New England University Transportation Center
77 Massachusetts Avenue, E40-279
Cambridge, MA 02139
utc.mit.edu

Year 25 Final Report

Grant Number: DTRT13-G-UTC31

Project Title:

Understanding the Adoption of and Education about New Auto Technologies among Older Adults

Project Number:	Project End Date:	Submission Date:
MITR25-5	9/30/19	12/15/19

Principal Investigator:	Lisa D'Ambrosio	**Co-Principal Investigator:**	
Title:	Research Scientist	**Title:**	
University:	MIT	**University:**	
Email:	dambrosi@mit.edu	**Email:**	
Phone:	617-452-2179	**Phone:**	

Executive Summary

Drivers today face an array of technologies in new vehicles that offer greater safety and the prospect of altering drivers' behavior with increased automation and direct support for the driving task. These emerging auto technologies present the possibility of older drivers extending their ability to drive safely with systems that provide some compensation for the physical changes that typically accompany aging, such as reduced range of motion. These newest technologies foreshadow the emergence of the fully autonomous vehicle.

The purpose of this study is to gain deeper insight into the factors that affect older drivers' understanding of and interest in purchasing new vehicle technologies as they continue to permeate the market. In particular, we are interested in people's reactions to new vehicle technologies when provided with information about them and the factors that might positively affect adoption. An additional focus of the study is on people's reactions to fully autonomous or self-driving vehicles. To examine this, we had 317 participants (balanced by gender and age, age groups were 50-59 and 60-69) respond moment-to-moment using Perception Analyzer dials and via questionnaire to a video explaining seven new vehicle technologies: reverse back up cameras; blind spot warning systems; lane departure warning systems; parking assistance; crash mitigation systems, smart headlights; and automatic/adaptive cruise control. Additionally, participants respond moment-to-moment and via questionnaire to a video about autonomous vehicles.

Across different methods, from the moment-to-moment responses to questionnaire data, people consistently ranked reverse back up cameras as the technology they would want the most. This was followed by blind spot warning systems. These two technologies were also among those more likely to be viewed by people as technologies whose most important effect was to improve driver safety.

While people generally reacted positively to the different technologies presented in the study, the results indicate that people are strongly sensitive to price effects. The conjoint analysis demonstrated a clear impact of price sensitivity on people's willingness to choose different features. This result was echoed in the questionnaire data in which participants indicated the different technologies' worth to them. Few people were willing to buy the technologies at any price; they were much more likely to do so if they felt the price was "right" or if they thought the technology did not add to the overall price of the vehicle.

Gender differences emerged in the analysis more strongly than did differences by age group. Women's Perceptional Analyzer ratings of parking assistance systems were higher than men's. They were more likely to say that they were willing to purchase reverse back up cameras, parking assistance systems, and smart headlights, relative to men. They were willing to pay more for reverse back up cameras and parking systems than men were. Women indicated that they would be more likely to use parking assistance systems and smart headlights if they had them. Men were more likely than women to report that they would use adaptive cruise control systems if they had access to them.

People's degree of technological savviness turned out to be an important factor in understanding people's responses. The measure of tech savviness reflects people's self-reported conceptions of their trust in, experience with, and ease of using technology; the tech savviness item effectively captures people's underlying levels of comfort with technology. Tech savviness was positively related to recommending that others should buy new vehicle technologies and to people's overall feeling about new vehicle technologies; people who were more tech savvy were more likely to feel positively. Tech savviness was also positively related to people's reported willingness to purchase smart headlights, adaptive cruise control, and an overall willingness to purchase score. Finally, tech savviness was positively related to the reported likelihood of vehicle technology purchase if an insurance discount was offered.

The autonomous vehicle video also sparked generally positive reactions from people. In the questionnaire data, women generally indicated less comfort with and more uncertainty around test-driving or purchasing an autonomous car than men. Women were also less comfortable than men with such vehicles generally – they scored lower than men on an overall rating of comfort with self-driving cars. Tech savviness again was an important predictor of attitudes around self-driving cars; those who were more tech savvy were more likely to be comfortable with self-driving vehicles. They were also more likely to report that they thought self-driving cars would be on the road within the next 10 years.

Introduction

The rate of deployment of new automotive technologies into vehicles has seemingly increased over the past decade. Drivers face an array of technologies in new vehicles today that provide the driver with increased automation and direct support for the driving task. Unlike advances in safety around air bags or electronic stability control, or changes in convenience offerings like intermittent windshield wipers, the newest technologies offer the prospect of altering drivers' behavior: drivers may transition from more of an active operator to more of a systems overseer during some aspects of driving. The technologies also offer the prospect of increased driver and passenger safety. Beyond the safety enhancements, these newest technologies foreshadow the emergence of the fully autonomous vehicle.

The emerging auto technologies also present the possibility of keeping drivers who might be more vulnerable driving more safely. Younger drivers might benefit from the systems that keep them safer in the advent of a crash, or from systems that reinforce behaviors, such as checking blind spots, that less experienced drivers may not have committed to habit. Older drivers may be able to extend their safe driving lifetimes longer with systems that provide some compensation for the physical changes that typically accompany age, such as reduced range of motion (e.g., Reimer et al. 2008). Enabling older adults to continue to drive safely longer has a positive impact on their mobility (e.g., Haustein & Siren 2014), well-being (e.g., Nordbakke & Schwanen 2014), and physical health (e.g., Marottoli et al. 1997).

The purpose of this study is to gain deeper insight into the factors that affect people's understanding of and interest in purchasing new vehicle technologies as they continue to permeate the market. In particular, we are interested in people's reactions to new vehicle technologies when provided with information about them. We want to learn more about which technologies people feel most positively toward and which they think they would be most likely to purchase if given the option. We also are interested in people's reactions to fully autonomous or self-driving vehicles. Google is one of several different companies that already have such vehicles in testing stages on the road (e.g., Reuters 2015a). GM, Audi, Mercedes-Benz, and Tesla have all indicated that they plan to bring semi-autonomous vehicles to the market within the next two years; several companies have targeted 2020 as the year when fully autonomous vehicles will be available (Reuters 2015b). While the present study does touch on older drivers' reactions to fully autonomous vehicles, the primary focus is on capturing older drivers' reactions to descriptions and demonstrations of several existing new vehicle technologies currently on the market, and on questions about which ones they think they would be most likely to purchase.

Methods

Procedure

Upon arrival at each study site, participants were given a COUHES-approved consent form to read and sign in order to take part in the research. Following this, participants completed a pre-test questionnaire. They then learned how to use the DialSmith Perception Analyzer dials, answered a practice question, and responded to a short practice video unrelated to any study content or to technology. Following training, participants watched a video about new vehicle technologies on the market and were instructed to set their dials to 50 and "Please use the dial to indicate how much you WANT the technology based on what you are viewing at that moment." The range for the dial was zero to 100. While watching the video, participants were asked to turn the dial clockwise for numbers greater than 50 if they wanted the technology or to turn the dial counterclockwise for numbers less than 50 if they did not want the technology. Participants were instructed to reset their dials to 50 between each video description, when a black screen with the name of each technology appeared. Participants then watched a second video about autonomous vehicles and were instructed to set their dials to 50 and "Please use the dial to indicate how INTERESTED you are in what you are viewing at that moment." While watching the video, participants turned the dial clockwise or counterclockwise to indicate their interest in what they were viewing. Following the videos, participants filled out a post-test questionnaire and took a short break. Each session concluded with a brief group discussion regarding participants' reactions to the videos facilitated by researchers. These short discussions were audio recorded. At the end of the group, any questions that participants had were answered and they were compensated $100 for their participation. Participants were also given a form asking them if they would be willing to be contacted in the future to talk further about their experiences in the research. Completion of this form was wholly voluntary.

Materials

The script for the vehicle technology video was created by the research team. The basic intent of the video was to educate viewers about seven different technologies: reverse back up cameras; blind spot warning systems; lane departure warning systems; parking assistance; crash mitigation systems, smart headlights; and automatic/adaptive cruise control. There were four different versions of the video, in which the introduction of the actor describing the technologies varied. The intent was to examine whether the source of information – in this case, an actor who identified himself in one of four different roles – go-to tech expert, friend of a friend, car salesperson, or retired automotive engineer and professor – had an impact on people's responses to the information. Following the introductions (which were all timed to the same length), the actor described and then either demonstrated on a vehicle or used footage from IIHS for each of the seven technologies. The tone of the video was educational, not sales oriented.

The autonomous vehicle video was made by Volvo and found on a public video website (https://youtu.be/-32mbQigilg). This video was chosen and deemed suitable for the study because of the factual nature of its description and presentation of autonomous vehicles, what current capabilities are, and what the future idea for the vehicles is. The video was also selected because its time length fit into the study parameters.

The Dialsmith Perception Analyzer system was used to gauge participants' moment-to-moment reactions to the two stimulus videos. Each participant had a handheld dial that he or she turned to select answers for multiple-choice questions or indicate their reaction to the question they had in mind while watching the videos. Participants were taught how to use this technology.

Questionnaires were developed and reviewed by the study team. Items included background demographics, personal vehicle information, driving and transportation habits, and attitudes toward technology and toward vehicle technology more specifically. Additionally, a series of conjoint questions were developed to understand how participants traded off the different technologies against each other and against price. In the conjoint questions, the seven technologies were reduced to five to facilitate analysis and comparison. Reverse back up cameras were dropped from the analysis because beginning in 2018 they will be required on all new vehicles (NHTSA 2014). Adaptive cruise control and crash mitigation systems were combined into one option, as these options are often sold together on vehicles. A luxury package (e.g., heated seats, leather seats, etc.) and a connected package (e.g., Bluetooth capability) were also offered to people as options in the analysis. Price points for the options ranged from $500 to $6000 in $500 increments.

Participants

The purpose of the study was to understand better what factors affect older drivers' decisions about purchasing new auto and safety technologies. In order to assess drivers, participants needed to have a valid driver's license and drive on average three or more days per week. Eligible participants also needed to be English-speaking, physically capable of participating in the session, and have a minimum household income of $35,000. Because we were interested in what might move drivers to adopt new technologies, people with advanced technologies on their vehicles (including six of the seven technologies featured in the study video) were excluded. People who had reverse back up cameras were allowed to participate in the study. Because the study is focused on older drivers, participants ages 50 to 69 were recruited.

An attempt was made to balance each of the 16 study sessions by gender and age group (50-59 and 60-69). Each session lasted about two hours. Eight sessions were held at professional focus group facilities in Schaumburg, Illinois, on May 4 and 5 and in Chicago, Illinois, on May 6 and 7, 2015. The professional facilities recruited participants using a COUHES-approved screener. Eight groups were also conducted at the MIT AgeLab in Cambridge, Massachusetts, between May 11 and May 17, 2015. Massachusetts participants were recruited through the MIT AgeLab database. Participants between the ages of 50 and 69 received an e-mail describing the study and directing them to a short form to complete if they were interested. Participants who met the screening criteria were contacted and given more information about the study via e-mail. If they wished to participate in the study, they signed up for a time slot online.

A total of 317 people completed the study. Several participants, however, were excluded from data analysis because they were out of the study age range, they did not meet the minimum income criteria, or they had poor data quality (e.g., responding to a series of questionnaire items with a single response, etc.). This reduced the effective number of participants to 302. Other participants were further excluded from the Perception Analyzer data analysis because subjects did not move their dials at all during the video sessions.

There were 88 participants in Schaumburg, 73 in Chicago, and 141 in Cambridge. Of the total sample, 154 participants were men and 148 were women; 148 were between the ages of 50 and 59 and 154 were between 60 and 69. The gender and age splits for the sample are presented in Table 1.

Table 1. Participant gender and age breakdowns.

	Age		**Total**
	50-59	**60-69**	
Male	77	77	154
Female	71	77	148
Total	148	154	302

Overall, the sample tended to be relatively well-educated and have higher levels of income than the population as a whole. They were also more likely to be married. About half of the sample reported that they were working for pay, and about one quarter of the participants said that they were retired from work. Most participants owned the vehicles they drove most frequently, and only about 15% said that they had a reverse back up camera on the vehicle they drove most often. Additional descriptive data for the study participants are shown in Table 2.

