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MOTORISTS' PREFERENCES FOR DIFFERENT LEVELS OF VEHICLE AUTOMATION: 2016

**BRANDON SCHOETTLE
MICHAEL SIVAK**



**SUSTAINABLE WORLDWIDE
TRANSPORTATION**

UNIVERSITY OF MICHIGAN

MOTORISTS' PREFERENCES FOR DIFFERENT LEVELS
OF VEHICLE AUTOMATION: 2016

Brandon Schoettle
Michael Sivak

The University of Michigan
Sustainable Worldwide Transportation
Ann Arbor, Michigan 48109-2150
U.S.A.

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16. Abstract <p>This report builds on our recent series of eight reports addressing public opinion, human factors, and safety-related issues concerning self-driving vehicles. An identical survey to that used in 2015 was administered. The survey was developed to examine motorists' preferences among levels of vehicle automation, including preferences for interacting with and overall concern about riding in self-driving vehicles. The survey yielded completed responses from 618 licensed drivers in the U.S.</p> <p>The main findings are as follows:</p> <ul style="list-style-type: none">• The most frequent preference for vehicle automation continues to be for no self-driving capability, followed by partially self-driving vehicles, with completely self-driving vehicles being the least preferred choice.• Concern for riding in self-driving vehicles remains higher for completely self-driving vehicles than for partially self-driving vehicles.• Respondents still overwhelmingly want to be able to manually control completely self-driving vehicles when desired.• Preferences were generally divided between touchscreens or voice commands to input route or destination information for completely self-driving vehicles.• Most respondents prefer to be notified of the need to take control of a partially self-driving vehicle with a combination of sound, vibration, and visual warnings.• Overall public opinion has been remarkably consistent over the two years that this survey has been conducted. The general patterns of responses have not changed over the course of these two surveys, despite the increased media coverage of self-driving vehicles.					
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Introduction

This report builds on a recent series of eight reports addressing public opinion, human factors, and safety-related issues concerning self-driving vehicles (Schoettle and Sivak, 2014, 2015a, 2015b, 2015c; Sivak and Schoettle, 2015a, 2015b, 2015c, 2015d). Specifically, this report documents a new wave of a survey originally implemented in 2015 on public preference for and concerns with different levels of vehicle automation (Schoettle and Sivak, 2015b). The report presents the results of this new wave, and compares the data with the previous wave.

Method

Survey instrument

An online survey was conducted using SurveyMonkey (www.surveymonkey.com), a web-based survey company. The identical questionnaire as previously administered in Schoettle and Sivak (2015b) was used. This questionnaire was developed to examine several issues related to motorists' preferences regarding control of both partially and completely self-driving vehicles, as well as overall preferences for having self-driving versus conventional (non-self-driving) vehicles. The text of the questionnaire is included in the appendix. The survey was performed in April 2016.

Respondents

SurveyMonkey's Audience tool was used to target and recruit licensed drivers 18 years and older from SurveyMonkey's respondent database in the U.S. Fully completed surveys were received for 618 respondents. The margin of error at the 95% confidence level for the overall results is +/- 3.9%. Demographic breakdowns for the respondents are presented in Table 1. The distributions of respondents by age and gender are closely matched to the latest U.S. Census population distributions (U.S. Census Bureau, 2010).

Table 1
Demographic breakdown for the 618 respondents.

Demographic aspect	Percent	
Age group	18 to 29	22.3
	30 to 44	26.2
	45 to 59	27.8
	60 or older	23.6
Gender	Female	50.8
	Male	49.2
Income	\$0 to \$24,999	12.0
	\$25,000 to \$49,999	18.0
	\$50,000 to \$74,999	17.2
	\$75,000 to \$99,999	16.5
	\$100,000 to \$124,999	8.4
	\$125,000 to \$149,999	8.1
	\$150,000 to \$174,999	2.9
	\$175,000 to \$199,999	1.8
	\$200,000 or more	3.9
	Prefer not to answer	11.2
U.S. region	New England	5.0
	Middle Atlantic	14.8
	North Central	26.1
	South Atlantic	16.3
	South Central	14.3
	Mountain	8.8
	Pacific	14.7

Results

Preferred level of vehicle automation

When respondents were asked about which level of vehicle automation they preferred (see the appendix for the definitions of each level of automation that were provided to respondents), the most frequent preference was for no self-driving (45.8%), followed by partially self-driving (38.7%), with completely self-driving being the least preferred (15.5%). Figure 1 summarizes the results for all respondents, while Table 2 presents a complete summary of responses by gender and age.

