Older Drivers and Their Attitudes Toward Autonomous Technologies and Electric Vehicles

By:
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Older Drivers and Their Attitudes Toward Autonomous Technologies and Electric Vehicles
1. Research motivation

- In Canada, similar to other developed countries, individuals aged 65 years and older represent a significant proportion of the overall population (approximately 17%).

- 15% increase in the number of older adults aged 65+ from 2013 to 2017 compared to only 4% increase in the population as a whole.
1. Research motivation

- There are limited mobility options for older Canadians beyond driving.

- A recent investigation conducted by the Government of Canada in 2017 suggests: “we are approaching the end of an era for the traditional, individually-owned, human-driven automobile. In the not-too-distant future, people will be able to summon a driverless taxi from their smartphone and may therefore decide to forego vehicle ownership in favour of these shared automated vehicles”.

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**Main forms of transportation for older adults in Canada**

<table>
<thead>
<tr>
<th>Age group - Both sexes</th>
<th>Driving one’s vehicle</th>
<th>Passenger in a vehicle (with driver’s licence)</th>
<th>Passenger in a vehicle (without driver’s licence)</th>
<th>Public transit</th>
<th>Walking or bicycling</th>
<th>Taxi or accessible transit</th>
</tr>
</thead>
<tbody>
<tr>
<td>45 to 54 years</td>
<td>79.2*</td>
<td>7.9*</td>
<td>2.8*</td>
<td>6.7</td>
<td>3.2*</td>
<td>F</td>
</tr>
<tr>
<td>55 to 64 years</td>
<td>75.2*</td>
<td>10.2</td>
<td>4.0*</td>
<td>5.8</td>
<td>4.0*</td>
<td>0.8*</td>
</tr>
<tr>
<td>65 to 74 years</td>
<td>67.9*</td>
<td>13.3</td>
<td>9.0*</td>
<td>5.5</td>
<td>3.2*</td>
<td>1.2*</td>
</tr>
<tr>
<td>75 to 84 years †</td>
<td>55.9</td>
<td>11.5</td>
<td>19.5</td>
<td>6.8</td>
<td>3.6*</td>
<td>2.6*</td>
</tr>
<tr>
<td>85 years and over</td>
<td>31.2*</td>
<td>8.6</td>
<td>40.6*</td>
<td>7.5*</td>
<td>4.6*</td>
<td>7.4*</td>
</tr>
</tbody>
</table>

[Martin Turcotte, 2012]
Older Drivers and Their Attitudes Toward Autonomous Technologies and Electric Vehicles

Outline

1. Research Motivation
2. Objectives
3. Data
4. Results
5. Conclusions
2. Objectives

• To provide a more comprehensive understanding of factors that influence older Canadians’ preferences and willingness to use autonomous (or self-driving) vehicular technology as well as electric vehicles.

• Also, to compare with results for younger adults to better understand the potential implications of these new technologies on mobility and quality of life.
Data

- Collected from the MITL 2018 national survey study.
- 3170 responses for older adults
Older Drivers and Their Attitudes Toward Autonomous Technologies and Electric Vehicles

Data

Distribution of older Participants by gender
- Male: 61%
- Female: 39%

Distribution of older participants by gender
- Male
- Female

Distribution of older participants by Employment status
- Retired or unable to work: 16%
- Employed: 84%

Distribution of older participants by education
- No certificate, diploma or degree: 2%
- High school diploma or equivalent: 19%
- Apprenticeship or trades certificate or diploma: 8%
- College, CEGEP or other non-university certificate or diploma: 24%
- University certificate or diploma below bachelor level: 8%
- University certificate, diploma or degree at bachelor level: 21%
- University certificate, diploma or degree above bachelor level: 18%
Older Drivers and Their Attitudes Toward Autonomous Technologies and Electric Vehicles

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1. Research Motivation
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Older adults’ responses to mode of travel questions