Analysis
Data analysis was conducted using several different programs. Perception Analyzer data were processed using Microsoft Excel (Professional Plus 2013) and SPSS versions 22.0 and 23.0. Conjoint data were processed using Microsoft Excel (Professional Plus 2013) and Sawtooth Software's SSI Web 8.3.10. Questionnaire data were analyzed using SPSS versions 22.0 and 23.0.

Questionnaire data were recoded as appropriate and some variables were combined to create indices.

An index of savviness with technology was created by scaling together responses to the following items:

- How experienced would you say you are with various types of technology (for example, computers, smart phones, cellular phones, etc.)?
- How much trust do you have generally that technologies will do what they are supposed to do?
- In general, how easily would you say you learn to use new technologies?

A variable that counted the different technological devices participants reported using (e.g., desktop computer, laptop computer, etc.) was also created. In analysis, this performed similarly to but less powerfully than the tech savviness variable. As a result, the tech savviness variable was used for analysis reported here.

Perception Analyzer data were analyzed by comparing respondents' mean scores over different time periods corresponding to each video. For the new vehicle technology video, a score was calculated for the time period corresponding to each of the individual technologies; thus, seven scores were calculated. However, the first five seconds following a black title screen and last five seconds of any description before a title screen were not included in the calculation of participants' dial scores to control for any adjustment respondents did at the beginning or end of a technology segment of interest, and to reduce the impact of any abrupt shifts from participants resetting their dials. In the autonomous vehicle video, one overall score was calculated. However, the first five seconds of the video and the period in which the credits for the video play were not included in the calculation of the score.

Table 2. Descriptive data for study participants.

		Total sample	Male	Female	Ages 50-59	Ages 60-69	Men ages 50-59	Men ages 60-69	Women ages 50-59	Women ages 60-69
Education	< High school diploma	.7	1.3	0.0	1.4	0.0	2.6	0.0	0.0	0.0
	High school diploma or GED	6.8	6.6	6.9	8.2	5.3	7.8	5.3	8.7	5.3
	Some college	25.0	22.4	27.8	26.7	23.3	22.1	22.7	31.9	24.0
	Bachelor's degree	27.7	30.9	24.3	31.5	24.0	33.8	28.0	29.0	20.0
	Advanced or professional degree	39.9	38.8	41.0	32.2	47.3	33.8	44.0	30.4	50.7
	Total N	296	152	144	146	150	77	75	69	75
Annual household income	$35K - $49,999	12.8	7.3	18.6	12.2	13.4	7.8	6.8	17.1	20.0
	$50K - $74,999	24.3	27.2	21.4	21.8	26.8	23.4	31.1	20.0	22.7
	$75K - $99,999	17.6	18.5	16.6	17.7	17.4	16.9	20.3	18.6	14.7
	$100K - $149,999	23.3	25.2	21.4	27.9	18.8	31.2	18.9	24.3	18.7
	> $150K	13.9	14.6	13.1	13.6	14.1	14.3	14.9	12.9	13.3
	Prefer not to answer	8.1	7.3	9.0	6.8	9.4	6.5	8.1	7.1	10.7
	Total N	296	151	145	147	149	77	74	70	75
Marital status	Married	57.7	69.1	45.9	55.8	59.6	63.6	74.7	47.1	44.7
	Living with partner	7.0	7.2	6.8	10.2	4.0	10.4	4.0	10.0	3.9
	Separated	.3	.7	0.0	0.0	.7	0.0	1.3	0.0	0.0
	Divorced	15.1	7.9	22.6	15.6	14.6	10.4	5.3	21.4	23.7
	Single, never married	15.8	13.8	17.8	16.3	15.2	15.6	12.0	17.1	18.4
	Widowed	3.7	1.3	6.2	1.4	6.0	0.0	2.7	2.9	9.2
	Prefer not to answer	.3	0.0	.7	.7	0.0	0.0	0.0	1.4	0.0
	Total N	298	152	146	147	151	77	75	70	76
Work status	Work full-time	49.8	56.6	42.8	74.7	25.8	80.5	32.0	68.1	19.7
	Work part-time	19.2	18.4	20.0	12.3	25.8	6.5	30.7	18.8	21.1
	Not employed but looking for work	5.4	3.9	6.9	5.5	5.3	5.2	2.7	5.8	7.9
	Retired for pay	25.6	21.1	30.3	7.5	43.0	7.8	34.7	7.2	51.3
	Total N	297	152	145	146	151	77	75	69	76
Own or lease vehicle	Own	96.7	97.4	95.9	97.3	96.1	97.4	97.4	97.2	94.8
	Lease	3.0	2.6	3.4	2.0	3.9	2.6	2.6	1.4	5.2
	Don't know	.3	0.0	.7	.7	0.0	0.0	0.0	1.4	0.0

		Total sample	Male	Female	Ages 50-59	Ages 60-69	Men ages 50-59	Men ages 60-69	Women ages 50-59	Women ages 60-69
	Total N	301	153	148	147	154	76	77	71	77
Current vehicle has reverse back up camera	**Yes**	14.6	12.3	16.9	12.2	16.9	11.7	13.0	12.7	20.8
	No	85.4	87.7	83.1	87.8	83.1	88.3	87.0	87.3	79.2
	Total N	302	154	148	148	154	77	77	71	77
Characterization of driving	**Primarily rural**	1.3	.6	2.0	1.4	1.3	0.0	1.3	2.8	1.3
	Mix of rural/suburban	12.0	13.0	10.9	12.2	11.8	13.0	13.0	11.3	10.5
	Mix of rural/urban	6.3	6.5	6.1	8.8	3.9	10.4	2.6	7.0	5.3
	Primarily suburban	22.6	22.7	22.4	24.3	20.9	24.7	20.8	23.9	21.1
	Mix of suburban/urban	45.8	46.8	44.9	44.6	47.1	42.9	50.6	46.5	43.4
	Urban	12.0	10.4	13.6	8.8	15.0	9.1	11.7	8.5	18.4
	Total N	301	154	147	148	153	77	77	71	76
Frequency driving on multi-lane highways	**4-7 days a week**	45.0	51.9	37.8	50.7	39.6	55.8	48.1	45.1	31.2
	1-3 days a week	35.1	35.1	35.1	29.7	40.3	31.2	39.0	28.2	41.6
	2-3 times per month	14.2	10.4	18.2	16.2	12.3	10.4	10.4	22.5	14.3
	Once a month	2.0	.6	3.4	.7	3.2	0.0	1.3	1.4	5.2
	At least once every 6 months	2.3	1.3	3.4	1.4	3.2	1.3	1.3	1.4	5.2
	< once every 6 months	.3	0.0	.7	0.0	.6	0.0	0.0	0.0	1.3
	Never	1.0	.6	1.4	1.4	.6	1.3	0.0	1.4	1.3
	Total N	302	154	148	148	154	77	77	71	77
Typical annual miles	**< 5K**	13.6	8.4	18.9	9.5	17.5	5.2	11.7	14.1	23.4
	5K – 9,999	30.1	27.9	32.4	22.3	37.7	23.4	32.5	21.1	42.9
	10K - 14,999	26.8	28.6	25.0	33.1	20.8	31.2	26.0	35.2	15.6
	15K - 17,499	11.9	11.7	12.2	12.8	11.0	10.4	13.0	15.5	9.1
	17,500 – 20K	7.3	11.0	3.4	8.8	5.8	11.7	10.4	5.6	1.3
	> 20K	7.9	11.0	4.7	12.8	3.2	18.2	3.9	7.0	2.6
	Don't know	2.3	1.3	3.4	.7	3.9	0.0	2.6	1.4	5.2
	Total N	302	154	148	148	154	77	77	71	77
Commute	**Driving personal vehicle by myself**	56.2	61.4	50.7	71.4	41.4	72.7	50.0	70.0	32.9
	Driving or riding with others (carpool)	1.0	0.0	2.1	1.4	.7	0.0	0.0	2.9	1.3
	Not employed, don't commute	25.8	20.3	31.5	8.2	42.8	7.8	32.9	8.6	52.6

		Total sample	Male	Female	Ages 50-59	Ages 60-69	Men ages 50-59	Men ages 60-69	Women ages 50-59	Women ages 60-69
	Work from home, don't commute	8.7	9.2	8.2	8.2	9.2	7.8	10.5	8.6	7.9
	Walking	1.3	0.0	2.7	1.4	1.3	0.0	0.0	2.9	2.6
	Biking	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Public transit	6.7	8.5	4.8	8.8	4.6	10.4	6.6	7.1	2.6
	Other	.3	.7	0.0	.7	0.0	1.3	0.0	0.0	0.0
	Total N	299	153	146	147	152	77	76	70	76
Personal vehicle has reverse back up camera	**Yes**	14.6	12.3	16.9	12.2	16.9	11.7	13.0	12.7	20.8
	No	85.4	87.7	83.1	87.8	83.1	88.3	87.0	87.3	79.2
	Don't Know	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total N	302	154	148	148	154	77	77	71	77
Plan to buy or lease next vehicle	**Within the next 6 months**	6.7	9.1	4.2	8.2	5.3	10.4	7.8	5.7	2.7
	6 months to 1 year	18.9	17.5	20.3	21.1	16.7	19.5	15.6	22.9	17.8
	1-2 years	26.9	30.5	23.1	27.9	26.0	32.5	28.6	22.9	23.3
	2-3 years	17.8	14.9	21.0	19.0	16.7	15.6	14.3	22.9	19.2
	>3 years	28.3	27.3	29.4	23.1	33.3	22.1	32.5	24.3	34.2
	Never again	1.3	.6	2.1	.7	2.0	0.0	1.3	1.4	2.7
	Total N	297	154	143	147	150	77	77	70	73
AARP member	**Yes**	47.5	44.4	50.7	27.4	66.9	28.9	60.0	25.7	73.7
	No	52.5	55.6	49.3	72.6	33.1	71.1	40.0	74.3	26.3
	Total N	297	151	146	146	151	76	75	70	76

Note: Table entries in the Total N rows are case counts; all other table entries are percentages.

Results

Study data were first analyzed to determine if there were any differences due to the video source for the new vehicle technologies video (i.e., whether the actor introduced himself as go-to tech expert, a friend of a friend, a salesperson, or a retired automotive engineer and current professor). No consistent, statistically significant differences emerged in this analysis suggesting that the source of the information made no difference to people's responses to th video.[1] Further, there were no differences by information source in people's responses to ite specifically asking them about the speaker's trustworthiness and credibility, as well as to an item that asked how likely people would be to take advice from him in terms of what vehicle buy. One statistically significant difference did emerge by video type for assessment of the knowledge of the speaker (F=2.629, df=3, p=.05, N=301). In the videos where the speaker identified himself as a car salesperson or a retired automotive engineer and current professo participants were more likely to rate the speaker as more knowledgeable. Because this was th only difference to emerge, however, and because no other indicators of the importance of source of information emerged in the other analysis run, all of the data have been combined and analyzed as a single group.

New Vehicle Technologies

Perception Analyzer Video Responses

Figure 1 displays the average Perception Analyzer score for each moment of the new technology video for the overall sample and for men and women separately. Figure 2 shows average Perception Analyzer score again for each moment of the new technology video for th overall sample and for each age group (50-59 and 60-69) separately. Figure 3 combines gende and age, displaying the average Perception Analyzer score for each of the four gender-age categories (i.e., women ages 50-59, women ages 60-69, men ages 50-59, and men ages 60-69) in the study. Clear peaks can be seen in each of the three figures for each individual technolo indicating that in general people responded positively on average to all seven of them.

The Perception Analyzer results to the new technology video can be explored in several different ways. First, we can look at overall mean ratings for each technology to see which technologies sparked the most positive responses. The mean scores for each technology for overall sample and for each of the sub-groups are displayed in Table 3.

