Consumer demand for partial driving automation and hands-free driving capability

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Abstract

Introduction: It is often assumed that consumers want partial driving automation in their vehicles, yet there has been little research on the topic. Also unclear is what the public's appetite is for hands-free driving capability, automated (auto)-lane-change functionality, and driver monitoring that helps reinforce the proper use of these features.

Method: Through an internet-based survey of a nationally representative sample of 1,010 U.S. adult drivers, this study explored consumer demand for different aspects of partial driving automation.

Results: Eighty percent of drivers want to use lane centering, but more prefer versions with a hands-on-wheel requirement (36%) than hands-free (27%). More than half of drivers are comfortable with different driver monitoring strategies, but comfort level is related to perceptions of feeling safer with it given its role in helping drivers use the technology properly. People who prefer hands-free lane centering are the most accepting of other vehicle technologies, including driver monitoring, but some also indicate an intent to misuse these features. The public is somewhat more reluctant to accept auto lane change, with 73% saying they would use it, and more often prefer it to be driver-initiated (45%) than vehicle-initiated (14%). More than three quarters of drivers want auto lane change to have a hands-on-wheel requirement.

Conclusion: Consumers are interested in partial driving automation, but there is resistance to more sophisticated functionality, especially vehicle-initiated auto lane change, in a vehicle that cannot technically drive itself.

Practical applications: This study confirms the public's appetite for partial driving automation and possible intention for misuse. It is imperative that the technology be designed in ways that deter such misuse. The data suggest that consumer information, including marketing, has a role to play to communicate the purpose and safety value of driver monitoring and other user-centric design safeguards to promote their implementation, acceptance, and safe adoption.

Keywords**:** acceptance; attitude; expectation; Level 2; driver monitoring; auto lane change

1 Introduction

Many of the vehicles one can buy today come equipped with driver assistance features. Some driving support is so sophisticated that it can give consumers the impression that the vehicle can drive itself. At present, however, there are no driverless or self-driving vehicles on the consumer market. Partial driving automation, also known as Level 2 systems (SAE International, 2021), is currently the most advanced vehicle technology available for purchase in North America. Most of these systems are designed to operate on highways or limited-access roads, and they provide continuous speed, headway monitoring, and steering support through the combined use of adaptive cruise control and sustained lane centering.

Partial driving automation requires the driver to supervise the road and the vehicle, and drivers must be able to intervene rapidly when these systems get into situations they cannot cope with (SAE International, 2021). On-road testing has shown that these systems can struggle to provide support under fairly benign conditions (American Automobile Association, Inc. [AAA], 2020; Insurance Institute for Highway Safety [IIHS], 2018; Kim et al., 2022); for example, they can have trouble steering the vehicle within the lane when traveling on hills or in curves or detecting stopped vehicles. In comparison with crash avoidance features, such as automatic emergency braking, which has empirical support for mitigating and preventing crashes (e.g., Cicchino, 2017), no clear crash-reduction effectiveness has been established for partial driving automation (Goodall, 2021; Highway Loss Data Institute [HLDI], 2021a, 2021b). Rather, these systems are often marketed as driver convenience features, as they are intended to make driving easier or more comfortable.

Unfortunately, human limitations make the partially automated nature of the technology an issue when it comes to its safe and proper use. People have difficulty supervising a task they are not actively or physically involved in, and this difficulty is exemplified when the driving task is supported by partial driving automation (Banks et al., 2018; Biondi et al., 2018; Gaspar & Carney, 2019). In addition, there is growing evidence that this technology increases the opportunity for distracted driving (Banks et al., 2018;

Dunn et al., 2021; Kim et al., 2022; Reagan et al., 2021), and driver distraction increases crash risk (Dingus et al., 2016). Most of these systems monitor the driver for behavior that indicates they are out of the loop; for example, steering wheel torque or capacitive touch sensors are typically used to detect when the driver's hands are off the wheel and cameras are used to detect when the driver's eyes or head position are directed away from the road. There has been a recent push for automakers to adopt eye-gaze or head-pose monitoring strategies (AAA, Inc., 2022; IIHS, 2022; Preston, 2021) because what the driver is paying attention to tends to be more reliably correlated with where the driver is looking than what the driver's hands are doing (for a review, see El Khatib et al., 2020), yet driver hand monitoring remains important for detecting manual distraction (Halin et al., 2021). Although there are societal, legal, and privacy concerns around driver monitoring (Ghazizadeh & Lee, 2018; Horrey et al., 2012), little is known about the driving public's attitudes concerning driver monitoring and whether they vary based on the design of the partial automation itself.

While most commercially available systems require drivers to keep their hands on the wheel, some allow drivers to take their hands off the wheel for extended periods. Systems that permit hands-free driving typically utilize eye-gaze or head-pose tracking to help ensure drivers fulfill their supervisory roles, but most do not monitor what the driver's hands are doing when hands-free driving is engaged. A concern is that hands-free driving might increase the likelihood of drivers doing non-driving-related manual activities, such as eating or texting. If the driver's hands are otherwise occupied, their reaction time to take the wheel will be slowed (Wang et al., 2019), even if they are attentively supervising and can see that steering intervention is required. While it remains to be demonstrated what the appeal of hands-free driving is among the driving public, it is also an open question whether consumer attitudes and expectations for different driver monitoring strategies vary based on the appeal of certain system functionalities, such as hands-free driving.

The increasing functionality of partial automation may also be exacerbating consumer misunderstanding about the driver's responsibilities and the technology's limitations (Banks & Stanton, 2016; Mueller et al., 2021). Some of these systems have automated (auto)-lane-changing functionalities,

where the vehicle will make a lane change on its own without the driver needing to steer. Despite this capability, the driver still has to make sure the maneuvers are safe to perform and to intervene when necessary to prevent crashes. It is difficult to convey the limits of partial driving automation to consumers when it can perform maneuvers that are inherently riskier than just steering within the lane. Some auto-lane-change-assistance features require driver input, for example by use of the turn stalk or button press, as a form of verification that the driver is in the loop before the system will perform the lane-change maneuver. This is known as driver-initiated auto lane change. Other versions of this feature, known as vehicle-initiated auto lane change, do not require any driver input and the vehicle can make the decisions to change lanes on its own. Vehicle-initiated auto lane change makes it difficult for even attentive drivers to anticipate these actions, let alone be able to determine whether it is safe for the maneuver to be performed before it happens. The complexity of the issue is amplified by the fact that some automakers plan to offer auto-lane-change functionality as hands-free soon.

1.1 Study objectives

The marketing of partial driving automation frequently assumes that features such as hands-free driving and auto lane change are what consumers want. However, while the appeal of fully self-driving technology has received much attention, few studies have explored what the public appetite is for partial driving automation that exists in production vehicles today (e.g., Daziano et al., 2017; Lee et al., 2021). The goal of this study was to provide clarity on the subject and to determine whether preferences for hands-free driving support are ubiquitous or whether there are differences between lane centering and auto lane change and, if so, why. Another aim of the investigation was to determine whether consumers accept and see the value of driver monitoring technologies that are commonly equipped with partial driving automation to ensure its proper use. Furthermore, do those attitudes vary between features that offer hands-free driving capability and those that require drivers to keep their hands on the wheel? We conducted a nationally representative survey of U.S. drivers to answer these questions.

2 Method

2.1 Procedure

The survey was conducted online from September to October in 2021 and was hosted on the Voxco platform. Individuals were recruited to participate by email invitation from the Lucid Online Marketplace, which is a community composed of hundreds of suppliers with a diverse set of recruitment and sourcing methodologies. Respondents were informed that the survey was about understanding public opinion concerning commercially available driver assistance technologies and that it would take approximately 15 minutes to complete. They provided written informed consent to participate before gaining access to the survey instrument. Each respondent who qualified and completed the survey was paid $5.00 by the marketplace supplier from whom they were recruited within the Lucid Online Marketplace. The study protocol was deemed exempt by Advarra, an independent IRB company.

