travel behaviors of the rural states".

In Canada, there is no other readily comparable data source to the NHTS so Canadian researchers have defaulted to using the NHTS. Conclusions drawn from NPTS data on older drivers were considered applicable to Canada by Myrick (2001) as a compromise since detailed transportation data on seniors in Canada is sparse. The Canadian Vehicle Survey is likely the closest approximation to the NHTS but has several limitations. It has no discussion or data on the difference between rural and urban, no reliable data for those older than 85 who have a vehicle, and data presented for female drivers over 55 years of age have a high coefficient of variation, therefore should "be used with caution" (Statistics Canada 2007a). In short, the Canadian Vehicle Survey as published is potentially a useful tool for national transportation discussions, but is inadequate for providing detailed information to assist transportation policy development for seniors in rural areas.

In Canada, there is no "Federal Transit Administration" or national body that exclusively or consistently funds the operating costs of transit; most transit costs are borne by municipalities or transportation authorities across municipalities (though there have been agreements to share capital costs between the national, provincial and local governments). In jurisdictions that lack a municipal or transportation authority structure (such as "Local Service Districts" where 270,000 rural New Brunswickers call home (Government of New Brunswick

2010), the provincial government has jurisdiction, meaning transportation planning falls under the auspices of the provincial transportation departments.

Hanson (2009) undertook a survey in 2008 of all provincial departments of transportation in Canada, including some municipalities, to get a better understanding of their transportation planning practices in rural areas in terms of supporting driving alternatives. While sophisticated modelling efforts supported by user demographic and origin/destination data were the norm for large urban centres, planning efforts in rural areas involved vehicle counts exclusively for infrastructure planning and maintenance purposes. There did not appear to be any demographic data collected by transportation agencies in support of rural driving alternatives for older people; consequently, it is unclear what data (if any) are used by transportation service providers in rural areas to support the development of their services. This may explain why Hanson (2009a) also found that "available transportation at the local level [in New Brunswick] is a mix of non-profit associations, nursing homes, private companies and municipally-sponsored systems", many of which did not see active ridership in rural areas or did not actually serve in rural areas.

Data availability appears to be an issue for rural transportation development in the United States as well. Painter, et al., (2007) prepared a report on the feasibility of the Transit Cooperative Research Program (TCRP) methods for use in rural transportation planning in Washington state. They argue that "these rural transit demand models do not provide a practical solution for rural transit demand estimation for many reasons", such as lack of data, lack of separation between program and non-program related trips, and applicability in counties that have the largest centre between 5,000 and 10,000 people. This raises the point: what

data are needed to help support rural transportation alternatives and can help determine whether rural older drivers can meet their needs without a car?

2.4 Need for revealed choice travel data of rural older drivers

It is unclear how policy-makers can truly understand the nature of the transportation need and scope of the issue to develop practical solutions with existing data sources. The result could be characterized as the consideration and application of urban-based solutions (transit and paratransit) for addressing rural-based mobility issues, solutions which have been generally unsuccessful (Kilh 1992). The question remains on how to collect the necessary data.

Ideally, study participants would be randomly sampled; however, driver's licensing issues are particularly sensitive, meaning that random sampling may ultimately be ineffective at securing participation. Blaxter, et al. (2006) suggest the non-probability approach is appropriate when dealing with an issue that is relatively sensitive. Traditional travel diary surveys also present a level of respondent burden that may preclude participation given that less burdensome efforts (such as mail-out surveys) have very low rates of return. Hague, et al., (2006) indicates convenience sampling is useful "when groups of respondents are hard to find" and the researcher has access to people who are "believed to be typical of the research population as a whole". The ITE Planning Handbook (1999) suggests non-probability sampling can give useful results "under the right conditions". Vardeman (1994) indicates that judgement based sampling "can in some circumstances yield samples that faithfully portray the important features of a population". There is precedent for using this method in transportation studies of older drivers: Rosenbloom (2007) employed "snowball" sampling (participants refer other participants) in a U.K. study of older drivers and their perceptions of driving skills.

The method of data collection itself is important, in particular to address issues with survey underreporting associated with certain groups. Bricka and Bhat (2006) found those 50 – 69 years older, men, people who are unemployed, those who travel long distances (> 32 km) on an average trip, and those who trip chain tend to underreport trips in conventional travel diaries. These are attributes that could typically be associated with a rural older driver population, suggesting the use of conventional diaries for this population would result in significant underreporting.