Table 3 shows that people consistently ranked reverse back-up cameras most highly, followe by blind spot warning systems. The third most highly rated technology was more variable acr

[1] By this analysis we do not mean to say that source of information never makes a difference in people's reactio opinions, or decisions. In this particular study, however, we do not find a consistent, statistically significant effe that would indicate that source made a difference to people's responses. We suspect that for the video respon data this may be due in part to the instruction to people to reset their Perception Analyzer dials to 50 as the description of each new technology began. While this may not account for the lack of difference found in the questionnaire data, we hypothesize for these results that the directions to reset the dial to 50 with the introduction of each new technology led people to focus on the descriptions and their reactions rather than attending to the source of the information.

groups. Adaptive cruise control and collision avoidance systems garnered a number of third places. Additionally, lane departure warning systems were rated third most highly among all women, all adults ages 60-69, and among women ages 60-69. With the exception of men ages 50-59, smart headlights rated the lowest; this may in part, however, be an artifact of smart headlights being the first technology people saw and heard described and their first use of the Perception Analyzer dials. Because we could not randomize the order of presentation of the different technologies in the video, we cannot rule out this possibility. Regardless, each of the technologies individually and overall scored on average above the 50 point beginning mark, indicating that people in general responded positively to the technologies.

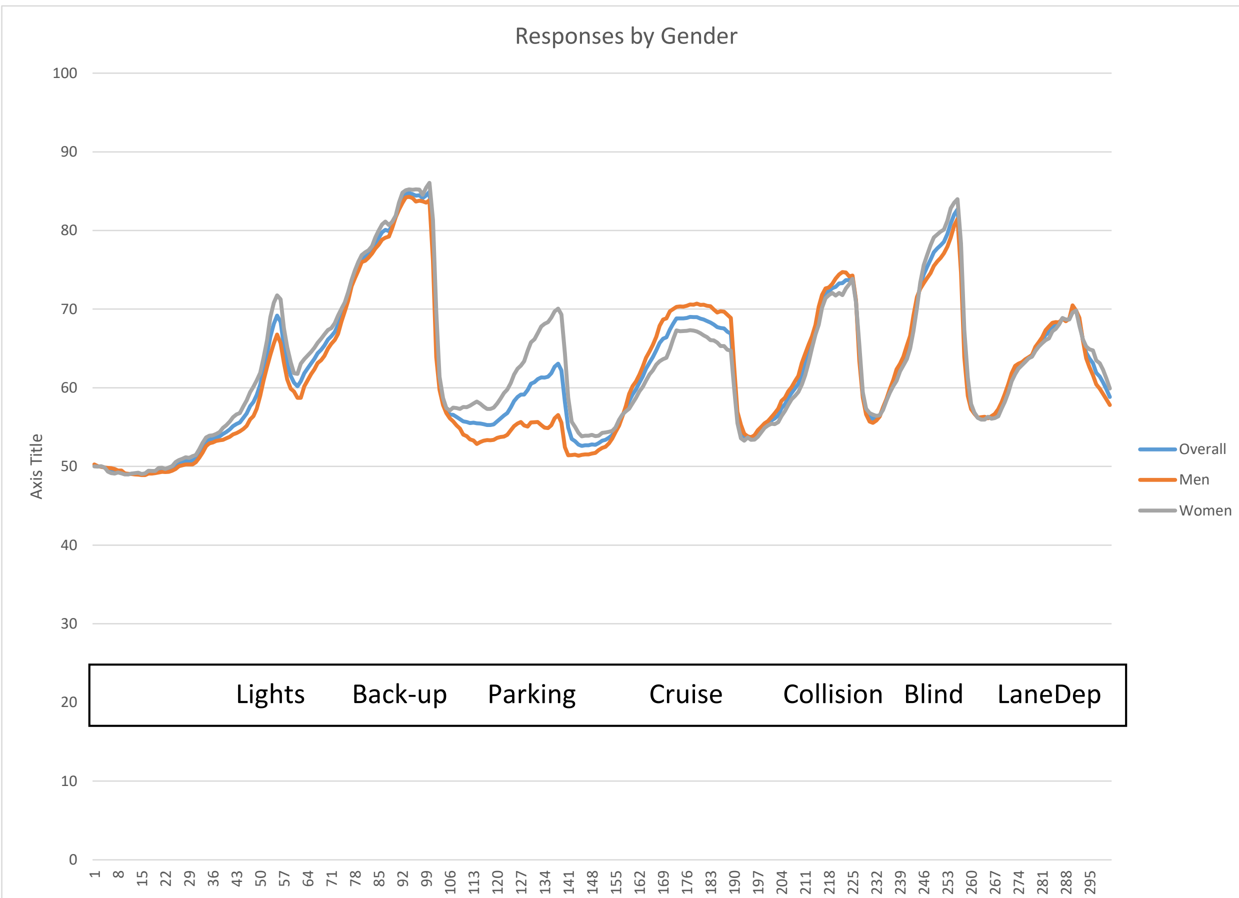

Figure 1. Average Perception Analyzer rating for each moment of the new technology video for the whole sample and by gender.

Table 3. Mean Perception Analyzer average scores for new technologies.

	Overall	Men	Women	Ages 50-59	Ages 60-69	Men ages 50-59	Men ages 60-69	Women ages 50-59	Women ages 60-69
Smart headlights	55.30	54.27	56.39	55.67	54.92	55.01	53.51	56.38	56.39
Back up camera	72.72*	71.86*	73.64*	72.81*	72.64*	72.58	71.13*	73.06*	74.21
Parking assist	57.20	54.44	60.15	56.44	57.97	52.94	55.98	60.28	60.03
ACC	61.46	62.23	60.64	62.76	60.16	64.37	60.04	61.00	60.29
Collision avoidance system	61.61	62.31	60.85	61.71	61.50	62.52	62.10	60.82	60.87
Blind spot warning	66.38*	66.15	66.62*	66.33	66.42*	68.19	64.06	64.29	68.88
Lane departure warning	60.99	61.29	60.67	60.49	61.50	60.63	61.97	60.34	61.00
Overall tech	62.24	61.80	62.71	62.31	62.16	62.32	61.26	62.31	63.10
N of cases	298	154	144	149	149	78	76	71	73

Notes: Overall tech score is the average of each of the seven individual technology scores. * indicates that the mean is statistically different from all of the other means in the column based on a repeated measures t-test analysis.

Although the graphs and the average Perception Analyzer scores suggest that there are some differences by gender and age, there are few differences that are statistically meaningful. In the case of blind spot warning systems, there is a significant interaction effect between age and gender ($F=7.017$, $p=.009$), as displayed in Figure 4. In this case, men ages 50-59 and women ages 60-69 responded more positively to this technology relative to men ages 60-69 and women ages 50-59. Note, however, that despite this difference, men ages 60-69 and women ages 50-59 on average still rated blind spot warning systems second only to reverse back up cameras.

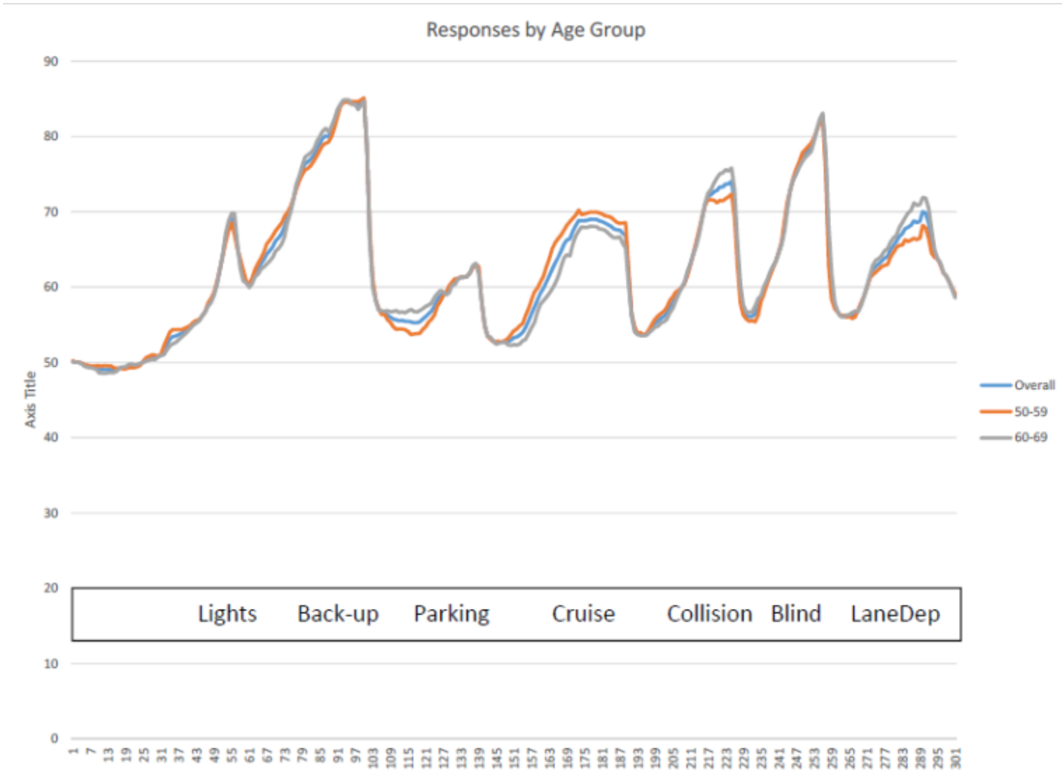

Figure 2. Average Perception Analyzer rating for each moment of the new technology video for the whole sample and by age group.

No other interaction effects for age and gender were statistically significant. When direct effects were considered, there were no statistically significant differences in mean Perception Analyzer scores by age group. By gender, there was a statistically significant difference between men and women in terms of their ratings of the parking assist technology (F=8.839, p=.003) and a marginally significant difference in terms of smart headlight ratings (F=3.114, p=.079). In both of these cases, women rated these technologies more positively than did men.

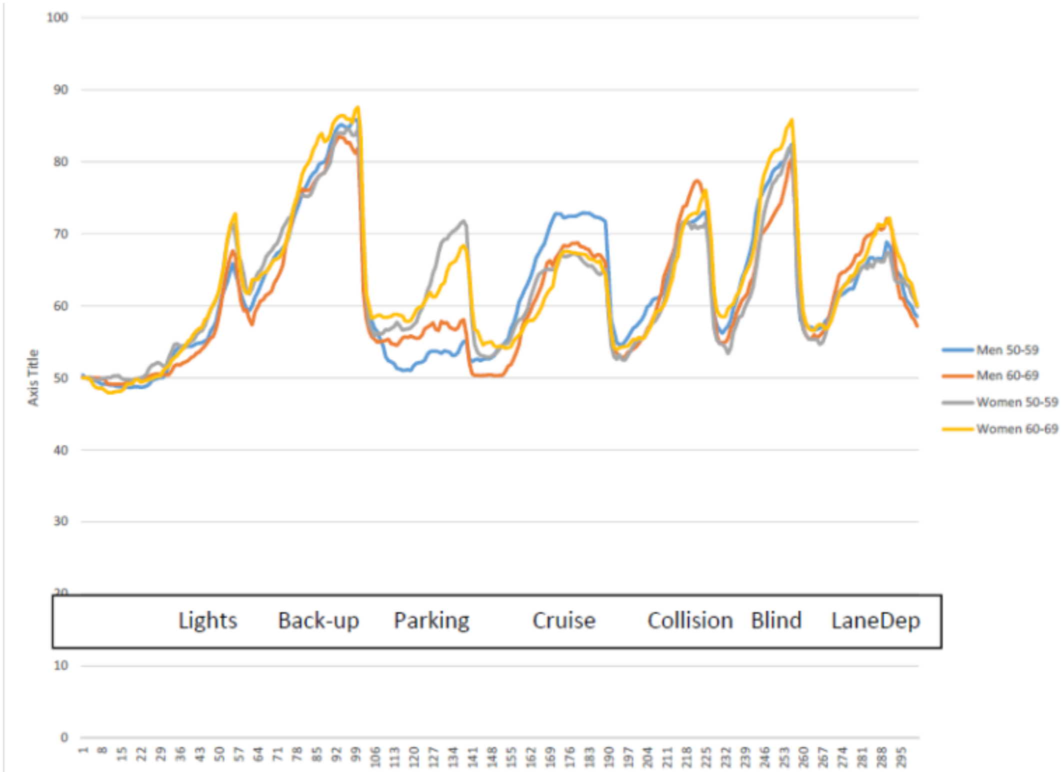

Figure 3. Average Perception Analyzer rating for each moment of the new technology video by gender and age groups.