No notable gender differences were observed, with similar percentages of females and males preferring no self-driving most frequently (48.4% and 43.1%, respectively).

Preference for having vehicle automation generally decreased as respondent age increased.

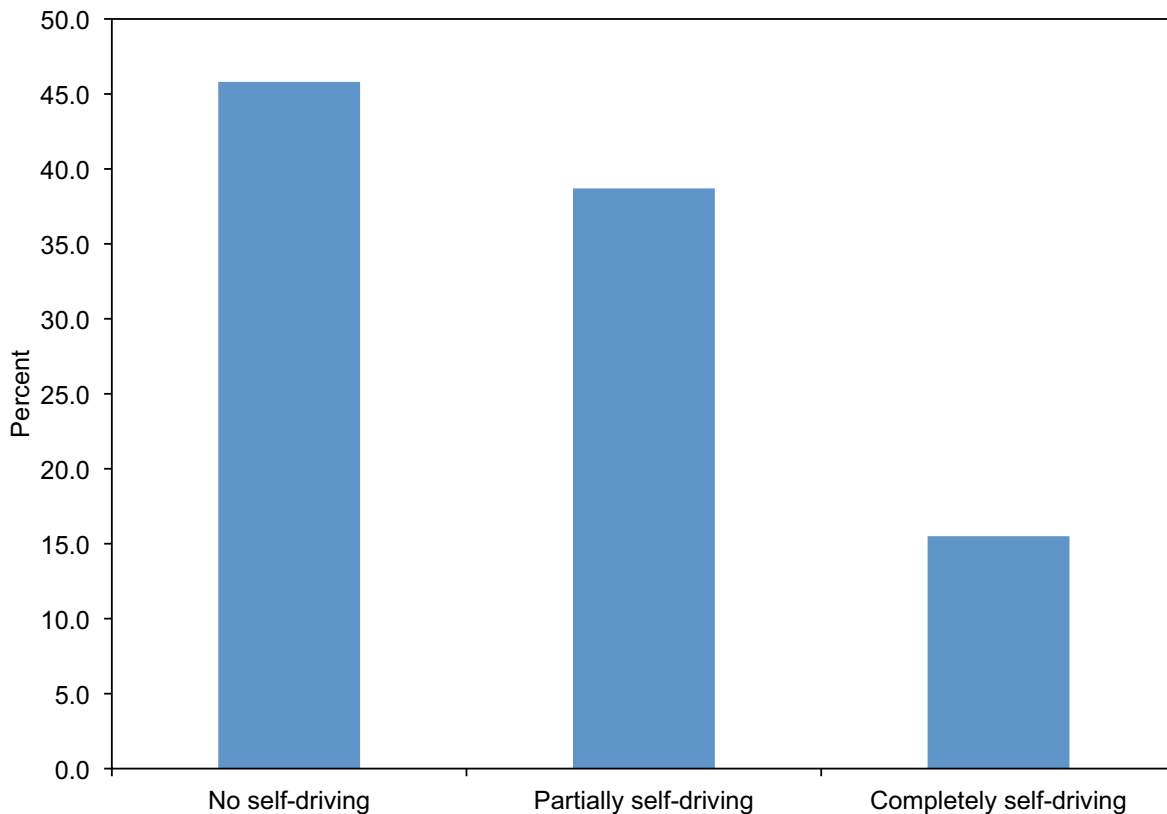


Figure 1. Summary of responses to Q1: “*Vehicle manufacturers are considering using one of three levels of automation in future vehicles. Which level would you prefer to have in your personal vehicle?*”

Table 2

Percentage of responses, by gender and age, to Q1: “*Vehicle manufacturers are considering using one of three levels of automation in future vehicles. Which level would you prefer to have in your personal vehicle?*”

Response	Gender		Age				Total
	Female	Male	18-29	30-44	45-59	60+	
No self-driving	48.4	43.1	41.3	35.2	50.6	56.2	45.8
Partially self-driving	39.8	37.5	39.9	42.6	37.8	34.2	38.7
Completely self-driving	11.8	19.4	18.8	22.2	11.6	9.6	15.5

