LEARNING FROM RURAL INNOVATION: WHAT CAN VOLUNTEER DRIVER PROGRAMS TEACH US ABOUT PLANNING FOR AUTONOMOUS VEHICLES?[1]

David Copp, University of New Brunswick
Trevor Hanson, University of New Brunswick

Introduction

Autonomous vehicles (AVs) are a new and innovative technology that are being pilot-tested across the world, and present a potential solution to the transportation issues faced by those who are automobile dependent but unable to drive themselves. One demographic seen as a potential user group for AVs are rural older adults (persons aged 65 years and older) who, due to health effects of aging, may no longer be able to meet their transportation needs independently by driving (Kalra, 2016), necessitating their reliance on others to provide transportation. By extension, it could be expected that AVs would be called upon to supplement or replace the transportation provided by others.

Car-based Volunteer Driver Programs (VDPs) are being used throughout the Province of New Brunswick to meet some of the transportation needs from rural populations, which include some older adults, who are unable to rely on their own car for transportation. It could be expected that the types of trips taken by VDPs users would be equivalent to the types of trips that would be demanded from AVs. This makes the study of VDP use an effective proxy to understanding the potential AVs have for meeting user needs. The challenge is that it is unclear to what degree AVs could supplement or replace trips as VDP drivers themselves are likely providing some type of service beyond the driving task, but there is little to no information available on what types of assistance are being provided in this context.

This paper summarizes the initial results of a study of 37 volunteer drivers (response rate of 62%)who responded to a survey to determine the role that they play (beyond the driving task) in providing assistance to program users in order to provide insight into the practicality of AVs to meet the needs of prospective AV users.

Background

The Canadian Council of Motor Transport Administrators (CCMTA) defines an autonomous vehicle (AV) as "a driverless vehicle; a vehicle that does not require human monitoring or interaction", a technology that could theoretically solve the transportation issues faced by non-drivers and the limitations of programs that currently serve them. While AVs present an option for non-drivers to meet their needs, little research has been done to determine the demand for this new travel alternative and the necessary attributes for success of these systems. One of the challenges with understanding the demand for AVs is the fact that most people have not experienced automated driving first hand, and are therefore hesitant to adopt the new vehicles. In addition, quantifying the potential uptake in AV ridership is difficult since most studies must rely on hypothetical usage scenarios rather than actual travel data for AV trip making as it is not yet available. Despite these challenges, there are a variety of studies conducted in recent years in an attempt to understand the potential impacts of AVs in the transportation market, as well as the attributes and likelihoods associated with the successful adoption of the new modality. Very few of these recent studies (Haboucha et al. (2017), Bellet et al. (2018), Harper et al. (2016)) conducted the research with a focus of older drivers, and none were specifically designed to understand the rural senior adoption of AVs.

VDPs are typically non-profit or charitable organizations that rely on volunteers and their vehicles to provide door-to-door transportation service to a region that has underserved transportation needs. The main charitable focus of these VDPs is the provision of transportation to a membership that

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generally lacks transportation options. This differentiates these programs from charities where transportation serves as an extension of a charity's overall mandate (e.g. Canadian Cancer Society transportation to cancer treatments), making VDPs more like a rural taxi service. VDPs are growing as alternatives for non-driving older adults, and others without transportation, in rural areas of New Brunswick (Hanson & Goudreau, 2017). VDPs arenotexclusivelydesigned to service older populations (aged 65+), but they do represent a significant portion (49%-65%) of the membership for the programs in New Brunswick (Hanson & Goudreau, 2019). While VDPs can offer some relief to some of the transportation issues faced within rural areas, they rely on volunteers and volunteer vehicles to deliver services.A recent study of one year's worth of VDP travel data from seven programs operating in New Brunswick showed a total of 5769 drives with 9028 stops, provided to a total of 8367 riders between February 2017 and January 2018. These drives were provided by a total volunteer pool of 117 people across all participating groups, accounting for a combined 8754 hours of volunteer time (Hanson & Goudreau, 2019). This study provides an excellent foundation for understanding the current VDP operation metrics in New Brunswick, which will prove to be a beneficial resource for continuing research regarding VDPs, volunteers, and rural transportation.

Methodology

For this work, apaper survey was developed to solicit information about what role a volunteer driver plays in supporting VDP users, beyond the driving task. It included: driver age group; weekly time spent volunteering; for most recent volunteer drive the number of stops, the destinations and stop purpose, the activities the driver performed in addition to driving, and the typical frequency that the volunteer provides additional assistance to users. Postage-paidsurveys were distributed to three VDPs throughout New Brunswick during the fall of 2018; 37 of 60 were completed and returned by mail to the research team. This project was reviewed by the Research Ethics Board of the University of New Brunswick and is on file as REB 2018-133.