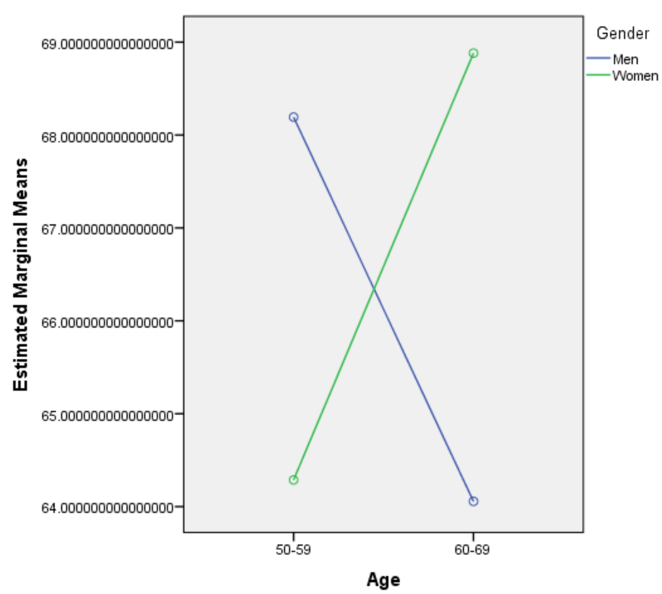

Figure 4. Estimated marginal mean Perception Analyzer scores for blind spot warning systems by gender and age.

Conjoint Analysis

Participants completed a series of 14 different choice questions which offered them different technology or feature packages available at different price points, all in reference to a base model which had none of the technologies or feature packages. Figure 5 displays the proportion of times each price point, technology, or feature package was chosen.

Figure 5 suggests that people were especially sensitive to price, with a $500 price point being most often selected when available. This was followed by a $1000 and then a $2500 price point. Among the different technologies and feature packages, blind spot warning systems were selected most frequently (27.4% of the time when available), followed by the connected package (26.4%), adaptive cruise control and crash mitigation (25.4%), and the luxury package (25.2%). Lane departure warning systems were chosen least frequently by a narrow margin (24.1% of the time, versus 24.2% of the time for parking assist systems). Nevertheless, the technologies and feature packages were all chosen more frequently than any option that was combined with a price tag of $3000 or more.

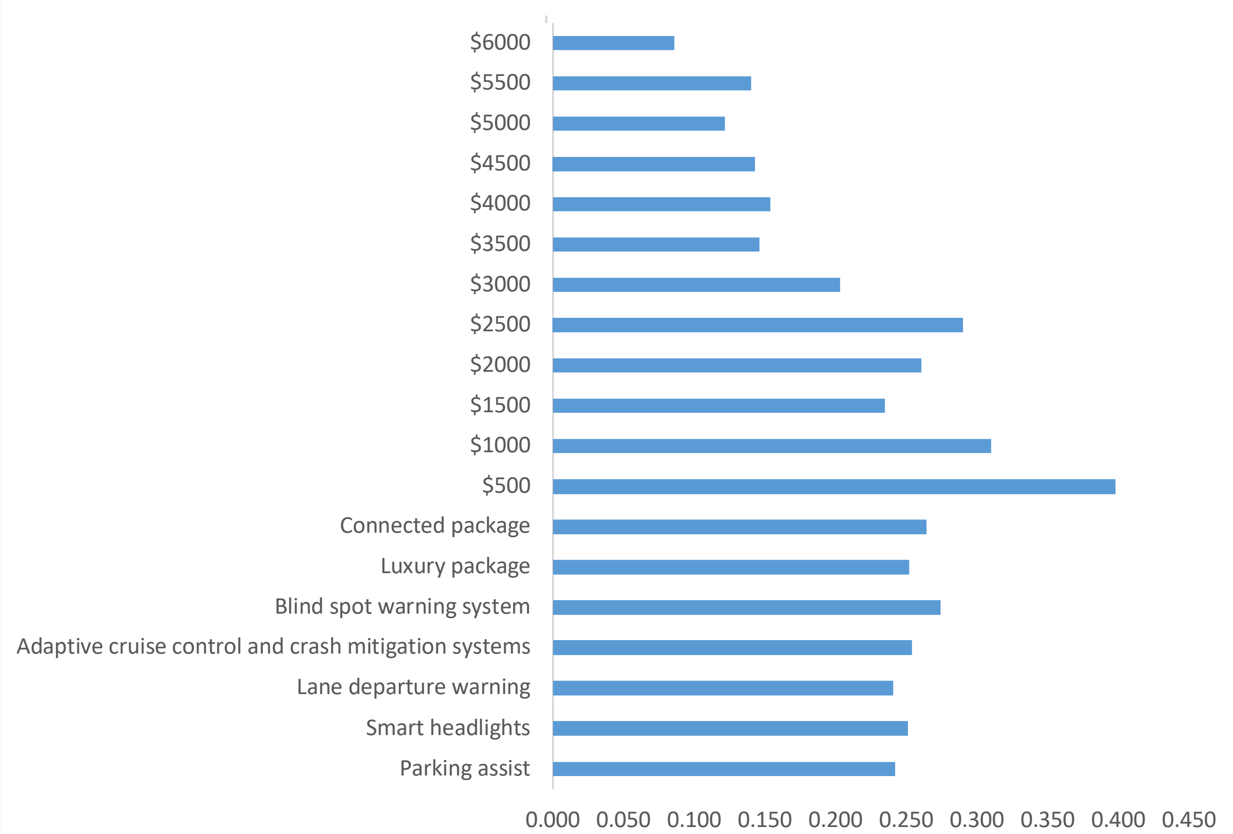

Figure 5. Proportion of times choices with particular options were chosen.
Note: The proportion is calculated by dividing number of times a technology or cost option was chosen, divided by the number of times that level occurred.

Figure 6 displays the percentage of times each technology or feature package was chosen controlling for price point. The downward slope of the graph with price suggests a strong price effect, with technologies and features chosen most frequently in the $500 to $2500 range. The crossing of the lines suggest that there may be some interaction effects with price and features, but none of these effects are statistically significant. The slight dominance of blind spot warning systems and the connected package are consistent with the results above, and regardless of price point, participants do not strongly seem to prefer any of the technologies to the feature connected or luxury packages.

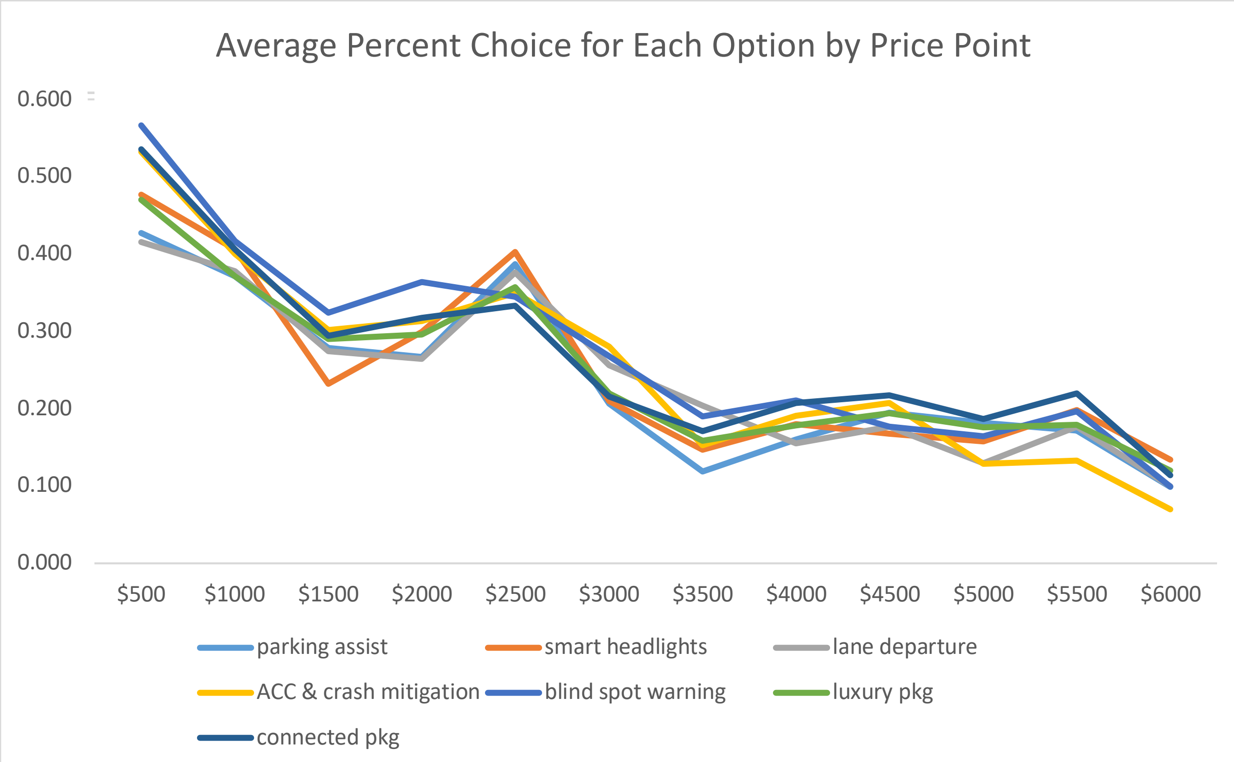

Figure 6. Average percent choice for each option by price point.

Questionnaire Data
Following viewing of both the new vehicle technologies and autonomous car videos, participants were asked to rank the top three technologies they would most like to have on their vehicle for their benefit as drivers. The results of this are displayed in Figure 7.

The popularity of reverse back up cameras is again evident, as it was the most selected first choice and the most selected overall among the top three. The popularity of this technology is followed by blind spot warning systems, which was selected second most frequently as people's top choice and most frequently as people's second and third choices. These technologies are then followed by collision avoidance systems, smart headlights, lane departure warning systems, smart headlights, and parking assistance.