Contextual information can be obtained through the use of travel diaries to catalogue daily travel, however, concerns with the accuracy of pen and paper diaries have prompted the development and use of electronic travel diaries with GPS travel data (see Murakami, et al. (1997), Draijer, et al. (2000), Wolf, et al. (2001), Bachu, et al. (2001)). Travel diary surveys have been around for decades but collecting travel information by electronic travel diaries and GPS is a relatively new method. Technology for data collection, such as electronic travel or activity diaries, has been employed by Murakami, et al. (1997), Doherty and Miller (2000) Draijer, et al. (2000), Wolf, et al. (2001), and Hildebrand, et al. (2004).

Hildebrand, et al. (2004) were the first known to apply GPS travel diaries exclusively to rural older drivers. GPS was installed in the older person's vehicle and used to collect the travel data over a 2 – 3 day period, while GIS was used to assist in prompted recall interviews. The benefit of using GPS with a travel diary is the development of a complete dataset of revealed travel behaviour.

The main difference among GPS-based travel diary surveys is that some require participant interaction with a Personal Digital Assistant (PDA) to enter trip purpose, passenger numbers, etc. (Murakami, et al. 1997) while others derive trip purpose solely from the GPS data (Wolf, et al. 2001), and others have employed prompted recall to fill in the data gaps (Bachu, et al. 2001, Clark and Doherty 2009). The prompted recall method with a GPS travel diary involves working with the participant to review their travel on a Geographic Information System (GIS) map of their travel following the study, and then prompting them to assign purposes to each trip. While innovative methods exist to undertake this process, such as internet-based review of trips followed by interviews (Clark and Doherty 2009), conducting face-to-face interviews for the entire process has advantages, in particular when the target population may not have internet access or be familiar with computers.

The use of the prompted recall method presents an additional opportunity to solicit participant responses on other contextual elements of their travel, such as how they would make the trip if they no longer had access to a vehicle. The framing of this scenario is referred to as Stated Adaptation (SA), as participants state how they would adapt to a certain scenario or constraint.

Lee-Gosselin (1995) defines Stated Adaptation as having a focus on reactive and trial behaviour, where constraints are mostly given and behavioural outcomes are mostly elicited. Stated Adaptation (SA) surveys have been gaining in popularity as more researchers question the usefulness of solely using revealed choices (such as from travel diaries) to determine the impact of future transportation decision-making on users (see Stopher 1998 and D'Arcier, et al. 1998). This technique has been used by researchers such as Doherty et al. (2002) and Roorda and Andre (2007) to study the changes in household travel patterns in

terms of activity rescheduling due to limitations on vehicle availability or delay. Applying this technique to better understand how rural older drivers would adapt their trip making if they no longer had access to a vehicle appears to a natural extension of the method.

3.0 Study methodology

The following section generally describes the methodology associated with the collection of the detailed travel data from the rural participants, including participant eligibility and recruitment and the actual data collection methods.

3.1 Eligibility and recruitment of participants

Eligible participants were those 60 years of age or older who resided in rural areas, though exceptions were made for those as young as 54 years (only two participants were younger than 60 years) if they were expected to demonstrate similar habits to those over 60 (e.g. a younger spouse, someone who had retired early). In transportation studies of seniors, the age of 65 has generally been the threshold to be considered in this category. Likely this threshold is chosen due to the (until recently) mandatory retirement age of 65 in Canada, however, there are studies that include participants as young as 50 and 55 years old (See Harrison and Ragland 2004 and Eck and Winn 2002). Occasionally the group has been subdivided into the “young-old” and “old-old”, as proposed by Neugarten (1975) cited in Cregger and Rogers (1998). The definition of those categories has varied between studies, though adopting the age divisions employed in work by Statistics Canada (Statistics Canada 2006) which include from 55-64 years, 65 – 74 years of age, and 75 years and above ensured comparability with existing census data. Statistics Canada data show that the average retirement age in

Canada has declined from 65 in 1977 to 61.5 in 2006 (Statistics Canada 2006), which supports the inclusion of younger “young-old” participants.

Participants were recruited through convenience sampling methods including: engaging rural service clubs or seniors clubs; advertising in rural newsletters; direct solicitation; and “snowball sampling”.