Concern about riding in self-driving vehicles

In two different questions, respondents were asked how concerned they would be about riding in a completely self-driving vehicle (Q2) and a partially self-driving vehicle (Q5). The respondents were more concerned about riding in a completely self-driving vehicle than in a partially self-driving vehicle. For example, 37.2% were very concerned about riding in a completely self-driving vehicle (and 66.6% were very or moderately concerned), as opposed to 17.0% for a partially self-driving vehicle (with 50.7% being very or moderately concerned). Conversely, 9.7% were not at all concerned with riding in a completely self-driving vehicle, as opposed to 16.5% for a partially self-driving vehicle. Figure 2 summarizes the results for all respondents, while Tables 3 and 4 present complete summaries of responses by gender and age.

Females expressed greater concern than males for riding in completely self-driving vehicles (very concerned: 43.0% versus 31.3%), but the difference was smaller for partially self-driving vehicles (very concerned: 17.5% versus 16.4%).

Older respondents tended to have greater concern than younger respondents for riding in self-driving vehicles. This was the case for completely self-driving vehicles (very concerned: 26.1% for 18-29 year olds versus 45.2% for those 60 and older), and partially self-driving vehicles (very concerned: 10.1% for 18-29 year olds versus 25.3% for those 60 and older).

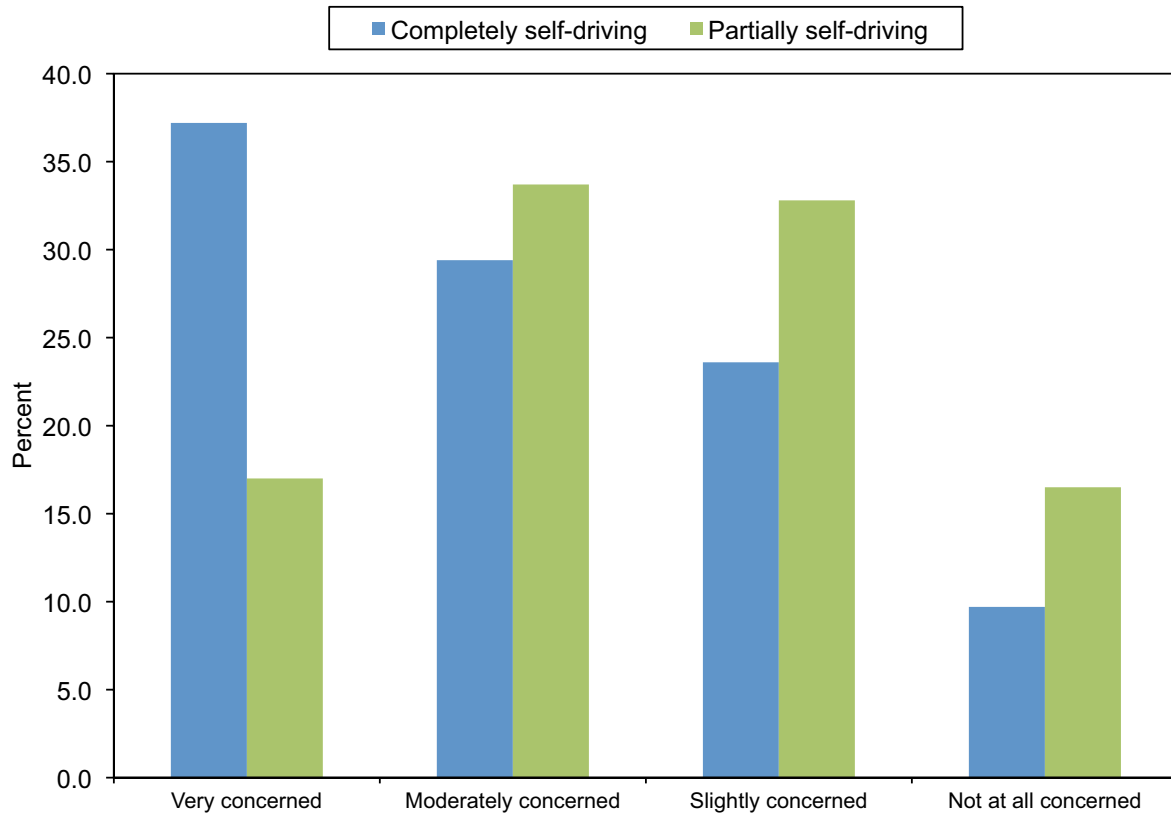


Figure 2. Combined summary of responses to Q2 and Q5: “If the only vehicles available were completely self-driving (Q2) or partially self-driving (Q5), how concerned would you be about riding in such vehicles?”