2.2 Sample

Quotas were used to match the sample to the age and gender distributions of the U.S. population aged 21 and older using 2010 Census data as the target basis because 2020 estimates were not yet available at the time of the survey; the 2010 age and gender distributions were similar to the 2020 middle series estimates of the U.S. resident population (United States Census Bureau, 2020). As most respondents were expected to be unfamiliar with the topics discussed in the survey, a pilot testing phase was necessary to refine survey language; however, the data collected from the pilot phase (n = 101) were not used for the study analysis. The final sample consisted of 1,010 U.S. residents aged 21 years and older who typically drove at least 1 day per week on highways. Six hundred and eighty other individuals agreed to participate but were determined to be ineligible—nine of whom were younger than 21 years, 294 did not drive at all, 85 drove less than 1 day per week, and 292 drove less than 1 day per week on highways. An additional 34 respondents were removed due to quality control issues and 775 other individuals started but did not complete the survey.

2.3 Survey instrument

Appendix A contains the survey instrument. Definitions about a technology's purpose, functional capabilities, and limitations were provided to respondents before they were asked about their opinions and preferences for that given technology. Lane-centering assistance was also described in the context of partial driving automation, in that it could be activated simultaneously with adaptive cruise control. To prevent respondents confusing lane centering with lane departure prevention, both features were defined independently to distinguish the temporary nature of lane departure prevention from the continuous steering support of lane centering. Hands-free and hands-on-wheel driving requirements were defined for lane centering and auto lane change. Driver-initiated and vehicle-initiated versions of auto lane change were characterized separately. The survey included sections on lane centering, driver monitoring, lane-change assistance, self-driving car appeal, and demographics and driving habits.

Lane centering. Respondents were asked if they would want to use lane-centering assistance, and if so, what type they would prefer (hands-free, hands-on-wheel, no preference). Five-point Likert scales assessed whether hands-free assistance would make driving more or less stressful, safe, and boring, and make the driver more or less comfortable, tired, distracted, and likely to do non-driving-related activities, compared with hands-on-wheel lane centering. Participants were additionally asked with 5-point Likert scales about their likelihood of buying or leasing their next vehicle with hands-free or hands-on-wheel lane centering, if cost was not an issue.

Driver monitoring. Using 5-point Likert scales, respondents were asked how comfortable they would be with different driver monitoring strategies for hands-on-wheel and hands-free versions of lane centering as well as how safe they would feel knowing that the vehicle would be monitoring them to help ensure the technology was being used as designed.

Auto lane change. Respondents were asked about the degree of confidence they had in their ability to make manual lane changes on the highway and the degree of stress they tend to experience when making those maneuvers with 5-point Likert scales. They were then asked about vehicle technologies that can assist with lane changing. Blind spot detection alerts the driver if there is another

vehicle in their blind spot when they want to change lanes. Respondents were asked whether they want to use blind spot detection, driver-initiated auto lane change, and vehicle-initiated auto lane change. Every respondent was then asked to specify whether they preferred to use hands-free or hands-on-wheel versions of driver- and vehicle-initiated auto lane change and why. Using 5-point Likert scales, respondents were asked about their willingness to purchase or lease their next vehicle with hands-free and hands-on-wheel versions of driver-initiated and vehicle-initiated auto lane change.

Self-driving technology appeal. Respondents were asked "How appealing would it be for you to own or regularly use a self-driving vehicle in the future? Self-driving means that the vehicle itself would control all the safety-critical functions, even allowing the vehicle to travel without a passenger if required. In other words, the vehicle would be able to drive itself anytime, anywhere, and under any conditions. You would be able to get into the vehicle, instruct it where you would like to travel to, and the vehicle would then carry out your desired route with no further intervention required from you. There might not even be a steering wheel or speed controls in the vehicle." Degree of appeal was captured through a 5-point Likert scale.

2.4 Data analysis

To simplify interpretation, Likert-scale data were grouped into broader categories. Differences in survey responses by preference for lane centering (referred to as lane-centering preference group), preference for auto lane change (auto-lane-change preference group), and self-driving car appeal were examined using chi-square tests. A critical p value of 0.05 was used to determine statistical significance and actual p values were reported for statistically significant results. Response categories were collapsed for select comparisons reported in the *Results* section, and all response categories for those survey items can be found in Appendix B.

3 Results

3.1 Sample

Table 1 shows the distribution of sample demographics for age, gender, education, income, U.S. Census region, weekly highway driving exposure, and experience with lane centering. The average age of respondents was 46 years (*SD* = 17, *min* = 21, *max* = 91). About half of the respondents reported having no experience with lane centering, and about a third said they had it in their personal vehicle. The majority drove on the highway 5 or more days per week on average.

Table 1

Sample demographics

	Percent (*N* = 1,010)
Age (years)	
21 to 34	26
35 to 64	51
65 and older	23
Gender	
Male	49
Female	51
Other	< 1
Education level	
High school diploma or less	23
Some college education, associate degree, or trade school	34
Bachelor's degree	24
Some graduate education	4
Graduate or professional degree	15
Income	
Less than $50,000	45
$50,000 to $74,999	20
$75,000 to $99,999	13
$100,000 to $149,999	13
$150,000 to $199,999	6
$200,000 or more	3

	Percent (N = 1,010)
Region	
Northeast	17
Midwest	21
South	39
West	24
Highway driving exposure (average days per week)	
5 days or more per week	58
3 to 4 days per week	24
1 to 2 days per week	19
Experience with lane centering	
Yes, in their personal vehicle	32
Yes, but in a vehicle that was not their own	14
No	53
Unsure	2

Note. Percentages may not sum to 100 due to rounding.

3.2 Lane centering

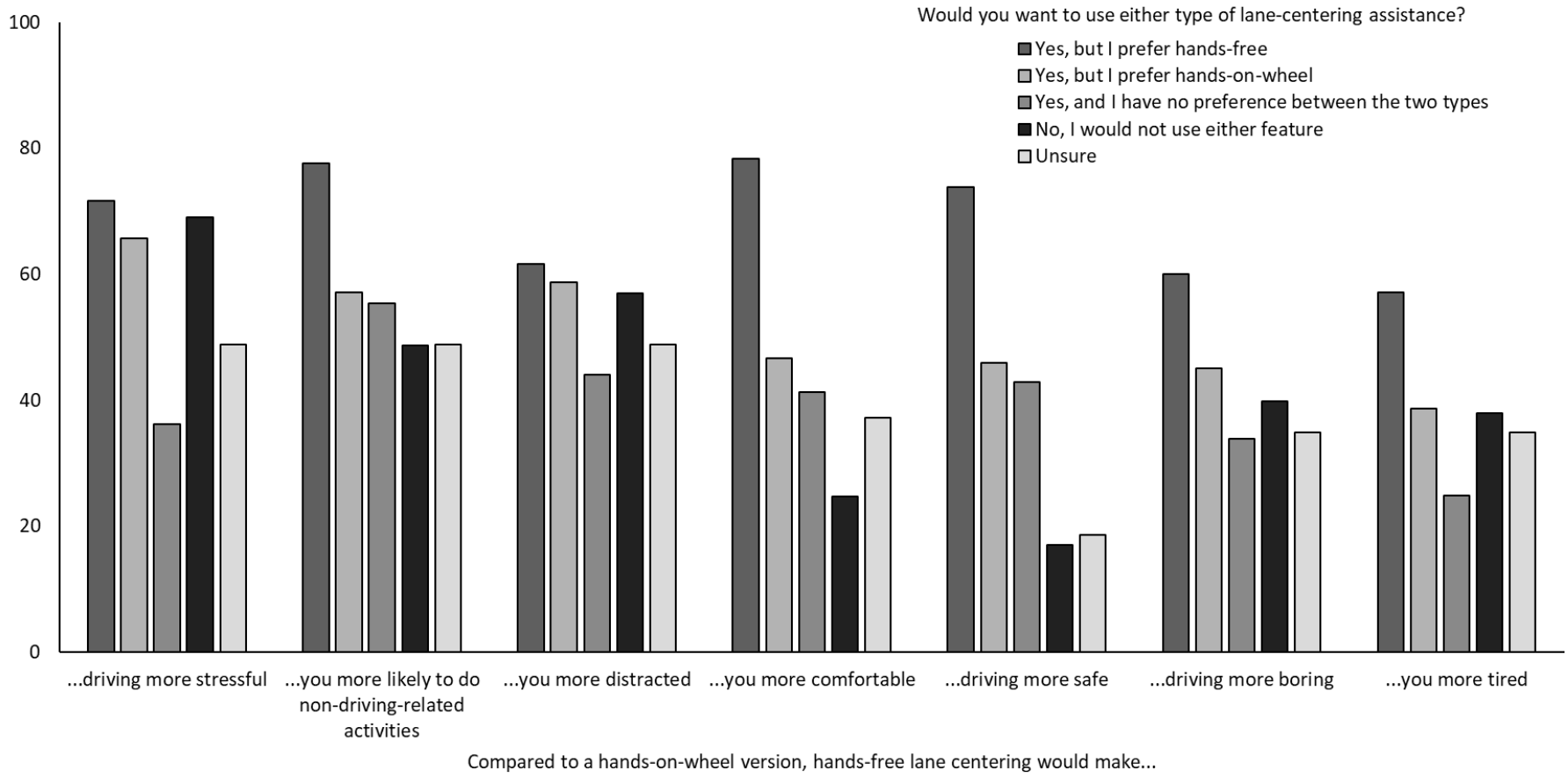
Eighty percent of the sample wanted to use at least some form of lane centering. More respondents preferred hands-on-wheel (36%) than hands-free lane centering (27%), and 18% had no preference between the two types. Sixteen percent did not want to use any form of lane centering and 4% were unsure.