<table>
<thead>
<tr>
<th>Variable</th>
<th>Extremely Important</th>
<th>Important</th>
<th>Moderately Important</th>
<th>Slightly Important</th>
<th>Not at all Important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driving without passengers</td>
<td>634 (20.0%)</td>
<td>693 (21.9%)</td>
<td>635 (20.0%)</td>
<td>398 (12.6%)</td>
<td>810 (25.6%)</td>
</tr>
<tr>
<td>Driving with one or more passengers</td>
<td>531 (16.8%)</td>
<td>858 (27.1%)</td>
<td>708 (22.3%)</td>
<td>452 (14.3%)</td>
<td>621 (19.6%)</td>
</tr>
<tr>
<td>Sharing rides as a passenger</td>
<td>140 (4.4%)</td>
<td>363 (11.5%)</td>
<td>614 (19.4%)</td>
<td>672 (21.2%)</td>
<td>1381 (43.6%)</td>
</tr>
<tr>
<td>Bicycle</td>
<td>112 (3.5%)</td>
<td>213 (6.7%)</td>
<td>327 (10.3%)</td>
<td>430 (13.6%)</td>
<td>2088 (65.9%)</td>
</tr>
<tr>
<td>Public Transit (e.g., bus, subway)</td>
<td>137 (4.3%)</td>
<td>211 (6.7%)</td>
<td>384 (12.1%)</td>
<td>562 (17.7%)</td>
<td>1876 (59.2%)</td>
</tr>
<tr>
<td>Commuter Rail</td>
<td>49 (1.5%)</td>
<td>114 (3.6%)</td>
<td>221 (7.0%)</td>
<td>315 (9.9%)</td>
<td>2471 (77.9%)</td>
</tr>
<tr>
<td>Walking</td>
<td>823 (26.0%)</td>
<td>881 (27.8%)</td>
<td>698 (22.0%)</td>
<td>425 (13.4%)</td>
<td>343 (10.8%)</td>
</tr>
<tr>
<td>Ride sharing (e.g., Uber)</td>
<td>15 (0.5%)</td>
<td>63 (2.0%)</td>
<td>165 (5.2%)</td>
<td>319 (10.1%)</td>
<td>2608 (82.3%)</td>
</tr>
<tr>
<td>Car Sharing (pay as you go car use)</td>
<td>18 (0.6%)</td>
<td>54 (1.7%)</td>
<td>134 (4.2%)</td>
<td>254 (8.0%)</td>
<td>2710 (85.5%)</td>
</tr>
<tr>
<td>Taxi</td>
<td>14 (0.4%)</td>
<td>79 (2.5%)</td>
<td>293 (9.2%)</td>
<td>729 (23.0%)</td>
<td>2055 (64.8%)</td>
</tr>
</tbody>
</table>
Older adults’ responses to mode of travel questions

Importance of each mode of travel for older adults during an average week (important or extremely important)
## Older adults’ attitudes towards autonomous vehicle technology

<table>
<thead>
<tr>
<th>Variable</th>
<th>Strongly agree</th>
<th>Slightly agree</th>
<th>Neutral</th>
<th>Slightly Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y1: I would pay more for a vehicle with autonomous features</td>
<td>95</td>
<td>414</td>
<td>525</td>
<td>602</td>
<td>1534</td>
</tr>
<tr>
<td></td>
<td>3.0%</td>
<td>13.1%</td>
<td>16.6%</td>
<td>19.0%</td>
<td>48.4%</td>
</tr>
<tr>
<td>Y2: I would feel comfortable riding in an autonomous vehicle only if I could intervene as needed</td>
<td>685</td>
<td>916</td>
<td>418</td>
<td>389</td>
<td>762</td>
</tr>
<tr>
<td></td>
<td>21.6%</td>
<td>28.9%</td>
<td>13.2%</td>
<td>12.3%</td>
<td>24.0%</td>
</tr>
<tr>
<td>Y3: I would own fewer vehicles if I could access autonomous taxi-service</td>
<td>63</td>
<td>269</td>
<td>600</td>
<td>584</td>
<td>1654</td>
</tr>
<tr>
<td></td>
<td>2.0%</td>
<td>8.5%</td>
<td>18.9%</td>
<td>18.4%</td>
<td>52.2%</td>
</tr>
<tr>
<td>Y4: I would prefer to be personally in control of my vehicle since autonomous technologies cannot be foolproof</td>
<td>1646</td>
<td>1041</td>
<td>327</td>
<td>112</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>51.9%</td>
<td>32.8%</td>
<td>10.3%</td>
<td>3.5%</td>
<td>1.4%</td>
</tr>
<tr>
<td>Y5: With less stressful autonomous vehicle commuting, I could easily live further from my workplace or other destination important to me</td>
<td>81</td>
<td>250</td>
<td>1034</td>
<td>496</td>
<td>1309</td>
</tr>
<tr>
<td></td>
<td>2.6%</td>
<td>7.9%</td>
<td>32.6%</td>
<td>15.6%</td>
<td>41.3%</td>
</tr>
<tr>
<td>Y6: The concept of large autonomous trucks for moving goods is a good idea</td>
<td>196</td>
<td>509</td>
<td>812</td>
<td>446</td>
<td>1096</td>
</tr>
<tr>
<td></td>
<td>6.2%</td>
<td>16.1%</td>
<td>25.6%</td>
<td>14.1%</td>
<td>34.6%</td>
</tr>
</tbody>
</table>
Older adults’ attitudes towards autonomous vehicle technology