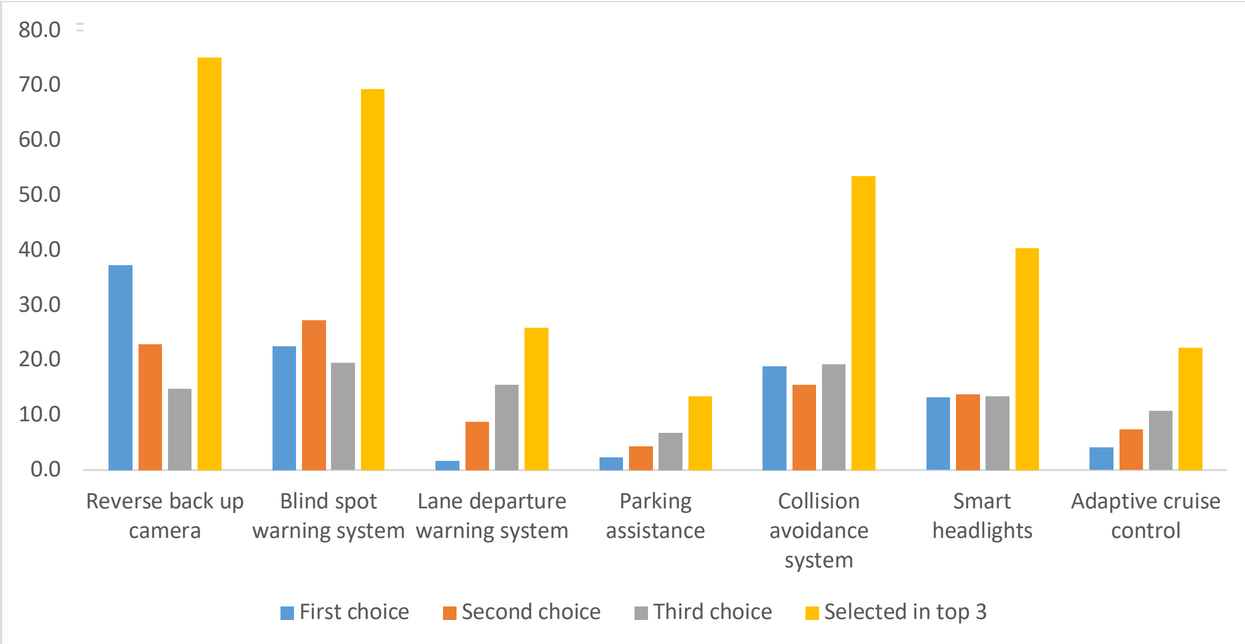

Figure 7. Participants' top three rankings of vehicle technologies they would want.

These data were also split by whether participants already had a reverse back up camera on their vehicles (see Figure 8).

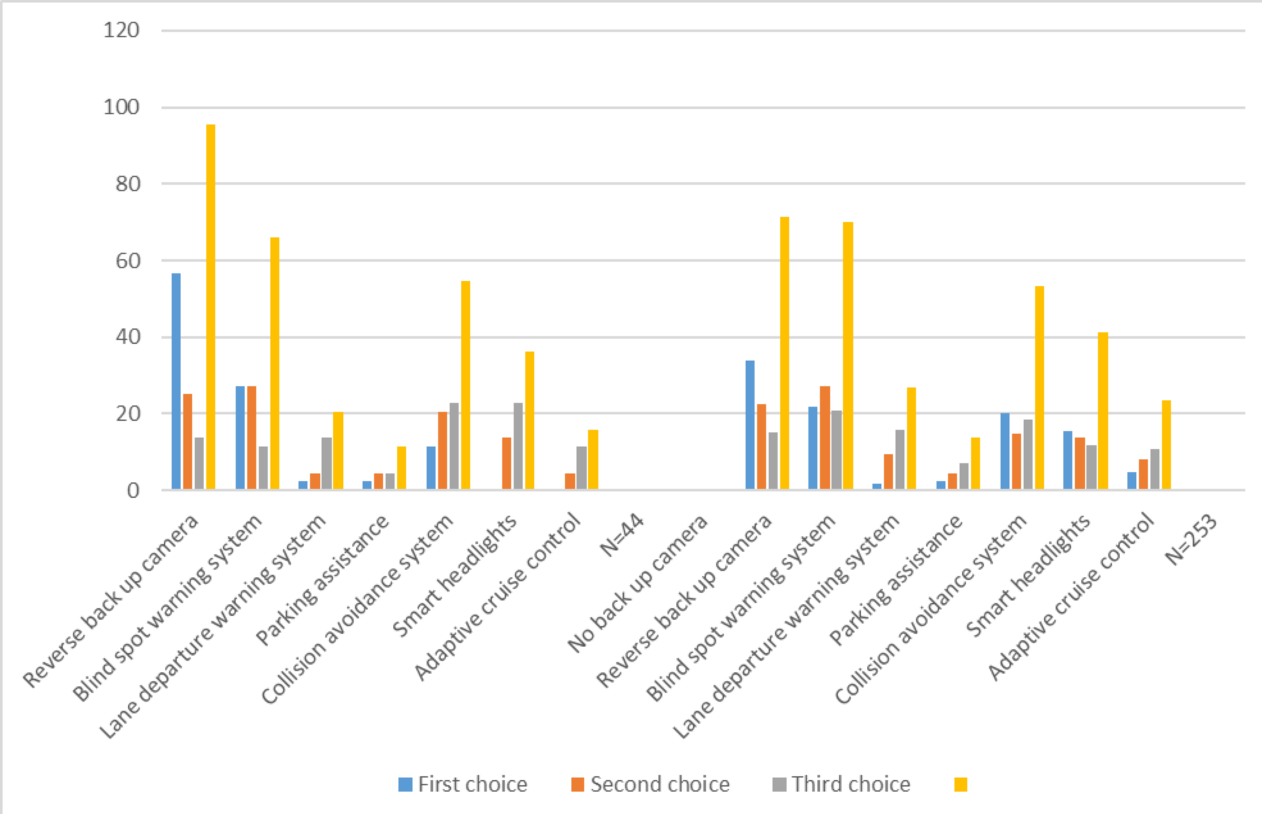

Figure 8. Participants' top three rankings of vehicle technologies they would want by whether their current vehicle had reverse back up camera.

The results in Figure 8 suggest that people who already had reverse back up cameras were more favorably disposed toward them than those who did not have them, with 95.4% of people who already had them choosing the cameras among their top three, compared with 71.5% of those who did not have them already. In spite of this difference, however, participants with and without cameras on their current vehicles shared the same ordering of technologies selected among their top three.

Some gender differences emerged in people's rankings of the technologies (see Table 4 below). While the top two choices were for men and women, women ranked reverse back up cameras more highly than men did, whereas among men blind spot warnings systems edged out reverse cameras. Third and fourth rankings were the same, but men rated collision avoidance systems more highly relative to smart headlights, whereas women rated them roughly equally.

Rankings of the top three most preferred technologies were similar by age, although there were differences across the particular percentages, as shown in Table 5. Older adults ages 60-69 were more likely to have selected blind spot warning systems in their top three technologies, for example, compared with adults ages 50-59.

Table 4. Participants' top three rankings of vehicle technologies they would want by gender.

Men	First choice	Second choice	Third choice	Overall	Ranking
Reverse back up camera	32.9	22.4	12.5	67.8	2
Blind spot warning system	21.1	25.7	22.4	69.2	1
Lane departure warning system	3.3	9.2	15.8	28.3	6
Parking assistance	2.6	2	6.6	11.2	7
Collision avoidance system	23	17.8	17.8	58.6	3
Smart headlights	11.2	13.2	11.2	35.6	4
Adaptive cruise control	5.9	9.9	13.8	29.6	5
N=152					
Women					
Reverse back up camera	42.1	23.4	17.2	82.7	1
Blind spot warning system	24.1	29	16.6	69.7	2
Lane departure warning system	0	8.3	15.2	23.5	5
Parking assistance	2.1	6.9	6.9	15.9	6
Collision avoidance system	14.5	13.1	20.7	48.3	3
Smart headlights	15.2	14.5	15.9	45.6	4
Adaptive cruise control	2.1	4.8	7.6	14.5	7
N=145					

Table 5. Participants' top three rankings of vehicle technologies they would want by age category.

Ages 50-59	First choice	Second choice	Third choice	Overall	Ranking
Reverse back up camera	34.2	21.9	18.5	74.6	1
Blind spot warning system	17.8	30.1	17.8	65.7	2
Lane departure warning system	1.4	11	15.1	27.5	5
Parking assistance	3.4	3.4	5.5	12.3	7
Collision avoidance system	21.2	13	17.1	51.3	3
Smart headlights	16.4	13	13	42.4	4
Adaptive cruise control	5.5	7.5	13	26	6
N=146					
Ages 60-69					
Reverse back up camera	40.4	23.8	11.3	75.5	1
Blind spot warning system	27.2	24.5	21.2	72.9	2
Lane departure warning system	2	6.6	15.9	24.5	5
Parking assistance	1.3	5.3	7.9	14.5	7
Collision avoidance system	16.6	17.9	21.2	55.7	3
Smart headlights	9.9	14.6	13.9	38.4	4
Adaptive cruise control	2.6	7.3	8.6	18.5	6
N=151					

Participants were also asked to rate their likelihood of recommending that a friend or family member buy one of the technologies described in the video, and how they felt about the new technologies overall. Regression results of these variables on gender, age, tech savviness, education, and income are displayed in Table 6.

Table 6. Regression of opinion variables on gender, age, tech savviness.

	Likelihood of recommending another should buy tech	Overall feeling about new vehicle technologies
Constant	4.755*** (.809)	5.102*** (.750)
Gender (1=women)	-.041 (.244)	-.172 (.226)
Age (1=60-69)	.027 (.248)	-.013 (.230)
Tech savviness	-.342*** (.128)	-.341*** (.117)
R2	.060	.090
Adjusted R2	.023	.055
SE estimate	1.958	1.816
N	270	270

Notes: Education and income variables were included as control variables. With one exception, none were statistically significant. Table entries are unstandardized regression coefficients with standard errors in parentheses. * $p < .10$; ** $p < .05$; *** $p < .01$

For both of these variables, degree of tech savviness was related to attitudes. People who had higher levels of tech savviness were more likely to recommend to a family member or friend to purchase a vehicle with new technologies, and they were also more likely to report feeling positively about new vehicle technologies overall. The only significant effect of a control variable was found in the regression of overall feelings about new vehicle technologies as well; people with household incomes of $150,000 or more per year were more likely to feel positively (b=-.984, se=.427, p=.022).

A series of items also assessed how participants thought about each of the technologies – in short, whether they viewed each as a safety feature, convenience or comfort feature, a distraction, or something else. Figure 9 below displays people's responses to these items.

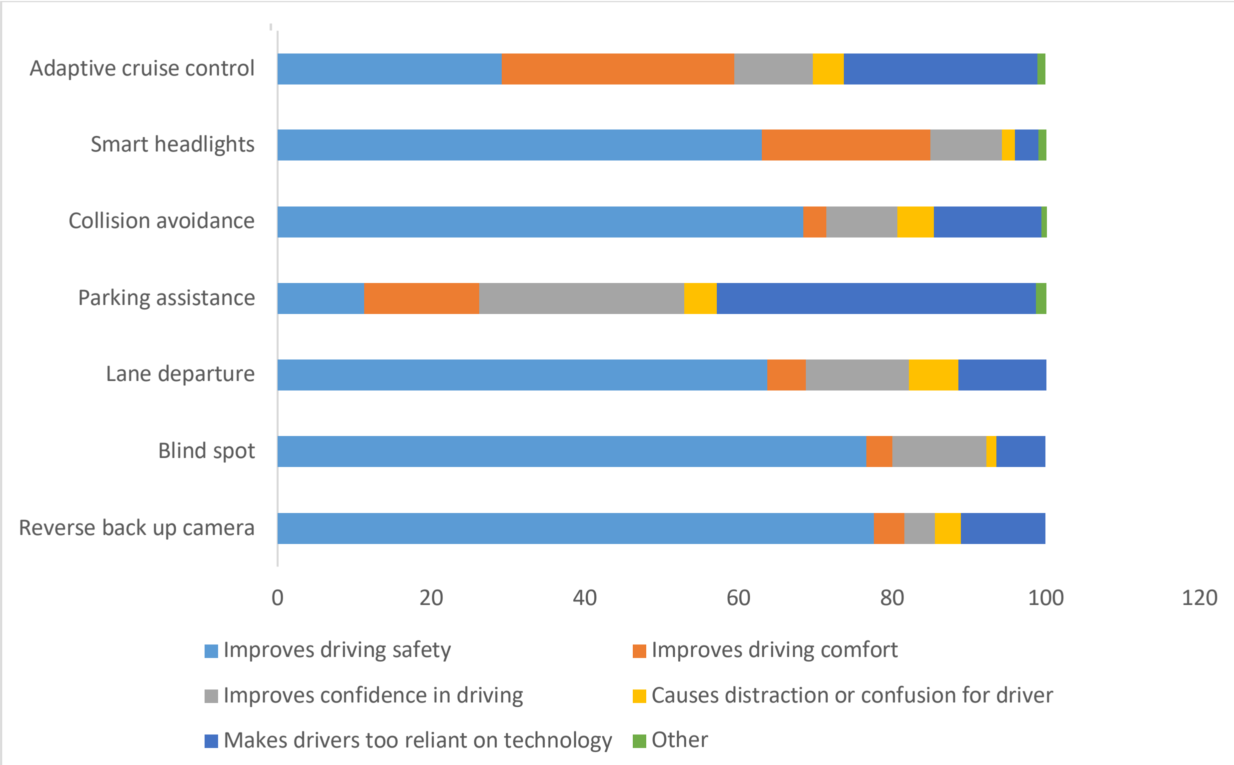

Figure 9. Participants' assessments of most important effect of each technology on drivers.
Note: N=299 to 302.