Table 3

Percentage of responses, by gender and age, to Q2:

“If the only vehicles available were completely self-driving, how concerned would you be about riding in such vehicles?”

Response	Gender		Age				Total
	Female	Male	18-29	30-44	45-59	60+	
Very concerned	43.0	31.3	26.1	30.2	45.9	45.2	37.2
Moderately concerned	30.3	28.6	30.4	34.0	25.0	28.8	29.4
Slightly concerned	22.0	25.3	29.7	23.5	21.5	20.5	23.6
Not at all concerned	4.8	14.8	13.8	12.3	7.6	5.5	9.7

Table 4

Percentage of responses, by gender and age, to Q5:

“If the only vehicles available were partially self-driving, how concerned would you be about riding in such vehicles?”

Response	Gender		Age				Total
	Female	Male	18-29	30-44	45-59	60+	
Very concerned	17.5	16.4	10.1	10.5	21.5	25.3	17.0
Moderately concerned	38.9	28.3	26.1	31.5	39.0	37.0	33.7
Slightly concerned	33.8	31.9	41.3	38.3	29.1	23.3	32.8
Not at all concerned	9.9	23.4	22.5	19.8	10.5	14.4	16.5

Preferences for controlling completely self-driving vehicles

Availability of vehicle controls. Nearly all respondents (94.5%) would want to have a steering wheel plus gas and brake pedals (or some other controls) available in completely self-driving vehicles. Figure 3 summarizes the results for all respondents, while Table 5 presents a complete summary of responses by gender and age.

No notable gender differences were observed, with similar percentages of females and males preferring to have controls on self-driving vehicles (96.2% and 92.8%, respectively).

Likewise, no meaningful age differences were observed, with each age group expressing a high degree of preference for having controls on self-driving vehicles (ranging from 93.0% to 96.3%).

