Autonomous Vehicles: Familiarity, Awareness, and Perceptions

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Autonomous Vehicle Definition

An **Autonomous Vehicle (AV)** is a vehicle that drives itself **without human supervision** or control. It picks up and drops off passengers including those who do not drive (e.g., children, elderly), goes and **parks itself**, and picks up and delivers laundry, groceries, or food orders on its own. When AVs become available, ridehailing companies (e.g., Uber and Lyft) will use them to provide rides **without a human driver** in the vehicle. When answering the questions in this section, please assume a future in which **autonomous vehicles (AVs)** are widely adopted, but human-driven vehicles are still present.

Source: Society of Automation Engineers
Previous Studies

**Benefits**
- Increased safety
- Enhanced mobility
- Increased roadway capacity
- No need to drive or park the car
- Multitasking
- Carsharing

**Concerns**
- Increase in VMT
- Increase in congestion
- Reduced vehicle occupancy
- Liability
- Data security
- Safety

TOMNET D-STOP Transformative Technologies in Transportation Survey (T4 Survey)

- Phoenix, Atlanta, Austin, and Tampa metro areas
- Summer and Fall 2019
- Random address-based sample with online instrument
- Comprehensive attitudinal survey on MaaS and AV
- Weighted to better represent Census distributions

<table>
<thead>
<tr>
<th></th>
<th>Phoenix, AZ</th>
<th>Atlanta, GA</th>
<th>Austin, TX</th>
<th>Tampa, FL</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample Size</td>
<td>1,027</td>
<td>944</td>
<td>1,127</td>
<td>260</td>
<td>3,358</td>
</tr>
<tr>
<td>%</td>
<td>30.6%</td>
<td>28.1%</td>
<td>33.6%</td>
<td>7.8%</td>
<td>100%</td>
</tr>
</tbody>
</table>
Survey Instrument

- Attitudes and Preferences
- Vehicles You Have and Where You Live
- Current Travel Patterns
- Mobility on Demand and Shared Mobility Services
- Autonomous Vehicles
- Background Information

Familiarity
Perceptions
Willingness to ride
Policies
AV Familiarity
Which of the following statements best describes your familiarity with AVs?

<table>
<thead>
<tr>
<th>Statement</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>I had never heard of AVs before taking this survey.</td>
<td>512</td>
<td>15.2%</td>
</tr>
<tr>
<td>I have heard of AVs, but don't know much about them.</td>
<td>1217</td>
<td>36.2%</td>
</tr>
<tr>
<td>I am somewhat familiar with AVs.</td>
<td>1165</td>
<td>34.7%</td>
</tr>
<tr>
<td>I am very familiar with AVs.</td>
<td>416</td>
<td>12.4%</td>
</tr>
<tr>
<td>I have actually taken a ride in an AV.</td>
<td>46</td>
<td>1.4%</td>
</tr>
<tr>
<td>Total</td>
<td>3358</td>
<td>100%</td>
</tr>
</tbody>
</table>

Not Heard 15%
Heard but not Familiar 36%
Familiar 49%
AV Familiarity across Jurisdictions

- **Austin (N=1127)**
  - Not heard: 16%
  - Heard but not familiar: 35%
  - Familiar: 48%

- **Tampa (N=261)**
  - Not heard: 21%
  - Heard but not familiar: 49%
  - Familiar: 30%

- **Atlanta (N=943)**
  - Not heard: 16%
  - Heard but not familiar: 35%
  - Familiar: 48%

- **Phoenix (N=1026)**
  - Not heard: 12%
  - Heard but not familiar: 35%
  - Familiar: 54%

Legend:
- Not heard
- Heard but not familiar
- Familiar
## AV Familiarity: Two Groups

<table>
<thead>
<tr>
<th>Description</th>
<th>N</th>
<th>%</th>
</tr>
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<tbody>
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</tr>
<tr>
<td><strong>Total</strong></td>
<td>3358</td>
<td>100%</td>
</tr>
</tbody>
</table>

**Not So Familiar**: 51%

**Rather Familiar**: 49%
AV Familiarity across Demographic Groups

N=3,355

<table>
<thead>
<tr>
<th>Gender</th>
<th>Not Familiar</th>
<th>Familiar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>40%</td>
<td>60%</td>
</tr>
<tr>
<td>Female</td>
<td>62%</td>
<td>38%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Not Familiar</th>
<th>Familiar</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-30 years</td>
<td>53%</td>
<td>47%</td>
</tr>
<tr>
<td>31-40 years</td>
<td>56%</td>
<td>44%</td>
</tr>
<tr>
<td>41-50 years</td>
<td>46%</td>
<td>54%</td>
</tr>
<tr>
<td>51-60 years</td>
<td>54%</td>
<td>46%</td>
</tr>
<tr>
<td>61-70 years</td>
<td>52%</td>
<td>48%</td>
</tr>
<tr>
<td>71+ years</td>
<td>45%</td>
<td>55%</td>
</tr>
</tbody>
</table>