Limitations

It is not possible to assess the representativeness of this sample with confidence or to assign a confidence interval to the findings as the demographic attributes of the population of VDP drivers is not known. Work by Hanson & Goudreau (2019) reported 117 volunteers among the seven participating VDPs in their research, of which three VDPs participated in this research, though the number of volunteers can be in flux.The number of surveys distributed was aligned with reported number of active volunteer driver among those three VDPs.The best that can be stated is that the sample of 37 represents approximately 30% of the known volunteer population of the seven partner VDPs and at least 50% of the active volunteers of the three participating organizations. These data are not meant to support statistical inference at this point; however, they provide sufficient detail about a previously unstudied topic to support developing initial estimations that could be valuable for sketch planning purposes.

Results

Two-thirds of the 37 respondent volunteer drivers were aged 65 and over, a higher percentage than national figures showing 10%-15% of volunteer drivers were aged 65 and older(Hanson, 2017), but likely a reflection of the local volunteer pool and demographics in rural New Brunswick which have higher average ages than in urban areas. These data show how it is not just younger working adults volunteering their free time to assisting the people of their community with transportation, but older adults that are helping as well. This may reflect the change in lifestyle that many people experience after the age of 65, the age around which many people begin considering retirement. With free time and a need in the community from mobility-disadvantaged peers, those individuals with the time and the ability to help appear to be excellent candidates for a volunteer driver.

The majority of respondents donated approximately 1-2 hours per week (Table 1), which is consistent with national figure reported by Hanson (2017)where those aged 55-64 contributed on average

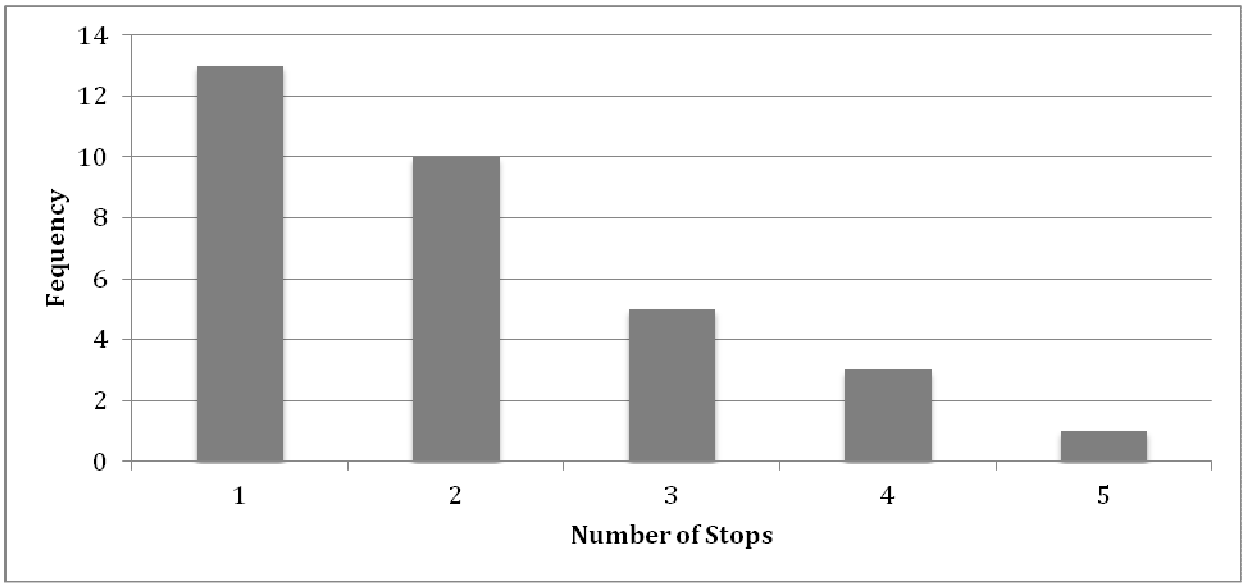
1.7 hours per week, while those ages 65-74 and 75+ contributed 1.3 hours/week and 1.4 hours/week respectively.