3.2 Definition of “rural”

The definition of rural can have several interpretations, but Statistics Canada defines rural areas as areas that are “not urban”, and urban areas are defined as having a minimum population value of 1000 with a minimum population density of no fewer than 400 persons per square kilometre (Statistics Canada, 2007). Participants were solicited from a study area which included four counties in New Brunswick, Canada (York, Sunbury, Queens, Kings), with a rural population of 93164 (Statistics Canada, 2007b). Exceptions were made for small “urban” areas where the transportation experience was not expected to be markedly different from other rural communities (e.g. one or fewer traffic lights in the community).

3.3 Data collection

The travel diary survey involved placing a passive GPS unit in a participant vehicle for a minimum of two days (average 5.3 days per participant). Upon retrieval, a GIS was used to display the route and destinations of a participant’s travel to prompt their memory to identify the trip purpose, number of passengers, and other contextual information. A “trip” was defined as travelling from an origin to a single destination. Each “trip” was assigned a purpose by participants in the prompted recall interview. If a participant undertook a “trip” with two stated

purposes (such as dropping off a passenger then buying groceries at the same destination) the two purposes were recorded. Following the completion of the prompted recall interview, the stated adaptation interview was conducted for the busiest travel day of the survey. The total time for these interviews was approximately 1 hour per participant.

The purpose of the stated adaptation interview was to understand the extent to which the participant might change their travel behaviour under the condition that they do have access to a vehicle as opposed to conditions such as “unable to drive” or “license restricted”. The main reason was to encourage participants to think critically about their access to alternate transportation given their current health and social engagement instead of introducing additional variables (e.g. “If I’m not healthy enough to drive, I’m not healthy enough to go anywhere). The responses acted as a proxy to understand the perceived availability of transportation alternatives in rural areas. Participants were also asked to rate the difficulty in securing an alternate mode.

Participants were asked how they would modify their trip-making if their household no longer had access to a vehicle. This was completed by taking one day from a participant’s travel and asking how they would modify their behaviour without access to a vehicle. Options included:

- Getting a drive with friends or family
- Taking a taxi
- Walking or biking
- Taking transit
- Not take the trip

Participants were also asked to rate the difficulty of finding the transportation alternative on the following qualitative scale, ranging from the easiest to secure alternatives to the most difficult.

- Not a problem
- Slight inconvenience
- Difficult, but doable
- Major inconvenience

Data collection occurred between December 2008 and September 2009, with the bulk of surveys taking place after March 2009. Data were not collected during inclement winter weather.

4.0 Results

Participants provided information on how they would modify their travel behaviour for one day of their travel, resulting in stated adaptation information for 281 trips (out of a total 1362 recorded).

4.1 Descriptive participant statistics, sample validation and tests of significance

A total of 60 participants (29 men, 31 women) from ages 54 – 92 years were recruited for this research, representing 13 organized communities and their surrounding areas from all four counties. There were only two major urban areas (>40,000 people) in the study area and they were approximately 100 km apart. The data in Table 1 provide a summary of participant attributes, including trip frequency and exposure information.

Table 1: Summary of participant attributes

	Male				Female			
	54-64	**65-74**	**>75**	**Total**	**54-64**	**65-74**	**>75**	**Total**
Participants	9	13	7	**29**	11	14	6	**31**
Avg. length of survey (days)	4.8	5.4	5.6	5.2	5.2	5.4	6.0	5.4
Single purpose trips/day as driver	6.88	6.52	2.96	5.77	3.80	3.35	2.65	3.38
Single purpose trips/day as pax.	0.06	0.00	0.92	0.24	1.85	1.71	0.47	1.52
Total trip making (trips/day)	6.94	6.52	3.88	6.01	5.65	5.06	3.12	4.90

While the participant sample was a convenience sample, the Chi-squared test was used to compare the distributions of the observed vs. expected sample by age and gender for:

- Driver population (Census data and New Brunswick driver data)
- Labour force characteristics (Census data)
- Household size (Census data)
- Sampled weekend days and weekdays
- Self-reported mileage to U.S. National Household Transportation Survey 2009 data

In each of these cases, the difference between observed and expected distributions was not found to be significant at the 5% level. There was insufficient evidence to conclude that the attributes of the participants by age and gender in terms of these key variables were different from the population from which they were drawn. While it is not possible (nor the intent of the study) to present results with an expressed confidence interval (due to the sampling method), it is reasonable to conclude that the convenience sampling method employed was successful at building a representative sample of the older driver population in the study area.