Expectations for hands-free vs. hands-on-wheel lane centering. As shown in Figure 1, compared with when using hands-on-wheel lane centering, most (62%) of the sample said that using the hands-free version would make driving more stressful, would make them more likely to do non-driving-related activities (e.g., eat, drink, text, groom, converse with a passenger) (61%), and more distracted (56%) and comfortable (50%). Nearly half said it would make driving safer (47%) or more boring (46%), and 41% said it would make them more tired.

Differences were noted among the lane-centering preference groups. A larger percentage of respondents who preferred hands-free or hands-on-wheel versions of lane centering, as well as those who did not want to use the feature, said hands-free lane centering would make driving more stressful, X^2 (4, 1010) = 69.16, $p < .0001$, or would make them more distracted, X^2 (4, 1010) = 15.70, $p = 0.003$, compared with those who had no preference or were unsure. Those who preferred hands-free lane centering also most often reported that the feature would make them more comfortable, X^2 (4, 1010) = 136.51, $p < .0001$, and make driving safer, X^2 (4, 1010) = 149.71, $p < .0001$; these opinions were reported least often among those who did not want to use any version of lane centering. Additionally, drivers who preferred hands-free lane centering most often reported it would make driving more boring, X^2 (4, 1010) = 36.47, $p < .0001$, and would make them more tired, X^2 (4, 1010) = 49.81, $p < .0001$.

Figure 1

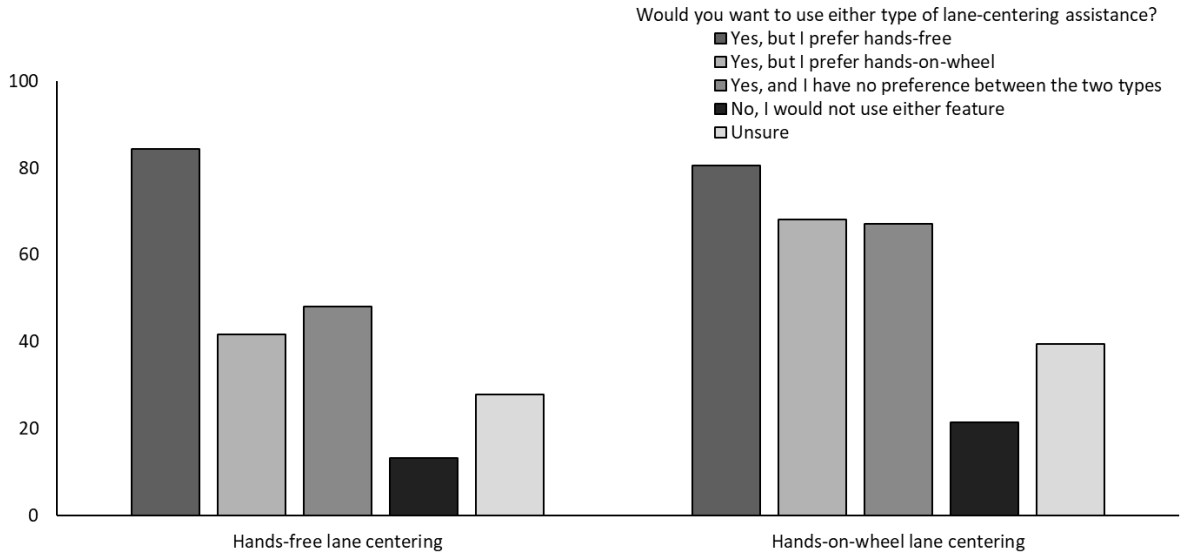
Percent of respondents by lane-centering preference group who agree that various outcomes would be greater when using hands-free than hands-on-wheel lane centering



Conceptual appeal and likelihood of purchasing lane centering. Assuming price was not an issue, a larger proportion of the sample was willing (defined by being at least moderately likely) to buy or lease their next vehicle with hands-on-wheel lane centering than a hands-free version, as shown in Figure 2. Willingness for hands-free (X^2 (4, 1010) = 229.81, $p < .0001$) and hands-on-wheel lane centering (X^2 (4, 1010) = 167.42, $p < .0001$) varied as a function of preference group. Over three quarters of respondents who preferred hands-free lane centering were willing to buy either a hands-free or hands-on-wheel lane-centering feature. More than two thirds of those who preferred hands-on-wheel lane centering or who had no preference were willing to buy a hands-on-wheel version, but less than half of them were willing to buy a hands-free version. Less than half of respondents who were unsure or who did not want any lane centering were willing to buy either type of lane-centering assistance, but willingness to purchase or lease a vehicle with a hands-on-wheel version was higher among both groups than for a hands-free one.

Figure 2

Percent of respondents at least moderately likely to buy or lease a vehicle with hands-free or hands-on-wheel lane centering per lane-centering preference group