TOMNET Transportation Center
Teaching Old Models New Tricks
Arizona State University
AV Familiarity by Education Attainment

N=3,355

- **Completed graduate degree(s)**: 36% Not Familiar, 64% Familiar
- **Bachelor's degree(s) or some graduate school**: 44% Not Familiar, 56% Familiar
- **Some college or technical school**: 49% Not Familiar, 51% Familiar
- **Completed high school or GED**: 61% Not Familiar, 39% Familiar
- **Some grade/high school**: 79% Not Familiar, 21% Familiar
AV Familiarity by Liking to Try New Things
N=3,356

I like trying things that are new and different.

![Bar chart showing familiarity by liking to try new things.]

- Strongly disagree: 4% (Familiar 4% Not Familiar 96%)
- Somewhat disagree: 34% (Familiar 34% Not Familiar 66%)
- Neutral: 36% (Familiar 36% Not Familiar 64%)
- Somewhat agree: 54% (Familiar 54% Not Familiar 46%)
- Strongly agree: 51% (Familiar 51% Not Familiar 49%)

TOMNET Transportation Center
Teaching Old Models New Tricks
Arizona State University
AV Familiarity by Liking to Try New Things

N=3,356

I like trying things that are new and different.

<table>
<thead>
<tr>
<th>Location</th>
<th>Sample Size</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phoenix, AZ</td>
<td>1,026</td>
<td>38%</td>
<td>57%</td>
<td>30%</td>
</tr>
<tr>
<td>Atlanta, GA</td>
<td>930</td>
<td>62%</td>
<td>43%</td>
<td>19%</td>
</tr>
<tr>
<td>Austin, TX</td>
<td>1,125</td>
<td>52%</td>
<td>37%</td>
<td>18%</td>
</tr>
<tr>
<td>Tampa, FL</td>
<td>261</td>
<td>54%</td>
<td>46%</td>
<td>18%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
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</thead>
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<td>62%</td>
<td>43%</td>
<td>19%</td>
</tr>
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<td>37%</td>
<td>18%</td>
</tr>
<tr>
<td>Tampa, FL</td>
<td>54%</td>
<td>46%</td>
<td>18%</td>
</tr>
</tbody>
</table>

Not Familiar   Familiar
AV Familiarity by Ridehailing Use

N=3,355

<table>
<thead>
<tr>
<th>Familiarity and Use of Private Ridehailing (e.g., Uber, Lyft)</th>
<th>Not Familiar</th>
<th>Familiar</th>
</tr>
</thead>
<tbody>
<tr>
<td>I use it weekly</td>
<td>34%</td>
<td>66%</td>
</tr>
<tr>
<td>I use it monthly</td>
<td>41%</td>
<td>59%</td>
</tr>
<tr>
<td>I use it rarely (e.g., less than once a month)</td>
<td>45%</td>
<td>55%</td>
</tr>
<tr>
<td>I am familiar but never used the service</td>
<td>57%</td>
<td>43%</td>
</tr>
<tr>
<td>I am not familiar with it</td>
<td>74%</td>
<td>26%</td>
</tr>
</tbody>
</table>
AV Familiarity by Ridehailing Use Across Locations

Ridehailing Familiarity and Usage

- **Phoenix, AZ**: 1,026
- **Atlanta, GA**: 944
- **Austin, TX**: 1,125
- **Tampa, FL**: 260
AV Positive Perceptions

N=3,356

AVs would make traveling by car less stressful for me.
- Somewhat or Strongly Disagree: 31%
- Neutral: 32%
- Somewhat or Strongly Agree: 37%

AVs would make me feel safer on the street as a pedestrian or as a cyclist.
- Somewhat or Strongly Disagree: 44%
- Neutral: 33%
- Somewhat or Strongly Agree: 23%

AVs would help me avoid impaired driving (e.g., under the effects of medication or alcohol).
- Somewhat or Strongly Disagree: 19%
- Neutral: 25%
- Somewhat or Strongly Agree: 56%
AV Negative Perceptions
N=3,356

I want the ability to take control of the AV at any time during the ride.

- Somewhat or Strongly Disagree: 8%
- Neutral: 18%
- Somewhat or Strongly Agree: 74%

I am concerned that my travel logs and personal information stored in AVs could be leaked.