In terms of revealed participant travel behaviour, comparisons were made between trip frequency as a driver and passenger for both sexes and the two oldest age groups using the Chi-squared test (where minimum class frequency could be obtained) and the t-test to identify where significant differences exist. The tests and their results are outlined in Table 2.

Table 2: Summary of tests of significance for differences in trip making rates by gender and age

Comparison	Attributes	Sig.diff @5%	Stat. test
Driving trip frequency	Men and Women	Yes	Chi-squared
Driving trip frequency	Men and Women	Yes	t-test
Driving trip frequency	65-74 and >75	Yes	t-test
Pax. trip frequency	Men and Women	Yes	t-test
Pax. trip frequency	65-74 and >75	No	t-test
Total trip frequency	Men and Women	No	t-test
Total trip frequency	65-74 and >75	Yes	t-test

The differences between the driving and passenger trip frequency of the men and women in this study were statistically significant. This is consistent with the Canadian Vehicle Survey that shows men typically have higher vehicle kilometres than women, while women have higher passenger kilometres than men (Statistics Canada, 2007a). Interestingly, when the driving and passenger trips were combined, the differences between the male and female participants were not statistically significant. This suggests that in this study, male and female participants had equivalent demand for transportation from their household vehicle, but that the older men completed most of their trips as driver while the older women completed a higher proportion of trips as passenger.

The differences between the driving trip frequency of the 65-74 age group and those 75 years and older in this study were statistically significant, but the differences in passenger trip frequency were not. These results regarding driving behaviour are consistent with the general consensus in the literature that travel frequency decreases with age. This provides additional confidence in the general conclusions drawn from the data and support further analysis by age and

gender. The sample size limited the ability to compare between genders by age group, though the trend of increasing passenger trip rates with age for men and decreasing rates for women is worthy of further investigation. It is possible that the older women were assuming a larger driving role in the household as their partners aged.

While there were significant differences between the sexes and two oldest age groups in terms of driving trip frequency, there was little observable difference between these groups in terms of how they distributed their trip making between "Life Maintenance", "Higher Order" and "Serving Others" trip categories (Table 3). Activity types and categories were adopted from Carp (1988) and Hildebrand, et al. (2004), though "Serving Others" was a subset of "Higher Order" trip types in their analyses.

Table 3: Proportion of participant driving trips taken by category, organized by age and gender

	Male				**Female**				
	54-64	**65-74**	**>75**	**Total**	**54-64**	**65-74**	**>75**	**Total**	**All**
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**
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**

It should be noted that in 11 of the 281 stated adaptation trips (69 of all 1362 participant driving trips) participants reported two district trip purposes to a single destination. The participants were asked for a single primary trip purpose, however, if purposes were mutually exclusive (such as dropping off a passenger at a destination where the participant was going shopping), a single trip with two purposes was coded into the trip database. The rationale for this was to quantify the need for replacement trips. Assuming each trip would only have one purpose, the value of replacement trips was expressed in "single purpose trips per day".

4.2 Estimating trip making discretion

Participants were presented with their revealed behaviour and asked to state how they would adapt to not having access to an automobile for each trip during one day of their GPS travel diary survey. Given the limited sample size of some of the trip types captured in the Stated Adaptation survey, participant responses were aggregated. The proportion of participants reporting that they would continue to take a certain trip even without access to a vehicle in their household was used to determine which trips participants considered discretionary (the higher the proportion, the less discretionary the trip). The data in Table 4 present: trip types and categories; frequency of the trip types recorded in the GPS travel diary survey; the number of trips by purpose explored in the Stated Adaptation survey; and the proportion of participants that would continue to take the trip. Trips considered dependent on vehicle ownership (vehicle errands or picking passengers) were ultimately excluded.