Table 1 Volunteer frequencies per week

Hours	Total Count	<65	65+	Total Percentage of respondents
Less than 1 Hour	2	1	1	5%
1-2 Hours	14	6	8	38%
3-4 Hours	9	1	8	24%
5-6 Hours	7	1	6	19%
7-8 Hours	1	1	0	3%
Over 8 Hours	3	2	1	8%
Blank	1	1		3%

Each survey participant was asked to recall their most recent volunteer driving experience, and for that drive to indicate how many stops they made, what the destinations and stop purposes were, what activities they performed in addition to driving, as well as the number of passengers at each stop. The definition of a stop and a drive is outlined in Hanson & Goudreau (2019) as follows: a stop (or trip leg) is defined as the one way travel activity from an origin to a destination during a drive (trip chain) and is associated with a physical stop by the vehicle; a drive consists of all sequential one-way stops to a destination and ends when the commitment to the client ends and the volunteer is free to serve other clients.The number of stops made by the 37 volunteers throughout the trip making is displayed in Figure 1 below.

Figure 1Frequency of stops by drivers on most recent drive



The drivers were instructed to report on their most recent VDP drive only, however there was a small number of participants (5 of 37) who appear to have neglected to provide information for just the most recent experience and the data suggest the inclusion of multiple drives. This is not to disqualify the provided stop information, as there can be trips with a large number of stops, however by considering the destinations of each stop the likelihood of multiple drives can be inferred. During data analysis, the drives with over five stops were flagged due to the repetitive destination locations (e.g. Hospital stops back-to-back repeatedly) that suggested it held more than just one drive's worth of stops. These flagged stops (those exceeding five stops) were excluded from the stops per drive assessment due to their ambiguity.

The drivers indicated the stop purpose based on four categories: Health, Life Maintenance, Quality of Life, and Work/Education. These categories align with the current reporting methods used by the VDPs, and can be used to identify patterns or trends amongst generalized trip making rather than exclusively by destinations. The total number of stops made by the volunteers for each purpose isdetailed in Table 2 below. Some stops were assigned to multiple purposes according to the drivers' discretion and knowledge of the users' needs and reasons for the stop.These multi-purpose stop categories are denoted with the initials of the primary stop purposes they involve (H for Health, LM for Life Maintenance, Q for Quality of Life, and W/Ed for Work/Education). Given that the number of total stops recorded was approximately 100, the number of stops is equivalent to a percentage.

Table 2 Number of stops by purpose

Purpose	Stops
Health	41
Life Maintenance	21
Quality of Life	21
Work/Education	7
H-LM	5
H-Q	2
H-LM-Q	1
LM-Q	2
Q-W/Ed	1
Total Stops	101

Five different categories of driver activities were presented to the respondents: open/close vehicle door, physically assist client(s) into/out of vehicle, escort client(s) between vehicle and destination door, escort client(s) into destination to provide further support, and assist with objects (mobility equipment, groceries, etc.). The drivers identified what tasks they performed to assist their clientele during their most recent drive, and the results were divided based on stop purpose. The type and frequency of activities performed in addition to driving by the volunteers is displayed in Table3.

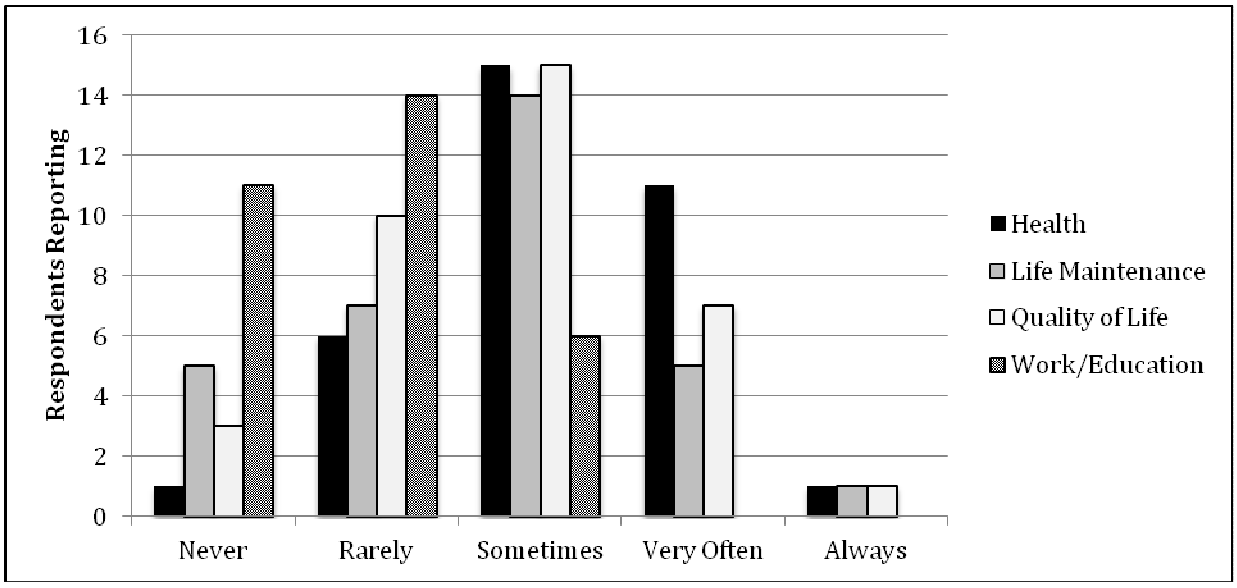
Table 3 Activities performed by stop purpose