The figure shows that reverse back up cameras, blind spot warning systems, lane departure warning systems, collision avoidance systems, and smart headlights were considered by a majority of participants to improve safety. Adaptive cruise control, smart headlights, and parking assistance systems drew a significant portion of people who indicated they thought the most important effect of these systems was on drivers' comfort. More so than any other technology, people thought of parking assistance systems as a convenience feature for drivers – and they also thought of these systems' primary effect as making drivers too reliant on technologies. Other technologies that people thought might lead drivers to become too reliant on them were adaptive cruise control and collision avoidance systems. While each technology drew a share of respondents who said they thought the most important impact was to serve as a distraction for drivers, overall this was a relatively small percentage for each. Among the seven technologies in the video, lane departure warning systems were most likely to be noted as such.

Participants were also asked about how willing they would be to purchase each of the new vehicle technologies on their next vehicle or to add to their current one. Each of the individual items, as well as an overall score for willingness to purchase all of the technologies, were regressed on gender, age, tech savviness, education, and income. The results are presented in Table 7 below.

Table 7. Regression results around willingness to purchase new technologies.

	Reverse back up camera	Blind spot warning system	Lane departure warning system	Parking assistance	Collision avoidance system	Smart headlights	Adaptive cruise control	Overall (mean of all items)
Constant	4.260*** (.762)	3.461*** (.686)	3.881*** (.736)	5.507*** (.843)	4.405*** (.742)	4.792*** (.706)	6.446*** (.830)	4.679*** (.459)
Gender (1=women)	-.527** (.223)	-.354* (.201)	-.002 (.215)	-.704*** (.246)	.017 (.217)	-.623*** (.207)	.399 (.243)	-.256* (.134)
Age (1=60-69)	-.485** (.225)	-.081 (.203)	-.020 (.217)	.098 (.249)	-.480** (.219)	-.013 (.208)	.252 (.245)	-.104 (.135)
Tech savviness	-.184 (.117)	-.131 (.106)	-.201* (.113)	-.242* (.130)	-.175 (.114)	-.378*** (.109)	-.495*** (.128)	-.258*** (.071)
Some college	.130 (.485)	.158 (.436)	.754 (.468)	.351 (.538)	-.496 (.472)	.521 (.449)	-.281 (.528)	.162 (.292)
College	-.009 (.482)	.313 (.435)	1.275*** (.467)	.204 (.534)	-.585 (.470)	.117 (.448)	-.741 (.526)	.082 (.291)
Advanced degree	.164 (.483)	.297 (.435)	.679 (.466)	.315 (,534)	_.327 (.470)	.510 (.447)	-.458 (.526)	.168 (.291)
HH inc $50K-75K	-.503 (.371)	-.393 (.334)	-.134 (.359)	.136 (.410)	.166 (.361)	.035 (.344)	.335 (.404)	-.051 (.223)
HH inc $75K-100K	-.238 (.393)	-.348 (.354)	-.433 (.380)	-.075 (.435)	-.165 (.383)	-.107 (.364)	-.292 (.428)	-.237 (.237)
HH inc $100K-150K	-.626* (.377)	-.383 (.339)	-.502 (.364)	.180 (.417)	-.195 (.367)	-.104 (.349)	.326 (.411)	-.186 (.227)
HH inc $150K+	-.759* (.425)	- 1.047*** (.383)	-.385 (.410)	.586 (.470)	-.043 (.414)	-.502 (.394)	.168 (.463)	-.283 (.256)
R2	.069	.055	.058	.061	.044	.116	.102	.086
Adjusted R2	.030	.016	.019	.022	.005	.079	.065	.048
SE estimate	1.725	1.553	1.666	1.906	1.678	1.598	1.878	1.038
N of cases	252	252	252	252	252	252	252	252

Notes: Table entries are unstandardized regression coefficients with standard errors in parentheses. * $p < .10$; ** $p < .05$; *** $p < .01$

Table 7 shows that few variables had consistent effects on all of the willingness to purchase variables. The results suggest that women were generally more likely than men to report they were willing to purchase new technologies for their next or their current vehicles; the results were statistically significant for reverse back up cameras, blind spot warning systems (marginal), parking assistance, smart headlights, and an overall willingness to purchase item (marginal). Controlling for other factors, people ages 60 to 69 reported that they were on average more willing to purchase reverse back up cameras and collision avoidance systems. Degree of tech savviness was marginally significant in the cases of lane departure warning systems and parking assistance, and it was significant in terms of collision avoidance systems, smart headlights, and an overall willingness to purchase item. In all cases, the direction of the effect was such that greater degrees of tech savviness were associated with a greater willingness to purchase.

Education and income variables were introduced as control variables. They did not demonstrate a pattern of effects, but for reverse back up cameras and blind spot warning systems, there is some evidence to suggest that participants with higher household incomes reported that they were more willing to purchase these technologies.

Study participants completed a series of questions asking them what they would value the worth of each technology was. Rather than expressing it in dollars, they were given the following response options: worth it at any price; worth it at the right price; worth it if it doesn't add to vehicle cost; not sure what it is worth; not worth having it; and indifferent to the technology. Figure 10 presents people's responses for each of the technologies.

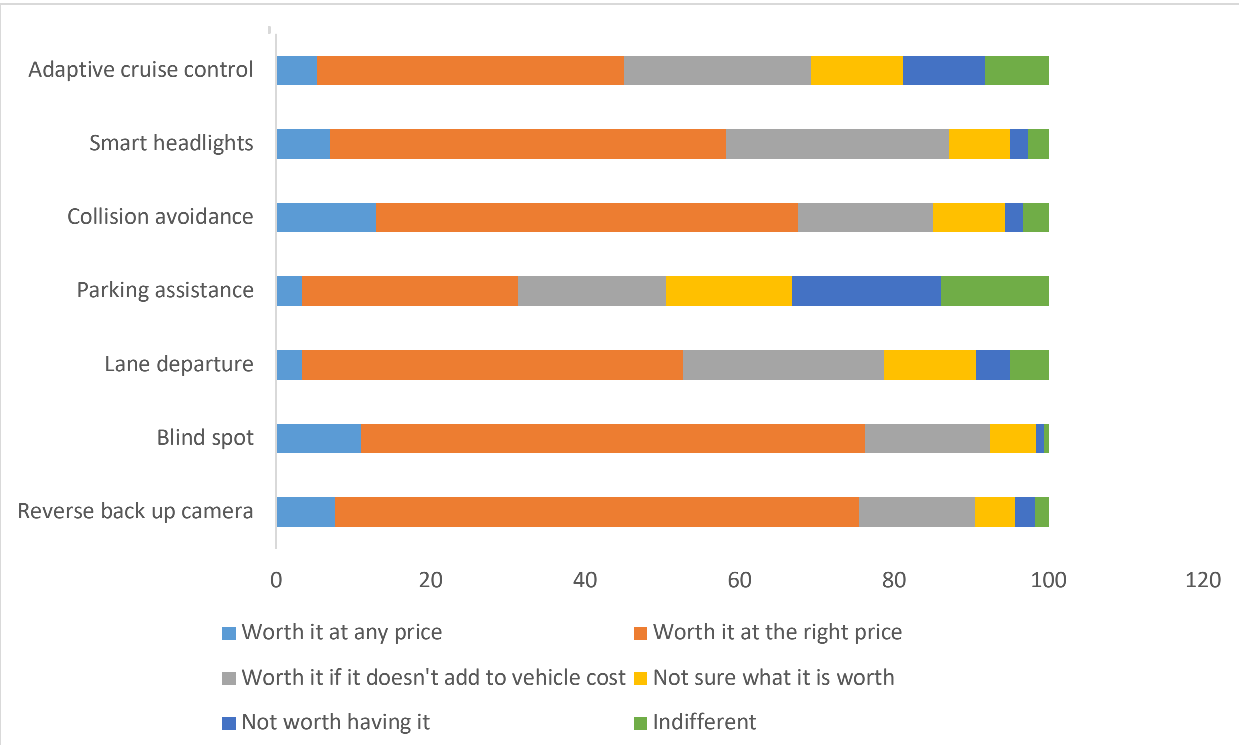

Figure 10. Responses to the worth participants assigned to each technology.
Note: N ranges from 300 to 302.

Figure 10 shows that people generally thought each of the technologies was worth having, as long as it was at what they considered to be the right price. Collision avoidance and blind spot technologies were more likely to be designated as worth it at any price, and people were clearly most indifferent or opposed to parking assistance systems from a value perspective. The graph suggests that people are quite sensitive to price for the technologies: they are worthwhile having, as long as they don't exceed the cost people think is the right price for the technology, or if the addition of the technology to the vehicle does not add to the overall cost.

The post-test questionnaire also included items which asked participants directly about the cost of new vehicle technologies. People were asked how much they would be willing to pay for each technology. Each of the individual willingness to pay items and a mean for all seven individual technologies were regressed on gender, age, tech savviness, education, and income. Selected results from this are presented in Table 8.

Table 8. Regression of willingness to pay price on gender, age, tech savviness, education, and income.

	Reverse back up camera	Lane departure warning system	Parking assistance	Adaptive cruise control
Constant	510.792* (268.478)	929.803* (532.082)	354.068 (252.923)	665.393** (254.982)
Gender (1=women)	156.672** (77.030)	38.817 (152.662)	219.472*** (72.567)	-80.172 (73.158)
Age (1=60-69)	143.348* (77.050)	-57.973 (152.700)	61.518 (72.585)	-12.444 (73.176)
Tech savviness	-16.233 (41.658)	38.812 (82.559)	-35.664 (39.244)	21.524 (39.564)
Some college	-19.289 (169.250)	-750.765** (334.604)	-15.368 (159.443)	-293.570* (160.741)
College	-69.819 (169.099)	-913.278*** (335.128)	-162.975 (159.302)	-238.319 (160.599)
Advanced degree	-22.631 (168.835)	-770.131** (334.604)	-70.983 (159.053)	-255.131 (160.347)
HH inc $50K-75K	-33.926 (127.824)	-52.196 (253.327)	78.119 (120.418)	-181.553 (121.398)
HH inc $75K-100K	5.118 (133.367)	378.604 (264.312)	98.622 (125.639)	-187.312 (126.662)
HH inc $100K-150K	-76.496 (129.709)	73.852 (257.064)	81.254 (122.194)	-145.555 (123.189)
HH inc $150K+	-47.950 (142.548)	-31.747 (282.508)	110.989 (134.289)	-112.278 (135.382)
R2	.047	.058	.059	.032
Adjusted R2	.005	.016	.017	-.011
SE estimate	567.233	1124.166	534.367	538.718
N of cases	234	234	234	234

Notes: Table entries are unstandardized regression coefficients with standard errors in parentheses. * p < .10; ** p < .05; *** p < .01

Results for blind spot warning systems, collision avoidance systems, smart headlights, and the overall mean of willingness to pay were not included in the table, as none of the predictors had a statistically significant relationship to the dependent variable. Further, although the results in the table above indicate that there are some relationships between price point and predictors, overall the linear models are relatively poor predictors of price. For the reverse back up camera, women were on average willing to pay more than men, controlling for other factors; adults ages 60 to 69 were more willing to pay more than adults ages 50 to 59 (although this latter result was marginally statistically significant). For lane departure warning systems, people with some college education or more were not willing to pay as much as those with a high school education or less. Women were on average willing to pay more than men for parking assistance systems. The education effect for adaptive cruise control is marginally statistically significant and does not appear to be part of a larger pattern.