Table 4: Proportion of participants that would still take the specified trip without household vehicle access

Trip types	Cat.*	Total out of home trips recorded	Total trips in Stated Adaptation Survey	Proportion of participants would still take trip	Trip dependent on vehicle ownership?
Vehicle Errands	LM	45	7	0.14	Yes-exclude
Pick up/ Drop off passenger	SO	130	17	0.53	Yes-exclude
Dining/ Entertainment	HO	109	24	0.54	
Errands for others	SO	52	11	0.55	
Volunteering	SO	87	18	0.56	
Personal errands	LM	131	40	0.67	
Shopping	LM	199	60	0.68	
Social visits	HO	165	32	0.75	
Work	LM	56	7	0.86	
Medical visits	LM	32	9	0.89	

*Trip purpose category: LM = Life Maintenance
HO = Higher Order, SO = Serving Others

"Dining out/Entertainment" had the highest rate of discretion for trips unrelated to vehicle ownership. "Church/Educational" trips were excluded as only one reported trip was captured in the Stated Adaptation survey. Surprisingly, participants still felt it necessary to pick up and drop off passengers in 53% of cases. This may be an extension of social ties and "altruism", as discussed in transportation research by Goulias and Henson (2006), who indicated growing awareness of this trait as a "determinant" of travel behaviour. It was also expected that such trips like "Errands for others", and "Volunteering" would be highly discretionary, but more than half of participants indicated they would still desire to make the trip without owning a vehicle.

"Life Maintenance" trips including "Personal Errands" and "Shopping" were less discretionary, with 67-68% stating they would still take the trip without a vehicle. Approximately 75% of "Social Visit" trips would still be taken, which suggests that participants placed a relatively high importance on those trips when compared to others. The least discretionary trips were "Work" trips and "Medical Visits", with only one reported instance each where the trip would not be taken.

4.3 Quantifying demand for replacement transportation

The revealed trip making behaviour obtained from the GPS travel diary survey was combined with the stated adaptation responses to develop an estimate of participant travel demanded from a source other than their own vehicle if access to their own vehicle was compromised. The proportions of participants reporting that they would continue to take certain trip types (Table 4) were applied to revealed trip frequency by type, with the trip frequencies combined to represent a daily trip making rate by age and gender (Table 5).

Table 5: Demand for replacement transportation in single purpose trips per day (by age and gender)

	M				F				Total
	54-64	**65-74**	**>75**	**Total**	**54-64**	**65-74**	**>75**	**Total**	
Single purpose trips per day	6.88	6.52	2.96	5.77	3.80	3.35	2.65	3.38	**4.54**
(A)	4.25	4.03	1.82	3.56	2.42	2.10	1.68	2.13	**2.82**
(B)	0.59	0.40	0.12	0.39	0.33	0.20	0.14	0.23	**0.31**
(C)	0.06	0.00	0.92	0.24	1.85	1.71	0.47	1.52	**0.90**
D=(A-B+C)	**3.72**	**3.63**	**2.61**	**3.41**	**3.94**	**3.61**	**2.01**	**3.42**	**3.42**

A -Trips/day participants would still take without vehicle
B - Trips/day related to vehicle ownership
C - Passenger trips/day taken by participants in own vehicle
D - Estimated demand for replacement transportation in single purpose trips per day

On average, male participants in this study had an estimated daily trip demand of 3.41 single purpose trips per day, while female participants had a daily trip demand of 3.42 trips per day. Female participants aged 75 years and older would have the lowest demand at 2.01 trips per day, with men 75 years and older at 2.61 trips per day.

4.4 Perceived ability to find alternatives

Participants were asked by what means they would complete the trip if they did not have access to a vehicle. Participants reported 52% of all trips would be taken with friends or family, 14% would walk or bike, 1% would take a taxi, and 34% of all trips would not be taken. This is described by data in Table 6.

Table 6: Summary of participant stated adaptation responses

Stated Adaptation	Number of vehicle trips selected	Proportion of all trips	Proportion of trips still taken
Drive with friends or family	146	0.52	0.79
Take a taxi	2	0.01	0.01
Walk or bike	38	0.14	0.20
Take transit	0	0.00	0.00
Not take the trip	95	0.34	
Total	**281**	**1.00**	**1.00**
Note: totals may not add up to 1.00 due to rounding			

The implication is that participants would seek the support from friends or family for 79% of the trips they would still take, meaning they believe only 21% of their trip needs can be met independently. The question remains whether the "friends or family" would be in a position to accommodate the replacement trip-making needs. The growing number of older people, combined with the shrinking number of children per family, may result in high latent demand for driving alternatives.