3.3 Driver monitoring

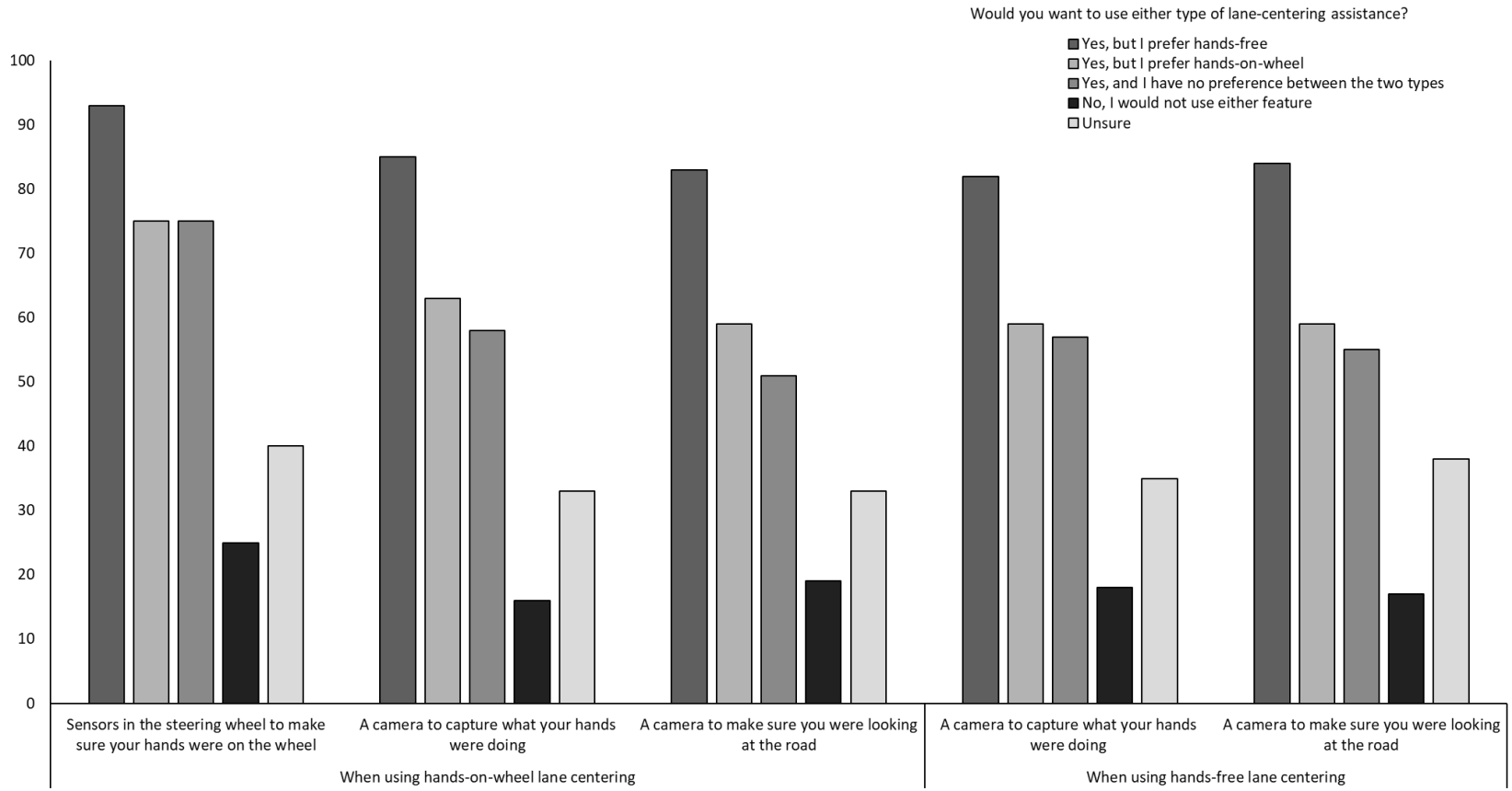
Attitudes concerning driver monitoring strategies. In the context of using a hands-on-wheel lane-centering feature, the majority of the sample was at least somewhat comfortable with all three driver monitoring strategies: 70% with steering wheel sensors to monitor driver hands, 59% with camera monitoring of driver hands, and 57% with camera monitoring of driver gaze. Similar percentages of respondents were at least somewhat comfortable with camera monitoring of driver hands (58%) and driver gaze (57%) in the context of hands-free lane centering.

Comfort with driver monitoring varied by lane-centering preference group for steering wheel sensor monitoring of driver's hands (X^2 (4, 1010) = 242.38, $p < .0001$), camera monitoring of driver's hands (X^2 (4, 1010) = 207.62, $p < .0001$), and camera monitoring of driver's gaze (X^2 (4, 1010) = 183.88, $p < .0001$) when using hands-on-wheel lane centering as well as camera monitoring of driver's hands (X^2 (4, 1010) = 177.32, $p < .0001$) and camera monitoring of driver's gaze (X^2 (4, 1010) = 193.11, $p < .0001$)

when using hands-free lane centering. The patterns observed for the overall sample were primarily driven by respondents who wanted some form of lane centering, although more respondents who preferred hands-free lane centering were extremely comfortable with all forms of driver monitoring for both types of lane centering compared with the other preference groups (Figure 3). Conversely, almost half of the respondents who did not want to use any lane-centering assistance reported being at least somewhat uncomfortable with driver monitoring when using either type of lane centering, especially camera-based monitoring.

Figure 3

Percent of respondents per lane-centering preference group reporting to be comfortable with driver monitoring strategies for hands-free and hands-on-wheel lane centering



Perceived safety of driver monitoring to ensure proper system use. While most respondents said that they would feel safer knowing that the vehicle was monitoring them to make sure that the feature was being used as it was designed to be used (Table 2), there were differences by lane-centering preference group, X^2 (4, 1010) = 185.99, $p < .0001$. Among those who did not want lane centering, only 27% reported they would feel safer with driver monitoring. In contrast, the majority of respondents who wanted hands-free lane centering said they would feel much safer with driver monitoring.

Table 2

Perceived safety of driver monitoring as a function of lane-centering preference (in percent)

Would you feel safer knowing that the vehicle is monitoring you to make sure you are using the feature as it was designed to be used?	Would you want to use either type of lane-centering assistance?					
	Yes, but I prefer hands-free	Yes, but I prefer hands-on-wheel	Yes, and I have no preference between the two types	No, I would not use either feature	Unsure	Total
	(*n* = 268)	(*n* = 364)	(*n* = 177)	(*n* = 158)	(*n* = 43)	(*n* = 1,010)
Much safer	60	32	30	9	16	35
Somewhat safer	28	40	36	18	35	33
Neither more nor less safe	9	22	28	47	42	25
Somewhat less safe	1	3	3	11	2	4
Much less safe	< 1	2	2	16	5	4

Note. Percentages may not sum to 100 due to rounding.

Differences were also seen with how safe driver monitoring would make people feel based on how comfortable they were with the different driver monitoring strategies (Table 3). People who were at least somewhat comfortable with different driver monitoring strategies reported feeling safer than those who were neutral or uncomfortable with driver monitoring. The pattern of the interaction between feeling comfortable and safe with driver monitoring was similar among the different strategies in the context of using hands-on-wheel and hands-free versions of lane centering. Specifically, the interaction persisted

with respect to steering wheel sensors to monitor the driver's hands (X^2 (4) = 345.12, p <.0001) and cameras to monitor the driver's hands (X^2 (4) = 371.12, p <.0001) and face (X^2 (4) = 393.19, p <.0001) in hands-on-wheel lane-centering systems as well as cameras to monitor hands (X^2 (4)= 380.41, p <.0001) and face (X^2 (4)= 359.81, p <.0001) in hands-free lane-centering systems.

Table 3

Perceived safety of driver monitoring as a function of being at least somewhat comfortable with different driver monitoring strategies (in percent)

Would you feel safer knowing that the vehicle is monitoring you to make sure you are using the feature as it was designed to be used?	In the case of hands-on-wheel lane-centering assistance, how comfortable would you be if the vehicle monitored you through…						In the case of hands-free lane-centering assistance, how comfortable would you be if the vehicle monitored you through…			
	sensors in the steering wheel to make sure your hands were on the wheel		a camera to capture what your hands were doing		a camera to make sure you were looking at the road		a camera to capture what your hands were doing		a camera to make sure you were looking at the road	
	At least somewhat comfortable	Neutral or not comfortable	At least somewhat comfortable	Neutral or not comfortable	At least somewhat comfortable	Neutral or not comfortable	At least somewhat comfortable	Neutral or not comfortable	At least somewhat comfortable	Neutral or not comfortable
	(*n* = 711)	(*n* = 299)	(*n* = 597)	(*n* = 413)	(*n* = 575)	(*n* = 435)	(*n* = 583)	(*n* = 427)	(*n* = 577)	(*n* = 433)
Much safer	47	6	53	9	56	7	55	8	55	9
Somewhat safer	38	21	37	27	34	30	35	29	35	29
Neither more nor less safe	12	54	8	48	8	46	8	47	9	46
Somewhat less safe	2	8	2	7	1	8	1	7	1	7
Much less safe	1	11	< 1	9	1	9	< 1	9	< 1	9

Note. Percentages may not sum to 100 due to rounding.

3.4 Lane-changing assistance

Manual lane-changing ability and lane-change assistance. Most of the sample (67%) indicated that they found changing lanes on highways at least somewhat stressful, yet 97% also said they were at least somewhat confident in their ability to perform those maneuvers. Even so, most (88%) reported that they would like the vehicle to warn them if there were another vehicle in their blind spot when they want to change lanes (i.e., a blind spot detection feature), whereas only 5% were unsure if they would like and 8% said they would not like such a feature. Fewer respondents had a desire for auto-lane-change assistance. When asked whether they would want to use either driver-initiated or vehicle-initiated auto lane change, 73% said they would use some form of auto lane change, with 45% indicating they would prefer to use driver-initiated auto lane change and far fewer (14%) preferring vehicle-initiated auto lane change. Few had no preference (13%) or were unsure (5%) if they would use either type of assistance, and 23% said they would not use either type.