Aside from price, participants were asked to evaluate how likely they thought they would be to use each of the different new vehicle technologies described in the video if they had the technology available to them. The likelihood of use for each individual item and for a mean score of use overall were regressed on gender, age, tech savviness, education, and income. Selected results are presented in Table 9.

Table 9. Regression of likelihood to use if had tech on gender, age, tech savviness, education, and income.

	Parking assistance	Adaptive cruise control	Collision avoidance	Smart headlights	Mean likely to use if had tech
Constant	5.565*** (.935)	5.146*** (.898)	3.459*** (.755)	2.809*** (.597)	3.467*** (.436)
Gender (1=women)	-.780*** (.280)	1.056*** (.269)	.177 (.226)	-.385** (.179)	-.021 (.131)
Age (1=60-69)	-.254 (.287)	.283 (.276)	-.207 (.232)	-.052 (.183)	-.142 (.134)
Tech savviness	-.266* (.143)	-.446*** (.138)	-.059 (.116)	-.163* (.091)	-.157** (.067)
Some college	-.044 (.570)	-.224 (.547)	-.973** (.460)	.062 (.364)	-.139 (.266)
College	-.020 (.572)	-.1061* (.549)	-.995** (.462)	-.201 (.365)	-.279 (.267)
Advanced degree	-.125 (.575)	-.886 (.552)	-.960** (.464)	-.010 (.367)	-.310 (.268)
HH inc $50K-75K	.392 (.478)	.589 (.460)	.249 (.387)	.291 (.305)	.197 (.223)
HH inc $75K-100K	.488 (.508)	.106 (.488)	.009 (.410)	.367 (.324)	.202 (.237)
HH inc $100K-150K	.198 (.487)	1.025** (.468)	.055 (.394)	.146 (.311)	.090 (.227)
HH inc $150K+	1.535*** (.543)	1.059** (.521)	-.041 (.438)	-.126 (.346)	.306 (.253)
R2	.092	.135	.038	.065	.049
Adjusted R2	.054	.099	-.002	.026	.010
SE estimate	2.168	2.083	1.752	1.385	1.012
N of cases	251	251	251	251	251

Notes: Table entries are unstandardized regression coefficients with standard errors in parentheses. * $p < .10$; ** $p < .05$; *** $p < .01$

Results for reverse back up cameras, blind spot warning systems, and lane departure warning systems were not included in this table, as none of the predictors had a statistically significant relationship to the dependent variable. Further, although the results in the table above indicate that there are some relationships between likelihood of use and predictors, overall the linear models are relatively poor predictors of people's likelihood of use if they currently had the technology. For the parking assistance systems, women were on average more likely to say they would use the technology if they had it than were men, controlling for other factors; the same was also true for smart headlights. For adaptive cruise control, however, men reported that they would be more likely to use the technology if they had it compared with women, controlling for other factors. For collision avoidance systems, people with some college education or more were more likely to say they would likely use the technology if they had access to it compared with those with a high school education or less. Finally, when it came to mean willingness to use the technologies if they had access to them, people with higher levels of tech savviness were more likely to say they would use the technologies, controlling for other factors.

Autonomous Vehicles

Perception Analyzer Video Responses

Figure 11 shows the average Perception Analyzer scores for each moment of the autonomous vehicle video for the overall sample and by gender and age group. Figure 12 displays the average Perception Analyzer scores for each of the four gender-age categories (i.e., women ages 50-59, women ages 60-69, men ages 50-59, and men ages 60-69) in the study.

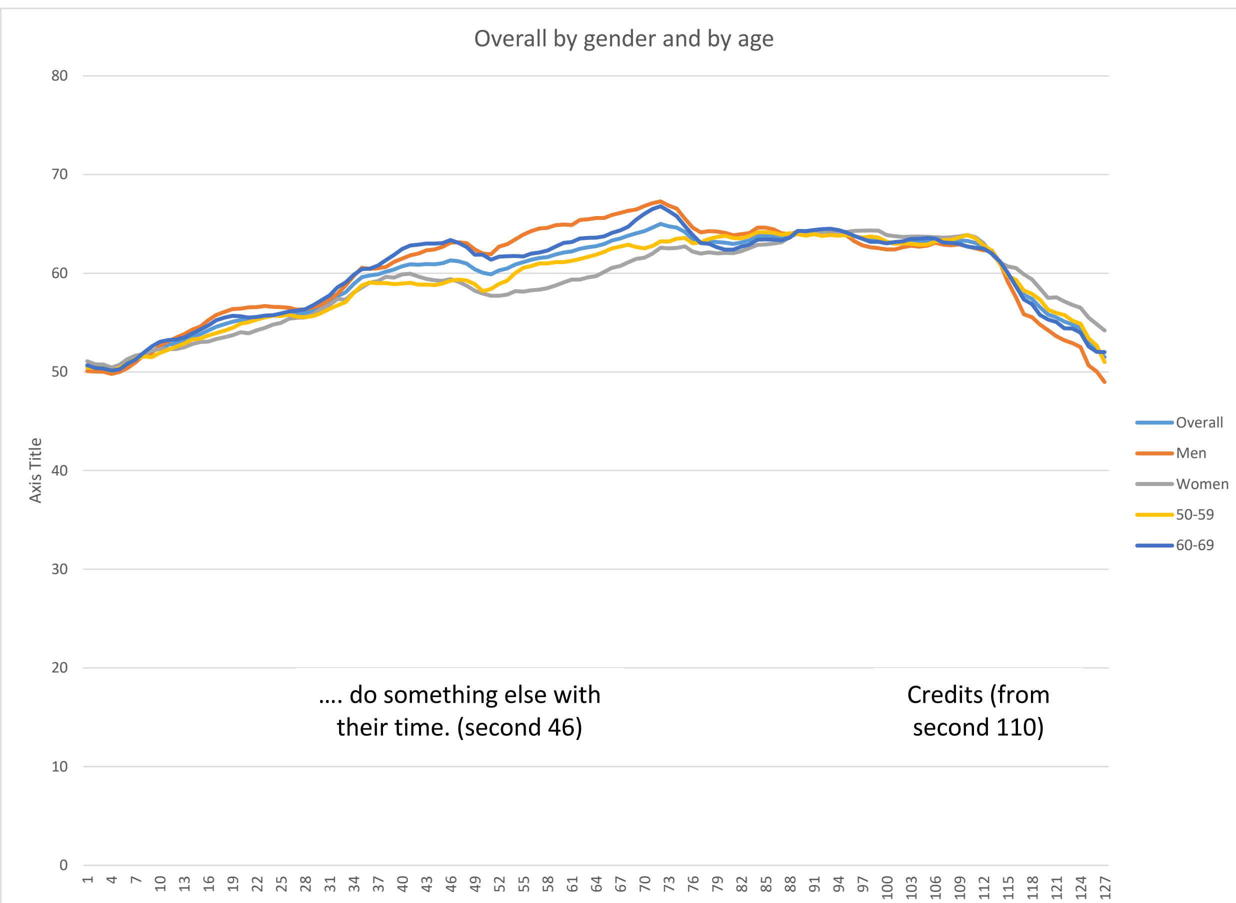

Figure 11. Average Perception Analyzer rating for each moment of the autonomous vehicle video overall and by gender and age.

Although men overall responded with a higher average rating to the autonomous vehicle video, and participants ages 60-69 had a higher rating on average than those ages 50-59, there were no statistically significant differences by age or gender, or by the interaction of these two variables, in the overall Perception Analyzer scores to this video.

Because the curves of the Perception Analyzer responses suggest that there may be some differences by gender and age, the overall video response was cut into segments: from introduction through second 46, where the individual in the video suggests that autonomous vehicles will allow drivers to be able to do something else with their time instead of driving, through second 96. This was further segmented into two parts, from 46 to 80 seconds and from 80 to 96 seconds into the video. Average Perception Analyzer scores for each of these segments (46-96, 46-80, and 80-96) were compared, but there were no statistically significant direct or interaction effects by gender or age.

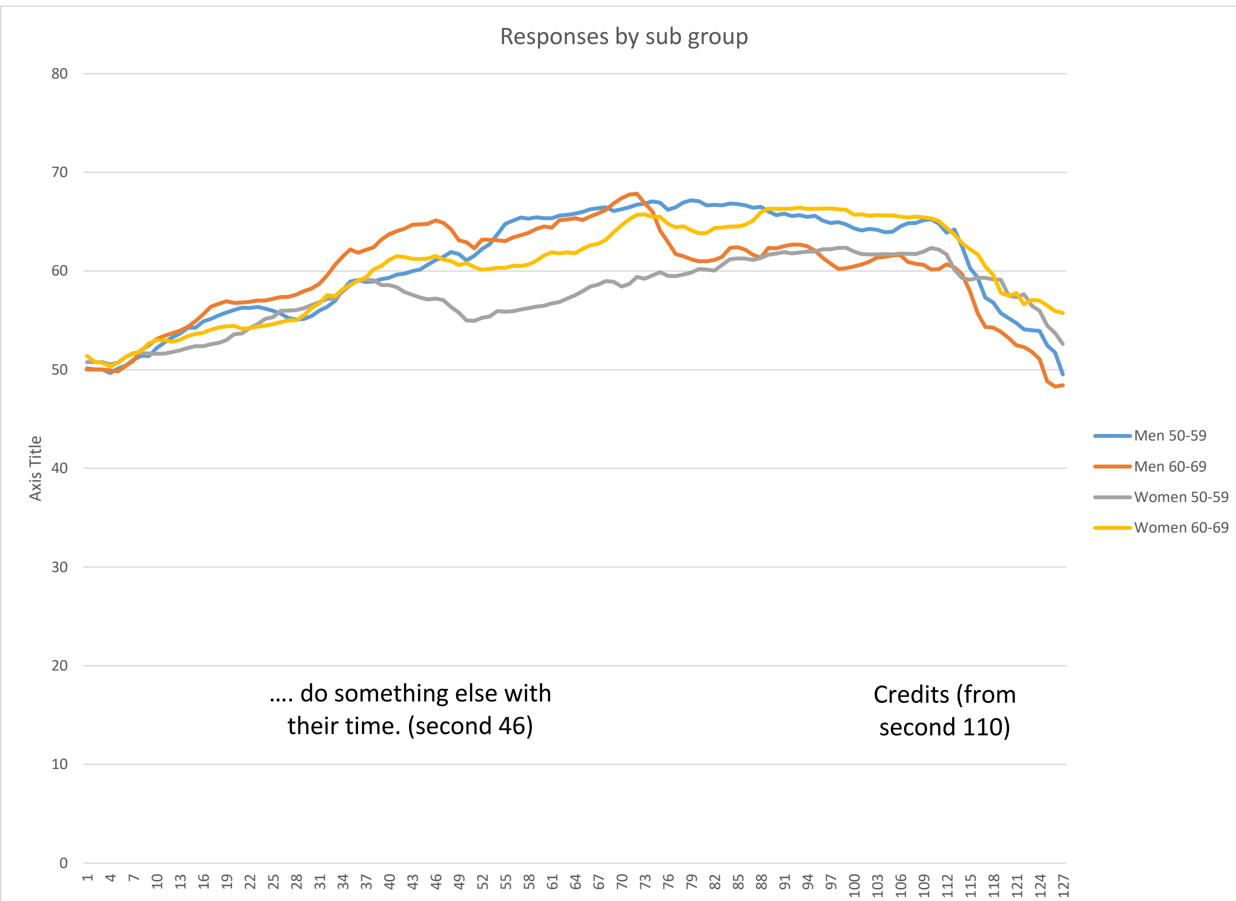

Figure 12. Average Perception Analyzer rating for each moment of the autonomous vehicle video by gender and age groups.