Data in Table 7 show that the degree of depending on family and friends varies, but is highest for trips longer than 20 km. "Driving with friends or family" appeared to be the most popular choice for all trip lengths, though "walking or biking" was a popular alternative for trips shorter than 5 km. "Taking a taxi" was only selected for a total of two trips. Transit was not considered an option for any trips, which was not surprising given Hanson's (2009) findings that there was a lack of any rural transit services within the study area. It was expected that the proportion of trips not taken would increase with trip length, but the proportion was relatively steady.

Table 7: Proportion of participant stated adaptation responses by length of trip

	Trip length (km)			
	0-5	**5-10**	**10-20**	**20-70**
Drive with friends or family	0.43	0.68	0.59	0.69
Take a taxi	0.00	0.02	0.03	0.00
Walk or bike	0.22	0.02	0.00	0.00
Take transit	0.00	0.00	0.00	0.00
Not take the trip	0.35	0.27	0.38	0.31
Total (%)	**1.00**	**1.00**	**1.00**	**1.00**

A Chi-squared test explored the observed number of Life Maintenance (LM) trips not taken that were shorter than 5 km and longer than 5 km versus the expected number of Higher Order/Serving Others (HO/SO) trips. The data in Table 8 show no significant differences between the distributions, suggesting that trip length may not have been the primary motivation for trip discretion.

Table 8: Chi-squared test of observed number of Life Maintenance trips not taken organized by trip length

	Life Maintenance (LM)	Higher Order/Serving Others (HO/SO)	X^2
Trip length	*Observed*	*Expected*	
0-5 km	18	20	0.200
> 5 km	15	13	0.311
		Sum	0.511
Degrees of Freedom = 1	At 5%, X^2 = 3.841		
H_o : LM = HO/SO	*Do not reject Ho*		

Participants were also asked to rate the difficulty of finding alternate arrangements for the trips they said they would take. They rated using the following four-point scale:

- Not a problem
- Slight inconvenience
- Difficult, but doable
- Major inconvenience

This scale was used to help qualify the potential for finding alternate arrangements as it is likely that the higher the perceived difficultly, the higher likelihood that a trip would not be taken. “Not a problem” implied that the participant had an informal transportation network (friends and family) or formal system (taxi or transit) readily accessible that they could contact to assist with trip-making. “Major inconvenience” implied significant outlay of effort by participants to make the trip. Responses for “Not a problem” and “Slight inconvenience” were combined, as were those for “Difficult but doable” and “Major Inconvenience”, then sorted in terms of highest proportion of participants reporting trips to be “Difficult but doable” and “Major Inconvenience” in Table 9.

Table 9: Proportion of participant responses to perceived ability to find alternate travel arrangements

Trip types	A	B
Medical visits	0.25	0.75
Personal Errands	0.42	0.58
Shopping	0.68	0.32
Social visits	0.79	0.21
Work	0.83	0.17
Errands for others	0.83	0.17
Dining/Entertainment	0.91	0.09
Volunteering	1.00	0.00
A – Combined responses for “Not a problem” and “Slight inconvenience” B – Combined responses for “Difficult but doable” and “Major Inconvenience”		

It appears that the most critical life maintenance trips, medical visits, were considered by participants to be the most difficult trips to make without having access to a vehicle. Other life maintenance trips including “Personal Errands” and “Shopping” also were considered difficult trips for which to find alternatives. When viewed in context with the discretionary nature of trip types, it appears that participants consider the least discretionary trip types as the most difficult to access without a vehicle. On a positive note, over 50% of participants reported

that going to work, dining out/entertainment, shopping trips and social trips would be “not a problem” if they did not own a vehicle.

4.5 Perception of the need for alternatives to driving

The availability and awareness of transportation alternatives to driving an automobile has been shown to be a key consideration by rural older people in retaining their driver’s license, however, when alternatives are available they are frequently underutilized. The majority of participant responses (70%) were in favour of some type of solution that did not involve depending on friends and family, with 26% of responses seeking a publicly funded government system.

5.0 Discussion

This paper details a novel data collection method applied to a group that is typically not profiled in this level of detail in travel studies, but the questions remain: what is the value of this method and these data to the practice of transportation engineering and planning and how is this an advancement on previous work that has explored similar questions regarding access to alternatives for older people?