- Somewhat or Strongly Disagree: 27%
- Neutral: 26%
- Somewhat or Strongly Agree: 47%

I am concerned about the potential failure of AV sensors, equipment, technology, or programs.

- Somewhat or Strongly Disagree: 14%
- Neutral: 18%
- Somewhat or Strongly Agree: 68%
AV Safety Concern Across Locations

I am concerned about the potential failure of AV sensors, equipment, technology, or programs.

- **Austin (N=1126):**
  - Disagree: 14%
  - Neutral: 19%
  - Agree: 66%

- **Tampa (N=260):**
  - Disagree: 15%
  - Neutral: 19%
  - Agree: 67%

- **Atlanta (N=941):**
  - Disagree: 10%
  - Neutral: 17%
  - Agree: 73%

- **Phoenix (N=1022):**
  - Disagree: 18%
  - Neutral: 15%
  - Agree: 67%
AV Safety Concern and Education

- Completed graduate degree(s):
  - Not Concerned: 15%
  - Neutral: 12%
  - Concerned: 73%

- Bachelor's degree(s) or some graduate school:
  - Not Concerned: 13%
  - Neutral: 9%
  - Concerned: 78%

- Some college or technical school:
  - Not Concerned: 16%
  - Neutral: 13%
  - Concerned: 71%

- Completed high school or GED:
  - Not Concerned: 11%
  - Neutral: 31%
  - Concerned: 57%

- Some grade/high school:
  - Not Concerned: 22%
  - Neutral: 20%
  - Concerned: 59%
AV Safety Concern by AV Familiarity

N=3,356

I am concerned about the potential failure of AV sensors, equipment, technology, or programs.

<table>
<thead>
<tr>
<th>Familiarity</th>
<th>Strongly disagree</th>
<th>Somewhat disagree</th>
<th>Neutral</th>
<th>Somewhat agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Familiar</td>
<td>8%</td>
<td>10%</td>
<td>12%</td>
<td>38%</td>
<td>32%</td>
</tr>
<tr>
<td>Not Familiar</td>
<td>5%</td>
<td>6%</td>
<td>22%</td>
<td>32%</td>
<td>34%</td>
</tr>
</tbody>
</table>
Willingness to Ride in an AV Across Locations

I will never ride in an AV.

- Phoenix (N=1,015):
  - Strongly or somewhat disagree: 21%
  - Neutral: 31%
  - Strongly or somewhat agree: 48%

- Atlanta (N=941):
  - Strongly or somewhat disagree: 19%
  - Neutral: 32%
  - Strongly or somewhat agree: 49%

- Tampa (N=260):
  - Strongly or somewhat disagree: 23%
  - Neutral: 36%
  - Strongly or somewhat agree: 41%

- Austin (N=1122):
  - Strongly or somewhat disagree: 18%
  - Neutral: 27%
  - Strongly or somewhat agree: 55%
Willingness to Ride in an AV by Education Levels

- **Completed graduate degree(s):**
  - Ride AV: 66%
  - Neutral: 18%
  - Never ride an AV: 16%

- **Bachelor's degree(s) or some graduate school:**
  - Ride AV: 60%
  - Neutral: 22%
  - Never ride an AV: 18%

- **Some college or technical school:**
  - Ride AV: 48%
  - Neutral: 31%
  - Never ride an AV: 21%

- **Completed high school or GED:**
  - Ride AV: 38%
  - Neutral: 42%
  - Never ride an AV: 20%

- **Some grade/high school:**
  - Ride AV: 50%
  - Neutral: 30%
  - Never ride an AV: 20%
Willingness to Ride in an AV by Age Group

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Ride AV</th>
<th>Neutral</th>
<th>Never ride an AV</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-30 years</td>
<td>55%</td>
<td>33%</td>
<td>12%</td>
</tr>
<tr>
<td>31-40 years</td>
<td>57%</td>
<td>23%</td>
<td>20%</td>
</tr>
<tr>
<td>41-50 years</td>
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<td>15%</td>
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<td>51-60 years</td>
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<td>26%</td>
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<tr>
<td>61-70 years</td>
<td>40%</td>
<td>39%</td>
<td>21%</td>
</tr>
<tr>
<td>71+ years</td>
<td>42%</td>
<td>25%</td>
<td>33%</td>
</tr>
</tbody>
</table>
### AV Perceptions Relationships