Attitudes towards hands-free and hands-on-wheel auto lane change. Respondents were asked whether they would prefer hands-free or hands-on-wheel requirements separately for driver-initiated and vehicle-initiated versions of auto lane change. Approximately three quarters preferred auto lane change to require the driver to keep their hands on the wheel, regardless of whether the feature was driver-initiated (77%) or vehicle-initiated (75%). Only 14% preferred the hands-free version for driver-initiated and vehicle-initiated auto lane change, and the remainder said they were unsure.

Those who preferred hands-free or hands-on-wheel driver- and vehicle-initiated auto lane change were asked to select reasons for their preference from a list of options, with multiple responses allowed (Table 4). The most common reasons were that they thought it would improve their driving comfort and make driving safer and less stressful. However, more respondents who preferred hands-on-wheel versions gave the reason that it would make driving safer than those who preferred hands-free versions. While respondents who preferred hands-free versions more often indicated that the reason for their preference was to have more opportunity to do non-driving-related activities, this reason was not selected by most of the sample regardless of hands-free or hands-on-wheel preference.

Table 4

Reasons why respondents preferred driver-initiated or vehicle-initiated auto lane change to allow hands off the wheel or require drivers to keep their hands on the wheel (percent)

Reason	Driver-initiated auto lane change		Vehicle-initiated auto lane change	
	Prefer it to allow you to have your hands off the wheel (n = 137)	Prefer it to require you to keep your hands on the wheel (n = 774)	Prefer it to allow you to have your hands off the wheel (n = 138)	Prefer it to require you to keep your hands on the wheel (n = 755)
Would make me more comfortable	58	53	46	51
Would make driving less stressful	41	43	40	44
Would make driving safer	30	46	33	45
Would make me less tired	29	20	22	23
Would make me less distracted	16	23	11	22
Would make driving less boring	16	16	20	15
Would give me more opportunity for non-driving-related activities, such as eating, texting, conversing with a passenger, etc.	15	4	14	5

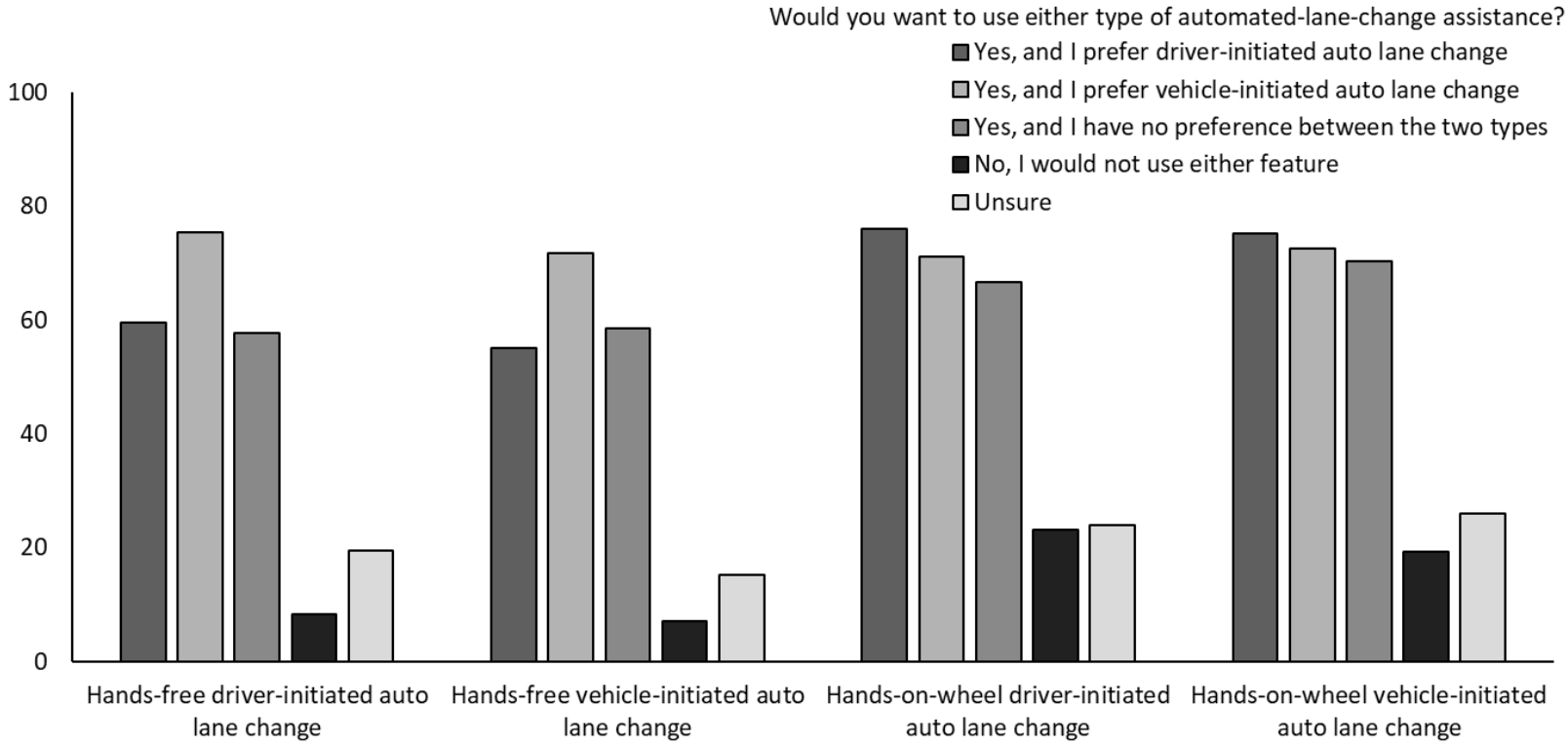
Note. Multiple responses were allowed, and preferences were asked separately for driving-initiated and vehicle-initiated auto lane change. Participants who were unsure about hands-free vs. hands-on-wheel requirement preferences for driver-initiated auto lane change (n = 99, 10% of the sample) and vehicle-initiated auto lane change (n = 117, 12% of the sample) were not asked about why they preferred hands-free or hands-on-wheel requirements.

Conceptual appeal and likelihood of purchasing auto lane change. Over half of the sample reported they would be at least moderately likely to get a form of auto lane change on their next vehicle if price were not an issue, and they were more willing to purchase or lease hands-on-wheel than hands-free versions (Figure 4). The proportion of respondents that were at least moderately willing to buy or lease their vehicles with various implementations of auto lane change differed based on their preferences to use driver- or vehicle-initiated versions (to buy hands-free driver-initiated: X^2 (4, 1010) = 231.93, p < .0001; to buy hands-on-wheel driver-initiated: X^2 (4, 1010) = 212.59, p < .0001; to buy hands-free vehicle-initiated: X^2 (4, 1010) = 219.90, p < .0001; to buy hands-on-wheel vehicle-initiated: X^2 (4, 1010) = 237.91, p < .0001). Respondents who indicated any preference for driver-initiated or vehicle-initiated auto

lane change indicated a greater willingness for their next vehicles to be equipped with these systems compared to respondents who were unsure about these features and or who do not want to use auto lane change at all. Unlike all the other preference groups, however, those who wanted vehicle-initiated auto lane change were similarly willing to have either hands-on or hands-free driver-initiated and vehicle-initiated versions in their next vehicle.

Figure 4

Percent of respondents at least moderately likely to buy or lease a vehicle with hands-free or hands-on-wheel versions of driver-initiated and vehicle-initiated auto lane change, per auto-lane-change preference group



3.5 Hands-free driving preferences for different driver support features

Differences were observed in hands-free and hands-on-wheel preferences for driver-initiated (X^2 (8, 1010) = 106.43, $p < .0001$) and vehicle-initiated auto lane change (X^2 (8, 1010) = 110.33, $p < .0001$) as a function of lane-centering preferences. As shown in Table 5, over 80% of respondents who wanted to use either hands-free or hands-on-wheel versions of lane centering preferred hands-on-wheel versions of driver- and vehicle-initiated auto lane change compared with hands-free versions of those features. Smaller majorities of the other lane-centering preference groups indicated a preference for hands-on-wheel versions of auto lane change.