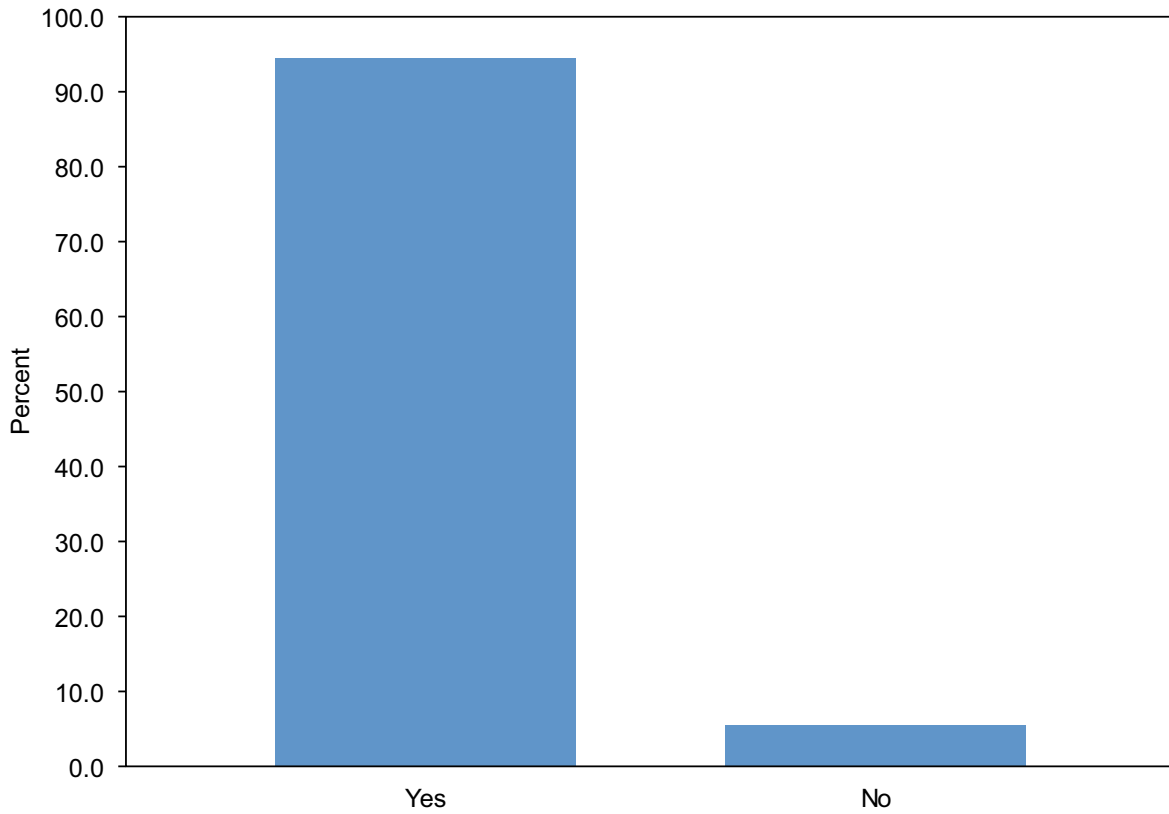


Figure 3. Summary of responses to Q3: “Would you prefer that a completely self-driving vehicle still have a steering wheel plus gas and brake pedals (or some other controls) to enable a driver to take control if desired?”

Table 5

Percentage of responses, by gender and age, to Q3: “Would you prefer that a completely self-driving vehicle still have a steering wheel plus gas and brake pedals (or some other controls) to enable a driver to take control if desired?”

Response	Gender		Age				Total
	Female	Male	18-29	30-44	45-59	60+	
Yes	96.2	92.8	93.5	96.3	93.0	95.2	94.5
No	3.8	7.2	6.5	3.7	7.0	4.8	5.5

Route or destination input. The most preferred method for inputting a route or destination was nearly equally divided between touchscreens (38.0%) and voice commands (34.5%). Figure 4 summarizes the results for all respondents, while Table 6 presents a complete summary of responses by gender and age.

The method most preferred by females was voice commands (40.1%), while the most preferred method for males was touchscreen (37.8%).

Younger respondents tended to prefer touchscreens, with preferences shifting to voice commands for older respondents.