	Health		Life Maintenance		Quality of Life		Work/ Education		Multi-Purpose	
Activity	Assisted	% of Stops	Assisted	% of Stops	Assisted	% of Stops	Assisted	% of Stops	Assisted	% of Stops
Open/close vehicle door	11	27%	5	24%	5	24%	4	57%	7	64%
Assist clients into/out of vehicle	7	17%	3	14%	2	10%	1	14%	4	36%
Escort clients between vehicle and destination door	14	34%	6	29%	2	10%	1	14%	4	36%
Escort clients into destination for further support	15	37%	5	24%	3	14%	0	0%	2	18%
Assist with objects	7	17%	8	38%	10	48%	0	0%	7	64%
Total stops	41		21		21		7		11	
Total activities	54		27		22		6		24	
Stops with no assistance	14		7		8		3		0	
% of stops without assistance	34%		33%		38%		43%		0%	

Health purpose stops were the most frequently reported and had the largest number of driveractivities performed overall (54), while Life Maintenance trips were most likely to have driver assistance. When accounting for multi-purpose trips, however, these combined-purpose stops exhibit the highest proportion of stops (100%) with additional assistance from the drivers, having all stops with assistance.Work/Education had the lowest number (6) of activities performed out of all stop purposes. Out of the total 101 stops, only 32 (32%) did not require any additional assistance from the driver. Across all stop purposes, the percentage of stops that did not require assistance range from 0% to 43%, which shows that approximately 57%-100% of stops encounter some form of assistance, depending on the stop purpose(s).

In addition to identifying what tasks they performed on their recent drives, the volunteers were also asked to indicate on a five-point Likert scale how often they generally provide additional assistance (like the tasks outlined previously) to the VDP users for each stop purpose category (Figure 2). There were several respondents who left items blank in this section, many of which indicating they had not driven for a particular trip purpose yet (e.g. Work/Education)and did not want to give false data representations by selecting the "Never" option. The data in Figure 2 show that Health stops are most likely to require assistance while Work/Education requires the least, consistent with the activities reported by respondents for their previous day of volunteering.

Figure 2 Assistance frequencies by stop purpose



Lessons from VDPs for rural AV operation

This distribution of tasks the drivers perform to support the VDP users introduces uncertainty into the concept of AVs as a useful service for non-drivers in rural areas. Respondents indicated they provided assistance in 68% of overall stops. If the percentage of stops requiring driver assistance are applied to the travel data (excluding home) of the seven groups studied by Hanson & Goudreau (2019), 65% of the Small & Medium groups stops and 64% of the Large group stops would involve driver assistance. It may be possible to automate some tasks, like opening a door, but the majority of tasks still require human interaction.

The data in Table 2 are consistent with some of the findings of Hanson & Goudreau (2019) across seven VDPs operating in New Brunswick, where Health stops were the predominant stop type, accounting for 49% of overall stops, ranging from 34% to 52% depending on group size (Small & Medium (fewer than 100 riders), or Large (101 – 300 riders). The ranges of stop purposes by group size