Y1: I would pay more for a vehicle with autonomous features

16.10%

Y2: I would feel comfortable riding in an autonomous vehicle only if I could intervene as needed

50.50%

Y3: I would own fewer vehicles if I could access autonomous taxi-service

10.50%

Y4: I would prefer to be personally in control of my vehicle since autonomous technologies cannot be foolproof

84.70%

Y5: With less stressful autonomous vehicle commuting, I could easily live further from my workplace or other destination important to me

10.50%

Y6: The concept of large autonomous trucks for moving goods is a good idea

22.30%
Participants attitudes towards autonomous vehicle technology (Comparison across age groups)

<table>
<thead>
<tr>
<th>Statement</th>
<th>65+</th>
<th>35-64</th>
<th>18-35</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y1: I would pay more for a vehicle with autonomous features</td>
<td>16.1</td>
<td>18.4</td>
<td>34.2</td>
</tr>
<tr>
<td>Y2: I would feel comfortable riding in an autonomous vehicle only if I could intervene as needed</td>
<td>10.5</td>
<td>14.7</td>
<td>26.5</td>
</tr>
<tr>
<td>Y3: I would own fewer vehicles if I could access autonomous taxi-service</td>
<td>10.5</td>
<td>19.3</td>
<td>34.1</td>
</tr>
<tr>
<td>Y4: I would prefer to be personally in control of my vehicle since autonomous technologies cannot be foolproof</td>
<td>10.5</td>
<td>19.3</td>
<td>34.1</td>
</tr>
<tr>
<td>Y5: With less stressful autonomous vehicle commuting, I could easily live further from my workplace or other destination important to me</td>
<td>10.5</td>
<td>19.3</td>
<td>34.1</td>
</tr>
<tr>
<td>Y6: The concept of large autonomous trucks for moving goods is a good idea</td>
<td>22.3</td>
<td>25.9</td>
<td>33.5</td>
</tr>
</tbody>
</table>

Percentages of Participants who slightly or strongly agree
Factors affecting older adults’ preferences and willingness to use autonomous features

Significant Variables?

Older adults’ willingness to use autonomous vehicles

Factor Analysis & Structural equation model
Results of Structural equation model (Factors affecting older adults’ preferences and willingness to use autonomous features)

- Using transportation modes other than driving
- Distance driven
- Income
- Importance of Driving
- Gender
- Urban-rural index score

Older adults’ willingness to use autonomous vehicles

Standardized path coefficient (S.E, t-value)

- 0.303 (0.018, 16.409)
- 0.075 (0.029, 2.598)
- 0.064 (0.027, 2.344)
- -0.021 (0.011, -1.942)
- 0.069 (0.018, 3.902)
- 0.035 (0.019, 1.772)
Attitudinal responses to use electric vehicles (Comparison across different age groups)

With an excellent battery warranty, I would not worry about buying an EV

I am willing to tolerate some periodic battery charging inconvenience for the benefits of driving an EV

I am willing to spend more money to buy an EV

I am willing to buy an EV in the near future.

In the long-term, I think owning an EV is more cost effective than owning a conventional vehicle.

I think buying an EV is a good decision.