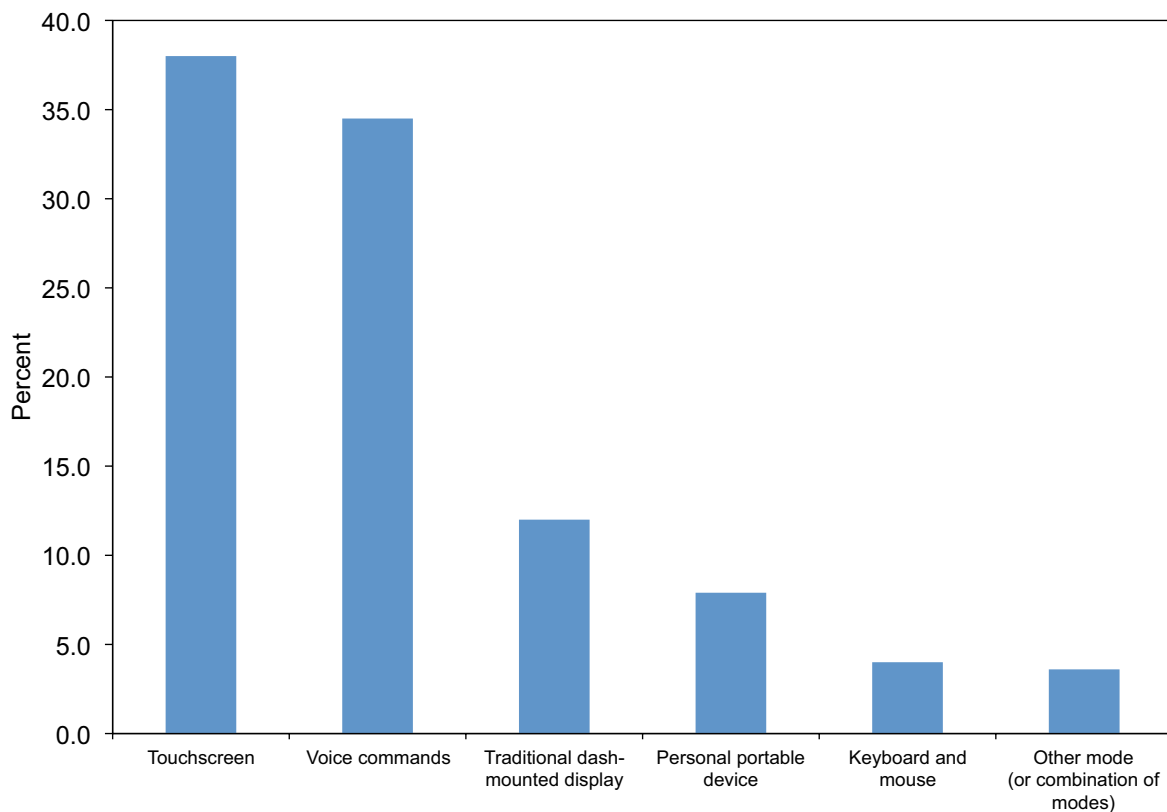


Figure 4. Summary of responses to Q4: “In a completely self-driving vehicle, how would you prefer to tell the vehicle your route or destination?”

Table 6
 Percentage of responses, by gender and age, to Q4: “*In a completely self-driving vehicle, how would you prefer to tell the vehicle your route or destination?*”

Response	Gender		Age				Total
	Female	Male	18-29	30-44	45-59	60+	
Touchscreen	38.2	37.8	50.0	42.6	34.3	26.0	38.0
Voice commands	40.1	28.6	19.6	34.0	37.8	45.2	34.5
Traditional dash-mounted display	10.5	13.5	7.2	11.1	15.1	13.7	12.0
Personal portable device	5.7	10.2	15.2	8.6	3.5	5.5	7.9
Keyboard and mouse	2.9	5.3	7.2	1.9	4.1	3.4	4.0
Other method	2.5	4.6	0.7	1.9	5.2	6.2	3.6

Preferred driver intervention notification for partially self-driving vehicles

When respondents were asked about how they preferred to be notified when a partially self-driving vehicle requires the driver to take control of the vehicle, the majority (59.1%) preferred a combination of three warning modes (sound, visual, and vibration). Figure 5 summarizes the results for all respondents, while Table 7 presents a complete summary of responses by gender and age.

Similar percentages of females and males prefer to be notified with a combination of all three modes (58.0% and 60.2%, respectively).

A majority of each age group indicated they prefer to be notified with a combination of all three modes (ranging from 54.1% to 64.5%).