<table>
<thead>
<tr>
<th></th>
<th>Not Concerned</th>
<th>Neutral</th>
<th>Concerned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not Familiar</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>64%</td>
<td>23%</td>
<td>39%</td>
</tr>
<tr>
<td>Familiar</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>26%</td>
<td>11%</td>
<td>27%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>27%</td>
<td>13%</td>
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<td></td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Not Concerned</th>
<th>Neutral</th>
<th>Concerned</th>
</tr>
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<tbody>
<tr>
<td>Not Familiar</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>81%</td>
<td>61%</td>
</tr>
<tr>
<td>Familiar</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>10%</td>
<td>26%</td>
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<td></td>
<td></td>
<td>13%</td>
<td>23%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>26%</td>
</tr>
</tbody>
</table>

- **Ride AV**: Indicates a willingness to ride an AV.
- **Neutral**: Indicates a neutral stance towards AVs.
- **Never ride an AV**: Indicates a lack of interest in riding an AV.

#### Safety Perceptions
- Familiarity
- Willingness to Ride
Attitudes Towards AV Policies

N=3,356

Laws should be passed to require AVs to travel at 25 mph or less on city streets.

- Disagree: 32%
- Neutral: 34%
- Agree: 34%

AVs should prioritize the safety of pedestrians and bicyclists on the road over that of passengers in the vehicle.

- Disagree: 24%
- Neutral: 33%
- Agree: 42%

AVs should be allowed on the market only when they prove to be at least as safe as human drivers.

- Disagree: 10%
- Neutral: 11%
- Agree: 79%
Attitudes Towards AV Policies – Across Locations

AVs should be allowed on the market only when they prove to be at least as safe as human drivers.

<table>
<thead>
<tr>
<th>Location</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austin (N=1121)</td>
<td>10%</td>
<td>11%</td>
<td>79%</td>
</tr>
<tr>
<td>Tampa (N=261)</td>
<td>9%</td>
<td>10%</td>
<td>81%</td>
</tr>
<tr>
<td>Atlanta (N=942)</td>
<td>10%</td>
<td>11%</td>
<td>79%</td>
</tr>
<tr>
<td>Phoenix (N=1024)</td>
<td>9%</td>
<td>13%</td>
<td>78%</td>
</tr>
</tbody>
</table>
Attitudes Towards AV Policies – Across Locations

AVs should prioritize the safety of pedestrians and bicyclists on the road over that of passengers in the vehicle.

- **Phoenix (N=1023)**: 22% Disagree, 34% Neutral, 44% Agree
- **Atlanta (N=940)**: 30% Disagree, 31% Neutral, 39% Agree
- **Tampa (N=260)**: 20% Disagree, 27% Neutral, 53% Agree
- **Austin (N=1126)**: 22% Disagree, 37% Neutral, 41% Agree
Multitasking in AV During Commute

- Talk on the phone/ text messages/ teleconference
- Enjoy the scenery
- Work or Study
- Sleep
- Eat and drink
- Entertainment
- Read

Pheonix (N=210)
Atlanta (N=214)
Tampa (N=63)
Austin (N=200)
How AVs Shape the Future of Mobility?
N=3,356

I would feel comfortable having an AV pick-up/drop-off children without adult supervision.

- Disagree: 18%
- Neutral: 21%
- Agree: 62%

I would send an AV to pick-up groceries/laundry/food orders by itself.

- Disagree: 23%
- Neutral: 28%
- Agree: 49%

AVs would save me time and money for parking by dropping me off and parking themselves.

- Disagree: 53%
- Neutral: 31%
- Agree: 16%
## Key Findings across Locations

<table>
<thead>
<tr>
<th>Location</th>
<th>Highest AV familiarity and average willingness to ride</th>
<th>Lowest AV safety concern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phoenix</td>
<td>Highest AV familiarity and average willingness to ride</td>
<td>Lowest AV safety concern</td>
</tr>
<tr>
<td>Atlanta</td>
<td>Average AV familiarity and willingness to ride</td>
<td>Highest AV safety concern</td>
</tr>
<tr>
<td>Austin</td>
<td>Highest AV willingness to ride</td>
<td>Average AV familiarity</td>
</tr>
<tr>
<td>Tampa</td>
<td>Lowest AV familiarity</td>
<td>Lowest willingness to ride</td>
</tr>
</tbody>
</table>
Key Highlights

• AV familiarity, safety concerns, and willingness to ride are closely related to one another

• But familiarity does not necessarily eliminate concerns around safety

• Remarkable consistency and similarity between geographic areas, suggesting that transferability of assumptions may be quite high

Next Step

• Further investigate relationships between AV familiarity, perceptions, and willingness to ride, both across locations and across demographic groups
Thank you!

Sara Khoeini, sara.khoeini@asu.edu