Firstly, based on previous explorations of rural transportation planning practice in Canada, the lack of any rural travel data collection in provinces like New Brunswick, combined with the challenges with the existing rural alternatives, suggests there is an incongruity between matching service with demand. This incongruity must emanate from how demand is measured (if it is measured), and as has been discussed, even the available tools such as those from TCRP have been found to have challenges.

Secondly, while qualitative and other research is excellent at scoping and identifying issues relating to mobility for older people, it is unclear how a rural transportation planning agency with limited resources can readily translate those findings into a practical delivery of services. This research, while subject to some limitations (a sample of the rural older *driver* population instead of a survey of the rural older *person* population), provides a valuable baseline in terms of the types, frequencies, destinations, etc. that could help jurisdictions estimate the potential need for alternatives. It also presents a method that could be replicated for use in other jurisdictions for the cost of the equipment and a researcher's time.

Finally, self-reported travel diary studies can involve underreporting and missed trips, and rural older drivers have the attributes associated with those who underreport (age, gender, how much they drive, etc). The GPS travel diary method is a substantial improvement since it collects revealed (what people actually did) behaviour instead of stated behaviour exclusively. While the data itself is valuable from a mobility perspective, it can also provide valuable data in terms of exposure metrics (speed, distances travelled, time of day travel).

There are some caveats for this research and conclusions drawn from it. Sampling active rural older drivers means the small (but undefined) population of licensed non-drivers risked exclusion (though one participant was a licensed driver but did no driving). The travel behaviour of non-licensed older people was excluded. Only vehicular travel behavior was studied, not travel by any other mode or with anyone outside of the household, though given high rates of vehicle ownership in rural areas, measuring one's personal vehicle use should capture most trip making. In terms of answering the question posed by this paper, if rural older drivers are successfully meeting their travel needs through other means

then their own vehicle, it is only the trip making that takes place in their own vehicle that would require replacement.

The notable differences between the age groups 65-74 years and those 75 years and older are worth further research, with a particular focus on those 85 years and older. This research was able to secure several participants from that age group, but a larger sample was needed to permit statistical comparability. Resource constraints meant that surveys were undertaken over several months; therefore, there may have been some seasonal effects on the behaviour of participants studied earlier in the research. Further research is recommended to further populate the travel database and refine the estimates presented here.

If participants instantly lost their ability to drive, with all else being equal, they would demand the equivalent level of transportation suggested by the data. In practice, all else would not be equal: the loss of a license is generally associated with a medical condition; therefore if they were not fit to drive, it is possible they may not be fit to do many other things they may currently do today. This is best left to other disciplines (medical, gerontological) to determine what degree; however, it is unlikely that anyone with similar demographic attributes to those in this research, yet have a medical condition, would demand *more* transportation than demonstrated by participants. It is this baseline which is likely of most value from this research.

6.0 Conclusions

Can rural older drivers meet their needs without a car? The answer based on these findings: yes, provided friends and family are available to help. If rural older drivers in general demonstrate similar trip making behaviour to the participants in this study, friends and family can expect that they will be asked to

provide approximately 52% of the driving trips currently taken by this group, a number that increases with trip length. It is unclear how much of that 52% of trips friends and families would be in a position to provide, which is the real impetus for further research into transportation alternatives.

Incorporating Stated Adaptation (SA) responses (with revealed travel data using GPS) to better understand how rural older drivers would adapt to not having access to a vehicle provided insight into the challenges faced by this demographic and provides opportunities for policy development. Participants reported that they would no longer take 36% of their driving trips if they did not have vehicular access, and of the remaining trips taken, 79% would be taken with friends and family. Not one participant indicated transit was a viable option for their trip making. While most stated they would rely on friends and family to meet their current transportation needs, most participants (70%) believed a solution is needed in rural areas that does not involve depending on friends and family, though 26% of these participants felt the system would not be used enough. Accordingly, transportation policies are needed that encourage the development and sustainability of alternatives that permit equivalent mobility and independence afforded by the private vehicle. Further research is also required to refine the estimates for travel demand.

7.0 Acknowledgements

The authors acknowledge the support of Professor Albert and Ena Stevens and the National Sciences and Engineering Research Council. The authors also want to thank the anonymous reviewers for their comments.

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