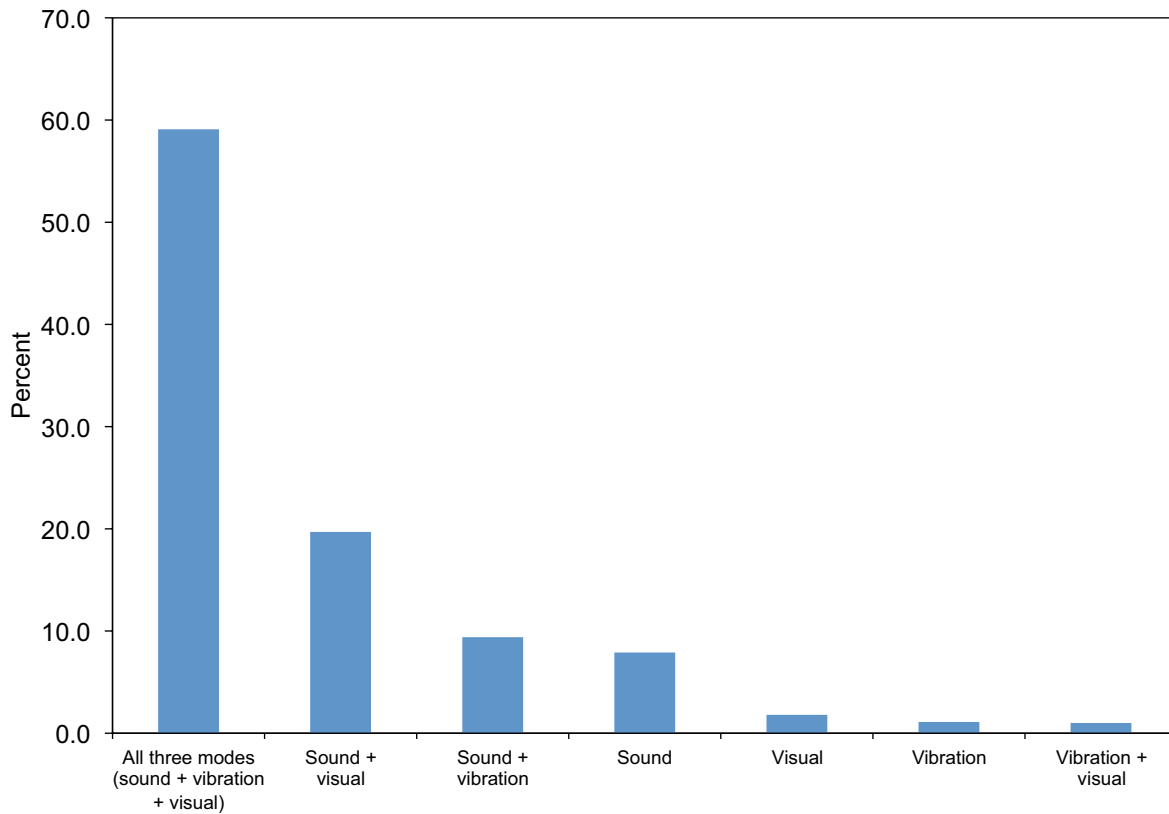


Figure 5. Summary of responses to Q6: “When a partially self-driving vehicle requires the driver to take control of the vehicle, how would you prefer to be notified?”

Table 7
Percentage of responses, by gender and age, to Q6: “When a partially self-driving vehicle requires the driver to take control of the vehicle, how would you prefer to be notified?”

Response	Gender		Age				Total
	Female	Male	18-29	30-44	45-59	60+	
All three modes (sound + vibration + visual)	58.0	60.2	64.5	59.9	54.1	58.9	59.1
Sound + visual	20.1	19.4	15.2	21.6	22.7	18.5	19.7
Sound + vibration	9.2	9.5	8.0	10.5	9.9	8.9	9.4
Sound	8.3	7.6	5.8	4.3	11.0	10.3	7.9
Visual	2.5	1.0	3.6	1.2	1.2	1.4	1.8
Vibration	0.6	1.6	1.4	1.2	0.6	1.4	1.1
Vibration + visual	1.3	0.7	1.4	1.2	0.6	0.7	1.0

Year-to-Year Comparisons

Tables 8 through 13 present comparisons of current results with the results obtained for the identical questions in 2015 (Schoettle and Sivak, 2015b). The main finding of these comparisons is that the general patterns of responses have not changed.

Table 8
Preferred level of vehicle automation: Schoettle and Sivak (2015b) versus the current study (2016). (Entries are percentages.)

Response	2015	2016
No self-driving	43.8	45.8
Partially self-driving	40.6	38.7
Completely self-driving	15.6	15.5

Table 9
Concern for riding in a completely self-driving vehicle: Schoettle and Sivak (2015b) versus the current study (2016). (Entries are percentages.)

Response	2015	2016
Very concerned	35.6	37.2
Moderately concerned	32.7	29.4
Slightly concerned	20.8	23.6
Not at all concerned	10.9	9.7

Table 10
Concern for riding in a partially self-driving vehicle: Schoettle and Sivak (2015b) versus the current study (2016). (Entries are percentages.)

Response	2015	2016
Very concerned	14.1	17.0
Moderately concerned	34.7	33.7
Slightly concerned	35.0	32.8
Not at all concerned	16.2	16.5

Table 11

Preference for availability of vehicle controls in a completely self-driving vehicle: Schoettle and Sivak (2015b) versus the current study (2016). (Entries are percentages.)

Response	2015	2016
Yes	96.2	94.5
No	3.8	5.5

Table 12

Preferred method for inputting route or destination: Schoettle and Sivak (2015b) versus the current study (2016). (Entries are percentages.)

Response	2015	2016
Touchscreen	37.8	38.0
Voice commands	36.2	34.5
Traditional dash-mounted display	11.7	12.0
Personal portable device	8.3	7.9
Keyboard and mouse	3.0	4.0
Other method	3.0	3.6

Table 13

Preferred method for inputting route or destination: Schoettle and Sivak (2015b) versus the current study (2016). (Entries are percentages.)