<table>
<thead>
<tr>
<th>Statement</th>
<th>65+</th>
<th>35-64</th>
<th>18-34</th>
</tr>
</thead>
<tbody>
<tr>
<td>With an excellent battery warranty, I would not worry about buying an EV</td>
<td>42.4</td>
<td>45.9</td>
<td>51.6</td>
</tr>
<tr>
<td>I am willing to tolerate some periodic battery charging inconvenience</td>
<td>30.1</td>
<td>37.3</td>
<td>48.2</td>
</tr>
<tr>
<td>I am willing to spend more money to buy an EV</td>
<td>21.7</td>
<td>25.8</td>
<td>38.6</td>
</tr>
<tr>
<td>I am willing to buy an EV in the near future.</td>
<td>27.5</td>
<td>39.3</td>
<td>51.4</td>
</tr>
<tr>
<td>In the long-term, I think owning an EV is more cost effective than owning</td>
<td>40.2</td>
<td>45.6</td>
<td>57.5</td>
</tr>
<tr>
<td>I think buying an EV is a good decision.</td>
<td>41.9</td>
<td>51.2</td>
<td>65</td>
</tr>
</tbody>
</table>
Barriers to acquire an electric vehicle by age groups

1. **EVs just cost too much to buy.**

2. I am content with conventional ICE vehicles.

3. The purchase experience for an EV (initial inquiry to delivery) is more difficult.

4. I find the dealers steer me away from the EVs.

5. I am worried about EV resale value.

6. There is a lack of marketing on EVs.

Percentage of participants who slightly or strongly agree
### Older Drivers and Their Attitudes Toward Autonomous Technologies and Electric Vehicles

Barriers to acquire an electric vehicle by age groups

<table>
<thead>
<tr>
<th>Barriers</th>
<th>18-34</th>
<th>35-64</th>
<th>65+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public charging is much slower than filling my tank.</td>
<td>50.9</td>
<td>59.3</td>
<td>60.5</td>
</tr>
<tr>
<td>A charging station may not be nearby when I really need to charge.</td>
<td>48.2</td>
<td>78.8</td>
<td>82.2</td>
</tr>
<tr>
<td>I am concerned about the time required for an EV to pay off.</td>
<td>55</td>
<td>56.4</td>
<td>56.4</td>
</tr>
<tr>
<td>I am concerned about EV technology (e.g. battery durability, safety).</td>
<td>27.3</td>
<td>27.9</td>
<td>27.9</td>
</tr>
<tr>
<td>I prefer larger vehicles that do not come as EVs.</td>
<td>27.9</td>
<td>27.9</td>
<td>27.9</td>
</tr>
</tbody>
</table>

Percentage of participants who slightly or strongly agree
The level of urgency respondents feel for their next household vehicle to be a plug-in electric vehicle.
What are the characteristics of older Canadians who feel it is urgent to have their next household vehicle as electric vehicle?

Ordered Probit Model

**Results:**
Older Canadians who feel it is urgent to acquire EV as their next household vehicle are:
1. Females.
2. Those with higher education degrees.
3. Individuals who live urban areas.
4. Those who currently own or lease EV
5. Individuals who have access to standard 120 volt electric outlet where they live.
6. Those who have space for charging station at their home.
7. Individuals who have short-term plan to purchase or lease another vehicle.
Older Drivers and Their Attitudes Toward Autonomous Technologies and Electric Vehicles

Outline

1. Research Motivation
2. Objectives
3. Data
4. Results
5. Conclusions
5. Conclusions (Autonomous Vehicle Technology)

• Older Canadians (aged 65+) expressed less interest in AV compared to their younger counterparts.

• Most of survey’s participants prefer to be personally in control of their vehicle since AV cannot be foolproof.

• Almost half of participants would feel comfortable riding in an AV only if they could intervene as needed.

• Older adults who are depending mainly on driving as a mode of their travel are more resistant to the AV technology.

• Older males, those who live in urban areas and finally those who have a higher income are more likely to use AV.
5. Conclusions (Electric Vehicle)

• Three main barriers might affect older Canadians’ decision to acquire EV: (1) cost, (2) charging time and (3) availability and distribution of charging stations.

• Overall, older adults 65+ are slightly less willing to buy and use electrical vehicles compared to younger participants aged 64 years and below.

• Older females, those with higher education degrees and seniors who live in urban areas are more willing to acquire EV.
Thank you

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