Table 5

Hands-free vs. hands-on-wheel driver-initiated and vehicle-initiated auto-lane-change preferences based on respondent preferences for lane centering (in percent)

Would you prefer a [driver-initiated or vehicle-initiated, separately asked] automated-lane-change assistance feature to require that you have your hands on the wheel the whole time or would you prefer it to be hands-free?		Would you want to use either type of lane-centering assistance?				
		Yes, but I prefer hands-free	Yes, but I prefer hands-on-wheel	Yes, and I have no preference between the two types	No, I would not use either feature	Unsure
		(n = 268)	(n = 364)	(n = 177)	(n = 158)	(n = 43)
Driver-initiated auto lane change	Prefer it to allow you to have your hands off the wheel	16	11	21	10	5
	Prefer it to require you to keep your hands on the wheel	82	84	64	68	60
	Unsure	2	5	15	22	35
Vehicle-initiated auto lane change	Prefer it to allow you to have your hands off the wheel	16	12	20	8	7
	Prefer it to require you to keep your hands on the wheel	81	82	66	63	58
	Unsure	3	7	14	29	35

Note. Percentages may not sum to 100 due to rounding.

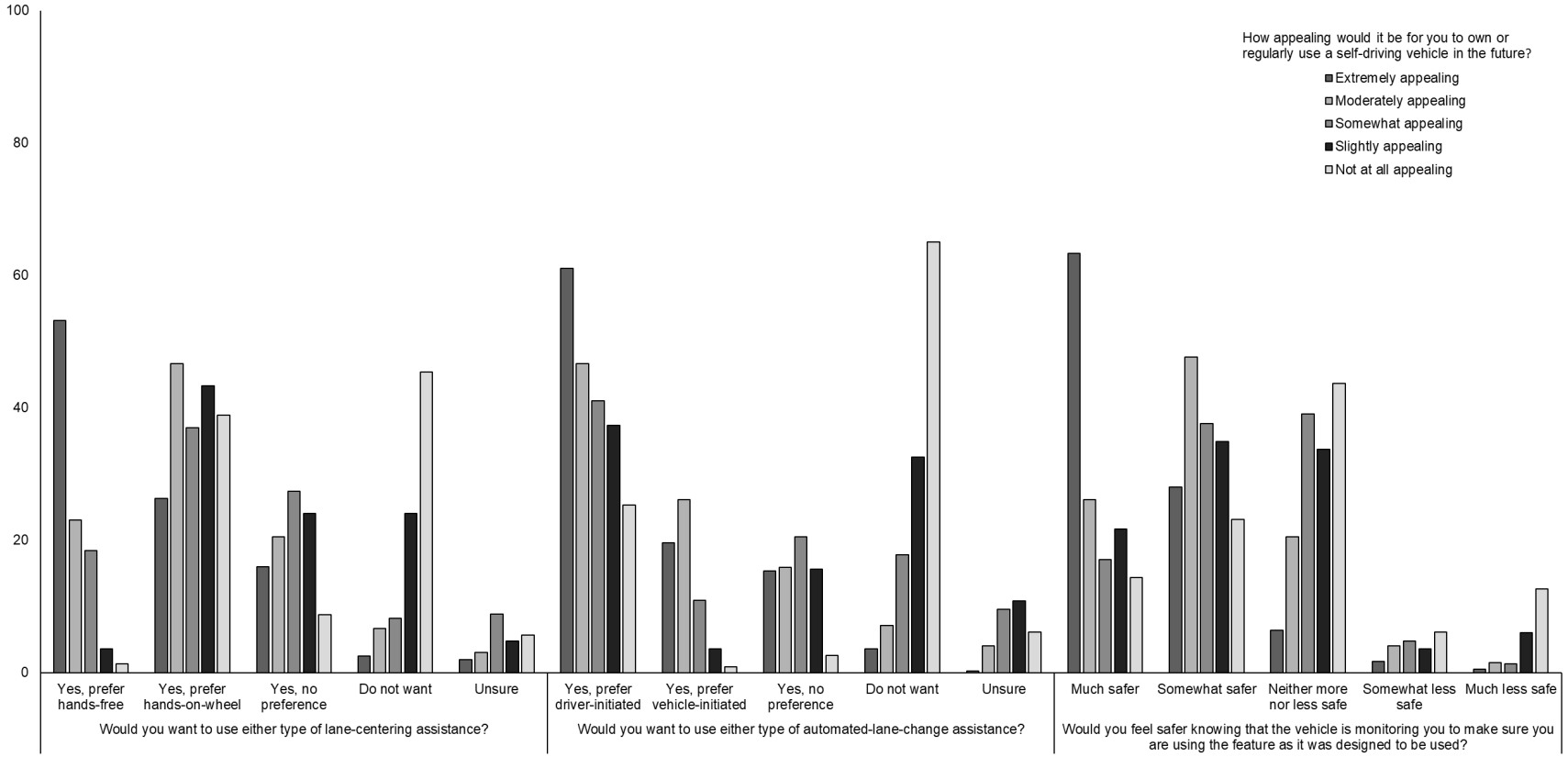
3.6 Self-driving technology appeal

Thirty-five percent of the sample said they found self-driving technology extremely appealing, 19% said moderately appealing, 14% said somewhat appealing, 8% said slightly appealing, and 23% said not at all appealing. Respondents who indicated they found self-driving technology appealing also indicated a desire for other vehicle technologies (Figure 5).

Lane-centering preferences (X^2 (16, 1010) = 412.23, $p < .0001$), feeling more or less safe with driver monitoring (X^2 (16, 1010) = 320.31, $p < .0001$), and the appeal of auto lane change (X^2 (16, 1010) = 428.40, $p < .0001$) varied with self-driving technology appeal. Respondents who found self-driving technology to be extremely appealing were most likely to prefer hands-free lane centering and report feeling much safer with driver monitoring. These respondents also most often wanted to use auto lane change, although like respondents in other groups, they preferred it to be driver-initiated rather than vehicle-initiated. Those said that self-driving technology was not at all appealing were most likely to not want to use any form of lane centering or auto lane change, and most frequently reported that driver monitoring would make them feel neither more nor less safe.

Figure 5

Percent of respondents per self-driving technology appeal rating with preferences for partial driving automation and safety ratings for driver monitoring



4 Discussion

While this study confirms that there is an appetite for partial driving automation, it also shows that the appeal of specific features varies. Lane centering was revealed to be more appealing than auto lane change, and vehicle-initiated auto lane change was overwhelmingly the least appealing of all. Moreover, hands-on-wheel requirements were widely preferred over hands-free driving capability for all these features, especially for both types of auto lane change. Driver monitoring was generally seen as acceptable, although there was less enthusiasm for camera-based monitoring than for steering wheel sensor monitoring, which is to be expected given consumer concerns about privacy and user autonomy (Ghazizadeh & Lee, 2018; Horrey et al., 2012). Even so, attitudes and expectations around driver monitoring corresponded with the perception of being safer with it, given its purpose to help prevent drivers from misusing the technology. This finding suggests that conveying the safety value of driver monitoring may be a key component for consumer education and acceptance (Abraham et al., 2018; Koppel et al., 2008; Trimble et al., 2020). Education around driver monitoring and other safeguards may promote adoption of in-vehicle technologies that help to prevent driver distraction and inattention more generally, outside the context of partial driving automation.

Individual differences also were observed in how appealing the features were. Respondents who found lane centering appealing tended to find other vehicle technologies also appealing, such as auto lane change and self-driving technology, which is consistent with previous research (e.g., Abraham et al., 2017). Those people were likewise more accepting of driver monitoring strategies and were more likely to say that they would feel safer with it. Interestingly, respondents who preferred hands-free lane centering were overwhelmingly the most accepting of all driver monitoring strategies, and they were also most willing to buy or lease a vehicle with either hands-on or hands-free versions of lane centering. The rest of the sample was far more willing to buy or lease their next vehicle with hands-on lane centering than a hands-free version. Although respondents were less enthusiastic to have their next vehicle equipped with

auto lane change, there was a general preference for it to be driver-initiated and require the driver to keep their hands on the wheel.