Questionnaire Data

Participants answered several different items about autonomous vehicles in the post-test questionnaire. They were asked if they would test drive such a vehicle, buy one if the price were the same as a regular car, and rate their agreement with a series of statements about their comfort level with the autonomous vehicle and its technologies.

Table 10 presents the frequencies for responses to the items about test driving and purchase. Note that over 16% of the sample indicated that they did not know if they would test drive a self-driving car. In terms of willingness to test drive, men indicated that they would be more likely to try compared with women, who were more likely to say no or “don’t know” (N=298, Chi-square=8.254, 2 d.f., p=.016; the analysis remains statistically significant if the “don’t know” option is removed from the analysis as well). There were no statistically significant differences in the distributions by age (this was true both for when the “don’t know” option was included in the analysis and when it was excluded).

Table 10. Frequencies for autonomous vehicle test-drive and purchase items.

	Overall	Men	Women	Ages 50-59	Ages 60-69	Men ages 50-59	Men ages 60-69	Women ages 50-59	Women ages 60-69
Would test-drive a self-driving car									
Yes	69.8	77.0	62.3	74.0	65.8	83.1	70.7	63.8	61.0
No	13.8	9.2	18.5	13.7	13.8	9.1	9.3	18.8	18.2
Don’t know	16.4	13.8	19.2	12.3	20.4	7.8	20.0	17.4	20.8
N of cases	298	152	146	146	152	77	75	69	77
If self-driving car and regular car were same price, which purchase									
Self-driving	30.5	38.2	22.6	31.7	29.4	40.8	35.5	21.7	23.4
Regular	38.9	36.2	41.8	39.3	38.6	35.5	36.8	43.5	40.3
Don’t know	30.5	25.7	35.6	29.0	32.0	23.7	27.6	34.8	36.4
N of cases	298	152	146	145	153	76	76	69	77

Note: Table entries in the N of cases are case counts; all other table entries are percentages.

Similar results are found for the item asking if people would purchase a self-driving car if it were the same price as a regular car. Men were more likely to agree than women were (N=298, Chi-square=8.918, 2 df=2, p=.012; the analysis remains statistically significant if the “don’t know” option is removed from the analysis as well), but there were no differences by age category in willingness to purchase a self-driving car at the same price as a regular one (true both when the “don’t know” option was included in or excluded from the analysis).

The five attitude statements about self-driving vehicles were the following:

- I would worry if many of the cars on the road with me were self-driving vehicles.
- I would be comfortable with a self-driving car as my primary vehicle.
- I think that self-driving vehicles will be on the road in the next 10 years.

- When more people are using self-driving cars, traveling on the road will be safer than it is today.
- I would trust the technology in a self-driving car.

Respondents used a five-point scale from "strongly agree" to "strongly disagree" to answer the items. A correlation matrix of the items, shown in Table 11, suggested that the first two and last two items were strongly related to each other; these items were scaled together to represent an overall level of comfort with self-driving vehicles and their technology (the first item was reverse scored before scaling together). The third item, indicating the respondent's belief about how soon such vehicles would be available, seemed to represent a different concept.

Table 11. Correlations of responses to self-driving vehicle attitude statements.

I would worry if many of the cars on the road with me were self-driving vehicles.	1 (299)				
I would be comfortable with a self-driving car as my primary vehicle.	-.605** (299)	1 (299)			
I think that self-driving vehicles will be on the road in the next 10 years.	-.300** (299)	.388** (299)	1 (300)		
When more people are using self-driving cars, traveling on the road will be safer than it is today.	-.681** (298)	.635** (298)	.435** (299)	1 (299)	
I would trust the technology in a self-driving car.	-.651** (298)	.661** (298)	.459** (299)	.749** (298)	1 (299)

Note: Table entries are Pearson correlation coefficients with number of cases in parentheses.
** $p < .01$

Table 12. Regression of comfort with self-driving vehicles on gender, age, and tech savviness.

	b	Standard error	p-value
Constant	3.321	.368	.000
Gender (1=women)	.334	.112	.003
Age (1=60-69)	-.037	.113	.743
Tech savviness	-.176	.057	.002

Note: N of cases= 268, $R2$=.075, adjusted $R2$=.039, SE of the estimate=.890. The output in this table reflects the inclusion of variables for education and income levels of the respondent as control variables; none of these were statistically significant.

The regression analysis in Table 12 suggests, consistent with the earlier results, that gender has a significant effect on reactions to the self-driving vehicles, with men reacting more positively and more comfortably to these new vehicles. There is also an effect of tech savviness, such that people who report being more comfortable with technology are more likely to indicate a higher degree of comfort with self-driving cars. There is no age effect, however, on degree of comfort with the vehicles.

Interestingly, however, when the question becomes one of belief that self-driving vehicles with be on the road within the next 10 years, there is only an effect of tech savviness (see Table 13).

Table 13. Regression of belief that self-driving vehicles will be on the road in next 10 years on gender, age, and tech savviness.

	b	Standard error	p-value
Constant	1.856	.373	.000
Gender (1=women)	.076	.113	.505
Age (1=60-69)	.173	.115	.133
Tech savviness	-.119	.058	.042

Note: N of cases= 300, R2=.035, adjusted R2=.025, SE of the estimate=.891. The output in this table reflects the inclusion of variables for education and income levels of the respondent as control variables; none of these were statistically significant.

In this case, those with higher levels of tech savviness were more likely to agree that autonomous vehicles would be available in the next decade.

Discussion

A primary focus of this study was to explore people's reactions to new vehicle technologies, and to examine what factors might positively affect adoption. Across different methods, from the moment-to-moment responses from Perception Analyzer dials to questionnaire data, people consistently ranked reverse back up cameras as the technology they would want the most. This was followed by blind spot warning systems. These two technologies were also among those more likely to be viewed by people as technologies whose most important effect was to improve driver safety.

While people generally reacted positively to the different technologies presented in the study, the results also indicate that people are strongly sensitive to price effects. The conjoint analysis demonstrated a clear impact of price sensitivity on people's willingness to choose different features. This result was echoed in the questionnaire data in which participants indicated the different technologies' worth to them. Few people were willing to buy the technologies at any price; they were much more likely to do so if they felt the price was "right" (however they so defined it) or if they thought the technology did not add to the overall price of the vehicle.

Gender differences emerged in the analysis more strongly than did differences by age group. Women's Perceptional Analyzer ratings of parking assistance systems were higher than men's. They were more likely to say that they were willing to purchase reverse back up cameras, parking assistance systems, and smart headlights, relative to men. They were also willing to pay more for reverse back up cameras and parking systems than men were. Women also indicated that they would be more likely to use parking assistance systems and smart headlights if they had them. Men were more likely than women to report that they would use adaptive cruise control systems if they had access to them.

People's degree of technological savviness also turned out to be an important factor in understanding their responses. The measure of tech savviness reflects people's self-reported conceptions of their trust in, experience with, and ease of using technology; rather than a count of technologies people use, the tech savviness item effectively captures people's underlying levels of comfort with technology. Tech savviness was positively related to recommending that others should buy new vehicle technologies and to people's overall feeling about new vehicle technologies; people who were more tech savvy were more likely to feel positively. Tech savviness was also positively related to people's reported willingness to purchase smart headlights, adaptive cruise control, and an overall willingness to purchase score.

The autonomous vehicle video also sparked generally positive reactions from people, although there were no significant differences in Perception Analyzer scores by age or gender. Differences by gender did emerge in the questionnaire data, however; compared with men, women generally indicated less comfort with and more uncertainty around test-driving or purchasing an autonomous car. Women were also less comfortable than men with such vehicles generally – they scored lower than men on an overall rating of comfort with self-driving cars. Tech savviness again was also an important predictor of attitudes around self-driving cars; those who were more tech savvy were more likely to be comfortable with self-driving vehicles. They were also more likely to report that they thought self-driving cars would be on the road within the next 10 years.

Conclusion

As with the advent of anti-lock brakes (ABS), many drivers may need to undergo some kind of re-training in order to use new vehicle technologies properly and to reap their benefits fully (Mollenhauer et al. 1997; Petersen, Barrett & Morrison 2006). The rapid influx of technologies to modern automobiles, and the prospect of self-driving cars, means that for many the driving task may fundamentally change. The role of the human operator in the vehicle may be less the active driver and more a periodic manager. Regardless, new technologies meant to enhance driver safety, comfort, and convenience may require that driver change a lifetime of habits first to adopt them and then to use them appropriately. Older drivers are in many ways poised to benefit greatly from this technological revolution in the vehicle, as such features may enable people to continue to drive safely for a longer period of time, enhancing mobility and health. The results of this study show, however, that although people may be positively disposed toward the technologies, there are barriers to adoption. Price of such technologies is a significant one; people do not want to overpay even for technologies primarily considered to be safety features. There is also a significant effect of comfort with technology on people's reported willingness to purchase and use. These obstacles are not insurmountable; manufacturers are increasingly offering these new vehicle technologies in entry-level models, and at price points that would have been difficult to imagine even several years ago. Price may become less of a barrier to people's choices than they think. People's level of comfort with technology, however, is a factor that affects not just purchase but also use. Helping people to improve their confidence in their use of such technologies may be an important component to encouraging adoption.

References

Haustein, S. and A. Siren, A. 2014. Seniors' unmet mobility needs - how important is a driving licence? *Journal of Transport Geography* 41:45-52.

Marottoli, R.A., C.F.M. deLeon, T.A. Glass, C.S. Williams, L.M. Cooney, L.F. Berkman, and M.E.Tinetti. 1997. Driving cessation and increased depressive symptoms: Prospective evidence from the New Haven EPESE. *Journal of the American Geriatrics Society* 45(2):202-206.

Mollenhauer, M.A., T.A.Dingus, C. Carney, J.M. Hankey, and S. Jahns. 1997. Anti-lock brake systems: An assessment of training on driver effectiveness. *Accident Analysis and Prevention* 29(1):97-108.

NHTSA. 2014. NHTSA announces final rule requiring rear visibility technology. NHTSA 09-14. Downloaded from http://www.nhtsa.gov/About+NHTSA/Press+Releases/2014/NHTSA+Announces+Final+Rule+Requiring+Rear+Visibility+Technology.

Nordbakke, S. and T. Schwanen. 2014. Well-being and mobility: A theoretical framework and literature review focusing on older people. *Mobilities* 9(1):104-129.

Petersen, A., R. Barrett, and S. Morrison. 2006. Driver-training and emergency brake performance in cars with antilock braking systems. *Safety Science* 44(10):905-917.

Reimer, B., L.A. D'Ambrosio, J.F. Coughlin, R. Puleo, J. Cichon, and J.D. Griffith. 2008. The effects of age on spinal rotation during a driving task. *Transportation Research Record* 2078:57-61. Also appeared in (2008) Proceedings of The Transportation Research Board 87th Annual Meeting, Washington, DC.

Reuters. 2015a. Google's self-driving cars involved in 11 accidents, director says. *New York Times*, May 11.

Reuters. 2015b. Ford joins rivals in ramping up pace of self-driving car tech. *New York Times*, June 23.

Outputs

Conference paper
D'Ambrosio, Lisa A., Dana R. Ellis, Richard Myrick, Beth Tracton-Bishop, Jodi Olshevski, and Joseph F. Coughlin. 2016. "Seeing and Believing: Attitudes about Advanced Vehicle Technologies." Conference paper presentation at HCI International, Toronto, Canada.

Public education/outreach
Safe Driving for a Lifetime: In the Driver's Seat: A Guide to Vehicle Safety Technology. The Hartford Property and Casualty Insurance Company, Center for Mature Market Excellence. https://s0.hfdstatic.com/sites/the_hartford/files/vehicle-technology.pdf

Web page
"Vehicle Technology Adoption." https://www.thehartford.com/resources/mature-market-excellence/vehicle-technology-adoption