Response	2015	2016
All three modes (sound + vibration + visual)	59.4	59.1
Sound + visual	19.4	19.7
Sound + vibration	9.7	9.4
Sound	7.9	7.9
Visual	1.8	1.8
Vibration	0.4	1.1
Vibration + visual	1.4	1.0

Key Findings

Preferred level of vehicle automation

- The most frequent preference was for no self-driving (45.8%), followed by partially self-driving (38.7%), with completely self-driving being the least preferred (15.5%).

Concern about riding in self-driving vehicles

- The respondents were more concerned about riding in a completely self-driving vehicle than in a partially self-driving vehicle. For example, 37.2% were very concerned about riding in a completely self-driving vehicle, as opposed to 17.0% for a partially self-driving vehicle.

- The level of concern for riding in completely self-driving vehicles is high, with two thirds of respondents feeling either very or moderately concerned.

Preferences for controlling completely self-driving vehicles

- Respondents overwhelmingly (94.5%) want to have a steering wheel plus gas and brake pedals (or some other controls) available to control completely self-driving vehicles when desired.

- The most preferred method for inputting a route or destination was touchscreens (37.8%), followed closely by voice commands (36.2%).

Preferred driver intervention notification for partially self-driving vehicles

- Most respondents (59.1%) prefer to be notified of the need to take control of a partially self-driving vehicle with a combination of sound, vibration, and visual warnings.

Year-to-year consistency between surveys

- Overall public opinion has been remarkably consistent over the two years that this survey has been conducted, despite the increased media coverage of self-driving vehicles. Furthermore, questions such as preferred destination input method or driver intervention notification method showed the same patterns in both in the order and magnitude of preferences as the previous survey.

- Although different in some aspects, two questions analogous to those regarding concern for riding in completely or partially self-driving vehicles (Q2 and Q5, respectively) were also asked in a survey conducted two years ago (Schoettle and Sivak, 2014). The results for that survey showed that concern for riding in completely self-driving vehicles of either type was just as high then as now. For example, 35.9% of respondents in the 2014 survey said they would be very concerned about riding in completely self-driving vehicles, compared with 35.6% in 2015 and 37.2% in 2016.

- In comparison, there was a reduction in concern for riding in partially self-driving vehicles from 2014 to 2015, but no further reduction from 2015 to 2016. For example, the percentages of those who were very concerned in 2014, 2015, and 2016 were 26.1%, 14.1%, and 17.0%, respectively.

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Appendix: Questionnaire

Driver preferences for controlling and interacting with automated vehicles

We are conducting a survey of opinions about vehicle automation and self-driving vehicles.

1) Vehicle manufacturers are considering using one of three levels of automation in future vehicles. Which level would you prefer to have in your personal vehicle?

- Completely self-driving. The vehicle will control all safety-critical functions, even allowing the vehicle to travel without a passenger if required.
 - Partially self-driving. The driver will be able to hand over control of all safety-critical functions to the vehicle; only occasional control by the driver will be required.
 - No self-driving. The driver will always be in complete control of all safety functions, but the driver will be assisted with various advanced technologies.
-

The next 3 questions are about completely self-driving vehicles.

2) If the only vehicles available were completely self-driving, how concerned would you be about riding in such vehicles?

- Very concerned
 - Moderately concerned
 - Slightly concerned
 - Not at all concerned
-

3) Would you prefer that a completely self-driving vehicle still have a steering wheel plus gas and brake pedals (or some other controls) to enable a driver to take control if desired?

- Yes
- No

(next page)

4) In a completely self-driving vehicle, how would you prefer to tell the vehicle your route or destination?

- Keyboard and mouse
- Personal portable device (smart phone, tablet, etc.)
- Touchscreen
- Traditional dash-mounted display with physical buttons
- Voice commands
- Other (please describe): _____

The next 2 questions are about partially self-driving vehicles.

5) If the only vehicles available were partially self-driving, how concerned would you be about riding in such vehicles?

- Very concerned
- Moderately concerned
- Slightly concerned
- Not at all concerned

6) When a partially self-driving vehicle requires the driver to take control of the vehicle, how would you prefer to be notified?

- Sound (such as a chime, alarm, or voice warning)
- Vibration (usually in the seat and/or steering wheel)
- Visual indicator (such as a light or symbol on the dash or information display)
- Sound + vibration
- Sound + visual
- Vibration + visual
- All three notifications (sound + vibration + visual)

Thank you for taking the time to complete this survey!