One of the aims of this study was to investigate the reasons behind preferences for hands-free or hands-on-wheel versions of driving automation. Compared with hands-on-wheel lane centering, respondents who wanted a hands-free version said it would make driving more comfortable and safer than other drivers. In an interesting display of cognitive dissonance, most of those respondents also said hands-free lane centering would make driving more stressful, boring, and tiring as well as increase distraction. Driver drowsiness and distraction are known crash risk factors (Dingus et al., 2016), and many other respondents shared these concerns too. When asked to choose between hands-free or hands-on-wheel versions of driver-initiated and vehicle-initiated auto lane change, the most common reasons for selecting either were to make driving more comfortable, less stressful, and safer—although more respondents identified "to make driving safer" as a reason for wanting a hands-on-wheel feature than a hands-free one. Evidently, more sophisticated functionality can lead some people to assume that these features have safety benefits, even though the survey never described them as such, and no data currently support those assumptions for partial driving automation in general (e.g., Goodall, 2021; HLDI, 2021a, 2021b). It is nevertheless curious that the vast majority of those respondents who preferred hands-free lane centering (as well as the rest of the sample) preferred hands-on-wheel versions of both types of auto lane change, which indicates some degree of understanding about the risk, driver responsibility, and maneuver complexity of the different functionalities.

Related to the common expectation that hands-free lane centering would increase driver distraction, most of the sample also acknowledged that it would make the driver more likely to do non-driving-related activities than hands-on-wheel lane centering. This attitude was particularly reflected among respondents who wanted hands-free lane centering. Furthermore, a subset of respondents who preferred hands-free auto lane change said they wanted that functionality to be hands-free because they wanted to do non-driving-related activities. These findings are relevant because, when these features were first described in the survey, respondents were informed that vehicles with these features are not

autonomous and require the driver to constantly supervise and intervene whenever necessary. This would suggest that informing consumers about the driver's responsibilities and the system's limitations does not necessarily prevent the intention of misuse, which raises concerns for consumer education efforts. That said, many of these respondents were also the most accepting of all types of driver monitoring when using any form of lane centering, which suggests that they may be also more willing to use systems that have safeguards built in, such as attention reminders and emergency escalation countermeasures (IIHS, 2022; Mueller et al., 2021). However, automakers must ensure that these safeguards are reliable and robust to inform and reinforce mental models about the driver's responsibilities and system limits (Cummings & Bauchwitz, 2021). Should systems not have adequate safeguards, there is the potential for hands-free driving to exacerbate the risk of driver disengagement, which has already been contributing to crashes involving the misuse of hands-on-wheel partial driving automation (e.g., National Transportation Safety Board, 2017, 2019, 2020).

Design philosophies that promote cooperative steering between the driver and the lane-centering support play an important role in keeping the driver engaged in the driving task. Information feedback between a driver's hands and gaze behavior helps to coordinate anticipatory steering control (Navarro et al., 2020). A shared control design philosophy is moreover beneficial for conveying the driver's autonomy in the driver-vehicle interaction (Wen et al., 2019). Designs that reinforce the driver's role and responsibilities in the interaction helps to prevent misperceptions around the use of the system as being "driver versus machine," and instead encourage the driver to work *with* the machine. More research is nevertheless needed to understand how hands-free driving capability affects a driver's mental model about the system limitations and their role and responsibilities when using it (Carsten & Martens, 2019).

4.1 Limitations

Unlike a lot of automaker advertising, the current survey emphasized the limitations of partial automation features and the driver's role when using them. The naming of these systems alone has been shown to mislead consumers about system capability (Teoh, 2020). It is possible that the skepticism exhibited by some of the sample could have been informed by the pragmatic descriptions used to introduce the features of interest.

This study captured the conceptual appeal of the technology, but it cannot predict purchasing behavior or actual use of these features. The intention to use a technology does not guarantee actual use (Turner et al., 2010), and the appeal of a technology can change once the individual has had experience using it (Kidd & Reagan, 2018). Moreover, owning or having regular access to vehicles equipped with partial driving automation can change driving habits and technology use (Hardman, 2021). While surveys such as this are useful for investigating the driving public's attitudes, expectations, and intentions concerning the latest advanced vehicle technologies, purchasing behavior itself is necessary to capture the uptake rate, and post-purchase/use research remains key to understanding consumer usage patterns (Melnicuk et al., 2019).

5 Conclusions

Prior to this study, little was known about the public's appetite for commercially available partial driving automation in the United States, especially with hands-free driving and automated-lane-changing capability. Results indicate that while some consumers find hands-free driving appealing, most prefer driver support features that require the drivers to keep their hands on the wheel. Although people are generally comfortable with driver monitoring, their acceptance level seems to be related to their belief that it improves safety by ensuring proper system use. There is an indication that consumers who prefer hands-free lane centering may be more likely to do non-driving-related activities when using it, yet those people are also the most comfortable with all types of driver monitoring strategies and their purpose.

Overall, drivers appear to understand the differences between lane centering and auto lane change, and the latter is less appealing especially in the form of vehicle-initiated auto lane change.

6 Practical applications

While the intention to misuse a technology does not necessarily mean it will occur, behavioral observation research indicates that driver disengagement can increase over time while using partial driving automation (Banks et al., 2018; Dunn et al., 2021; Kim et al., 2022; Reagan et al., 2021). The results from this study suggest that informing consumers about the limitations of partial driving automation does not necessarily deter the intention to misuse it. Design safeguards with responsible application of automated functionality are necessary to impose functional 'guardrails' that minimize opportunity for misuse. One of the mechanisms supporting these safeguards is driver monitoring. This study's data show that the public's acceptance of it appears to be connected to the understanding of its purpose in helping drivers use the technology properly. Notably, this acceptance does not appear to differ between the context of using hands-free or hands-on-wheel partial automation. Therefore, in conjunction with design safeguards, consumer information should convey the purpose of driver monitoring to promote its acceptance and adoption.

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8 References

Abraham, H., Lee, C., Brady, S., Fitzgerald, C., Mehler, B., Reimer, B., & Coughlin, J. F. (2017). Autonomous vehicles and alternatives to driving: Trust, preferences, and effects of age. Proceedings of the Transportation Research Board 96th Annual Meeting (TRB'17).

Abraham, H., Reimer, B., & Mehler, B. (2018). Learning to use in-vehicle technologies: Consumer preferences and effects on understanding. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting, 62*(1), 1589–1593. https://doi.org/10.1177/1541931218621359

American Automobile Association, Inc. (2020). *Evaluation of active driving assistance systems*. https://newsroom.aaa.com/asset/report-fact-sheet-evaluating-active-driver-assistance-systems/

American Automobile Association, Inc. (2022). *Effectiveness of driver monitoring systems*. https://newsroom.aaa.com/asset/technical-report-effectiveness-of-driver-monitoring-systems

Banks, V. A., Eriksson, A., O'Donoghue, J., & Stanton, N. A. (2018). Is partially automated driving a bad idea? Observations from an on-road study. *Applied Ergonomics, 68,* 138–145. https://doi.org/10.1016/j.apergo.2017.11.010

Banks, V. A., & Stanton, N. A. (2016). Keep the driver in control: Automating automobiles of the future. *Applied Ergonomics, 53*(Part B)*,* 389–395. https://doi.org/10.1016/j.apergo.2015.06.020

Biondi, F., Lohani, M., Hopman, R., Mills, S., Cooper, D., & Strayer, D. (2018). 80 mph and out-of-the-loop: Effects of real-world semi-automated driving on driver workload and arousal. *Proceedings of the Human Factors and Ergonomics Society 2018 Annual Meeting*, *62,* 1878–1882. https://doi.org/10.1177/1541931218621427

Carsten, O., & Martens, M. (2019). How can humans understand their automated cars? HMI principles, problems and solutions. *Cognition, Technology & Work, 21*, 3–20. https://doi.org/10.1007/s10111-018-0484-0

Cicchino, J. B. (2017). Effectiveness of forward collision warning and autonomous emergency braking systems in reducing front-to-rear crash rates. *Accident Analysis & Prevention, 99*(Part A), 142–152. https://doi.org/10.1016/j.aap.2016.11.009

Cummings, M. L., & Bauchwitz, B. (2021). Safety implications of variability in autonomous driving assist alerting. *IEEE Transactions on Intelligent Transportation Systems*, 1–11. https://doi.org/10.1109/TITS.2021.3109555

Daziano, R. A., Sarrias, M., & Leard, B. (2017). Are consumers willing to pay to let cars drive for them? Analyzing response to autonomous vehicles. *Transportation Research Part C: Emerging Technologies, 78,* 150–164. https://doi.org/10.1016/j.trc.2017.03.003