suggests that each group may be responding to different transportation needs, meaning that the introduction of AV may not be uniformly effective. There are some stop purposes that require relatively little assistance on behalf of the volunteer (Work/Education), while there are stops that consistently show driver involvement with the clients (e.g. Health purpose trips). The data suggest that for trips that are not medically focused, nor to facilitate the transportation of large quantities of household goods (e.g. Life Maintenance tasks like grocery shopping), that AVs would be capable to replicate the trip making. The fact that nearly one third of stops did not require additional assistance suggests that AV's may still have utility in a limited capacity. If a program were to be interested in adopting AVs in the future despite the poor fit with certain stops, the volunteers might consider transitioning from driver to companion rider in the AVs on trips where their presence is requested. This way, those clients who do not want/need any assistance can use the AV for their travel but those individuals who depend on the additional services will still have them available upon request. This format would remove the wear and tear on the volunteers' personal vehicles, as well as increase the socialization between clients and volunteers, which is a highly valued component of VDPs.The time spent by respondents providing transportation services to users is relatively small on a weekly basis, suggesting thattheoretically, existing needs may be satisfied with fewer AVsrather than having multiple drivers volunteering for small periods. However, one potential drawback for the AVs would be if the system implemented a very small fleet, but there was a large demand for particular days/times that the supply might not meet the demand. This issue would fall to whoever is designing the scheduling system to ensure the user schedules are suited by the availability of the AVs.

Conclusions

The results of the volunteer driver survey indicate a dependence on the additional services provided by the drivers for trips related to a user's health, as well as instances associated with transporting large quantities of household goods like getting groceries. Stops for the purpose of Work and Education show the least dependency on the driver for anything other than driving. The volunteer driving participants in this survey reported a total of 133 assistance tasks across the 101 stops included in the study, the largest portion of which (41%) are attributed to Health-only purpose stops. Two-thirds of the volunteers surveyed are aged 65 years and older, and 38% of respondents indicated typically volunteering between one and two hours per week. Over half (62%) of respondents reported stopping only once or twice on their most recent volunteer drive, which suggests these programs are not being used for long stop-and-go trips.

AVs appear to be capable of meeting the needs of users for approximately one third of stop purposes; however,the mixed dependence on the drivers would require some careful planning. One solution to this issue would be to have volunteers available if needed to accompany clients in a companion capacity rather than as a driver in an AV. This would reduce the demand on volunteers' time since they would only be present by request, and increase the level of assistance they could provide to users. The major benefit of AVs is that no driver is needed; however, to facilitate the additional assistance the users appear to rely upon, a human presence would still be necessary, ultimately defeating the purpose of an AV. The results of this study suggest that AVs may have limited utility in the meeting the needs of rural users dependent on others for transportation, as drivers play important roles in the majority of observed stops. Further research is recommended from the perspective of the VDP usersthat would focus on the value they place on assistance being provided by volunteers. Ranking of client assistance activities, as well as rating the importance each task has on the user's ability and comfort to use these programs would provide additional insight into the potential of AVs to replicate VDP trips.

References

Bellet, Thierry, Jean-Christophe Paris, and Claude Marin-Lamellet. 2018. "Difficulties Experienced by Older Drivers during Their Regular Driving and Their Expectations towards Advanced Driving Aid Systems and Vehicle Automation." *Transportation Research Part F: Traffic Psychology and Behaviour* 52 (January). Pergamon: 138–63. https://doi.org/10.1016/J.TRF.2017.11.014.

Canadian Council of Motor Transport Administrators (2016) *Automated Vehicles in Canada.*White Paper Report.

Haboucha, C., Ishaq, R., &Shiftan, Y. (2017). *User Preferences Regarding Autonomous Vehicles.* Transportation Research Part C: Emerging Technologies 78: 37-49. https://doi.org/10.1016/j.trc.2017.01.010.

Hanson, T.R., Goudreau, M. (2017). *How Many New Brunswickers Rely On Organized Volunteer Driver Programs? Preliminary Tolls And Approaches To Help Us Find The Answer*. Paper presented at the Proceedings of the Canadian Transportation Research Forum 52nd Annual Conference, 2017.

Hanson, T. R., & Goudreau, M. (2019). Developing Transportation Engineering and Planning Metrics for Rural Volunteer Driver Programs. Transportation Research Record. https://doi.org/10.1177/0361198118821377

Harper, C.D., Hendrickson, C.T., Mangones, S., & Samaras, C. (2016).*Estimating potential increases in travel with autonomous vehicles for the non-driving, elderly and people with travel-restrictive medical conditions*. Transportation Research Part C: Emerging Technologies, 72, 1-9. DOI:10.1016/j.trc.2016.09.003

Kalra, N. (2016).*Shaping the Future of Autonomous Vehicles: How Policymakers Can Promote Safety, Mobility, and Efficiency in an Uncertain World.* Santa Monica, CA. https://www.rand.org/pubs/testimonies/CT459.html.