Dingus, T. A., Guo, F., Lee, S., Antin, J. F., Perez, M., Buchanan-King, M., & Hankey, J. (2016). Driver crash risk factors and prevalence evaluation using naturalistic driving data. *Proceedings of the National Academy of Sciences, 113*(10), 2636–2641. https://doi.org/10.1073/pnas.1513271113

Dunn, N., Dingus, T., Soccolich, S., & Horrey, W. (2021). Investigating the impact of driving automation systems on distracted driving behaviors. *Accident Analysis & Prevention, 156*, 106152. https://doi.org/10.1016/j.aap.2021.106152

El Khatib, A., Ou, C., & Karray, F. (2020). Driver inattention detection in the context of next-generation autonomous vehicles design: A survey. *IEEE Transactions on Intelligent Transportation Systems, 21*(11), 4483–4496. https://doi.org/10.1109/TITS.2019.2940874

Gaspar, J., & Carney, C. (2019). The effect of partial automation on driver attention: A naturalistic driving study. *Human Factors, 61*(8), 1261–1276. https://doi.org/10.1177/0018720819836310

Ghazizadeh, M., & Lee, J. (2018). Modelling driver acceptance: From feedback to monitoring and mentoring systems. In M. A. Regan, T. Horberry, & A. Stevens (Eds.), *Driver acceptance of new technology: Theory, measurement and optimisation* (pp. 51–70). CRC Press.

Goodall, N. J. (2021 ,October 21). A methodology for normalizing safety statistics of partially automated vehicles. Virginia Transportation Research Council, University of Virginia. https://doi.org/10.31224/osf.io/m8j6g

Halin, A., Verly, J., & Van Droogenbroeck, M. (2021). Survey and synthesis of state of the art in driver monitoring. *Sensors, 21*(16), 5558. https://doi.org/10.3390/s21165558

Hardman, S. (2021). Investigating the decision to travel more in a partially automated electric vehicle. *Transportation Research Part D, 96*, 102884. https://doi.org/10.1016/j.trd.2021.102884

Highway Loss Data Institute. (2021a). Advanced driver assistance systems on the 2017–19 Nissan Rogue. *HLDI Bulletin*, *38*(1), 1–16.

Highway Loss Data Institute. (2021b). 2013–17 BMW collision avoidance features—A 2021 update. *HLDI Bulletin*, *38*(26), 1–30.

Horrey, W., Lesch, M., Dainoff, M., Robertson, M., & Noy, I. (2012). On-board safety monitoring systems for driving: Review, knowledge gaps, and framework. *Journal of Safety Research, 43*(1), 49–58. https://doi.org/10.1016/j.jsr.2011.11.004

Insurance Institute for Highway Safety. (2018). IIHS examines driver assistance features in road, track tests. *Status Report, 53*(4), 3–6. https://www.iihs.org/news/detail/iihs-examines-driver-assistance-features-in-road-track-tests

Insurance Institute for Highway Safety. (2022). *IIHS creates safeguard ratings for partial automation*. https://www.iihs.org/news/detail/iihs-creates-safeguard-ratings-for-partial-automation

Kidd, D., & Reagan, I. (2018). System attributes that influence reported improvement in drivers' experiences with adaptive cruise control and active lane keeping after daily use in five production vehicles. *International Journal of Human-Computer Interaction, 35,* 972–979. https://doi.org/10.1080/10447318.2018.1561786

Kim, H., Song, M., & Doerzaph, Z. (2022). Is driving automation used as intended? Real-world use of partially automated driving systems and their safety consequences. *Transportation Research Record*, *2676*(1), 30–37. https://doi.org/10.1177/03611981211027150

Koppel, S., Charlton, J., Fildes, B., & Fitzharris, M. (2008). How important is vehicle safety in the new vehicle purchase process? *Accident Analysis & Prevention, 40*(3), 994–1004. https://doi.org/10.1016/j.aap.2007.11.006

Lee, C., Gershon, P., Reimer, B., Mehler, B., & Coughlin, J. F. (2021). Consumer knowledge and acceptance of driving automation: Changes over time and across age groups. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting, 65*(1)*,* 1395–1399.https://doi.org/10.1177/1071181321651116

Melnicuk, V., Birrell, S., Thompson, S., Mouzakitis, A., & Jennings, P. (2019). How acceptable is it to monitor driver state? Using the UTAUT model to analyse drivers' perceptions towards the system. In N. Stanton (Ed.), *Advances in Human Aspects of Transportation: Proceedings of the AHFE 2018 International Conference on Applied Human Factors and Ergonomics* (pp. 579–590). Springer International Publishing.

Mueller, A. S., Reagan, I. J., & Cicchino, J. B. (2021). Addressing driver disengagement and proper system use: Human factors recommendations for Level 2 driving automation design. *Journal of Cognitive Engineering and Decision Making, 15*, 3–27. https://doi.org/10.1177/1555343420983126

National Transportation Safety Board. (2017). C*ollision between a car operating with automated vehicle control systems and a tractor- semitrailer truck near Williston, Florida, May 7, 2016* (Highway Accident Report NTSB/HAR-17/02).

National Transportation Safety Board. (2019). *Collision between car operating with partial driving automation and truck- tractor semitrailer: Delray Beach, Florida, March 1, 2019* (Highway Accident Brief NTSB/HAB-20/01).

National Transportation Safety Board. (2020). *Collision between a sport utility vehicle operating with partial driving automation and a crash attenuator: Mountain View, California, March 23, 2018* (Report No. Highway Accident Report NTSB/HAR-20/01).

Navarro, J., Hernout, E., Osiurak, F., & Reynaud, E. (2020). On the nature of eye-hand coordination in natural steering behavior. *PLoS one, 15*(11), e0242818. https://doi.org/10.1371/journal.pone.0242818

Preston, B. (2021). Call for driver monitoring systems to improve safety. *Consumer Reports*. https://www.consumerreports.org/car-safety/callfor-driver-monitoring-to-improve-car-safety-a3949626347/

Reagan, I., Teoh, E., Cicchino, J., Gershon, P., Reimer, B., Mehler, B., & Seppelt, B. (2021). Disengagement from driving when using automation during a 4-week field trial. *Transportation Research Part F, 82*, 400–411. https://doi.org/10.1016/j.trf.2021.09.010

SAE International. (2021). *Taxonomy and definitions for terms related to driving automation systems for on-road motor vehicles* (SAE Standard J3016, Report No. J3016_202104). https://doi.org/10.4271/J3016_202104

Teoh, E. R. (2020). What's in a name? Drivers' perceptions of the use of five SAE Level 2 driving automation systems. *Journal of Safety Research, 72,* 145–151. https://doi.org/10.1016/j.jsr.2019.11.005

Trimble, T. E., Baker, S., Russell, S., & Tidwell, S. (2020). *Consumer driving automation system education: A learning and retention assessment* (Report No. 20-UO-089). Virginia Tech Transportation Institute, National Surface Transportation Safety Center for Excellence.

Turner, M., Kitchenham, B., Brereton, P., Charters, S., & Budgen, D. (2010). Does the technology acceptance model predict actual use? A systematic literature review. *Information and Software Technology, 52*(5), 463–479. https://doi.org/10.1016/j.infsof.2009.11.005

United States Census Bureau. (2020). *National demographic analysis tables: 2020.* https://www.census.gov/data/tables/2020/demo/popest/2020-demographic-analysis-tables.html

Wang, Z., Zheng, R., Kaizuka, T., & Nakano, K. (2019). Relationship between gaze behavior and steering performance for driver–automation shared control: A driving simulator study. *IEEE Transactions on Intelligent Vehicles*, *4*(1), 154–166. https://doi.org/10.1109/TIV.2018.2886654

Wen, W., Kuroki, Y., & Asama, H. (2019). The sense of agency in driving automation. *Frontiers in Psychology*, 2691. https://doi.org/10.3389/fpsyg.2019.02691

9. Appendix A: Survey instrument

[Please note: Survey skip/end logic instructions are bolded and in square brackets beside the relevant responses.]

There are different types of driver assistance technologies on the market today. Some of them can help you to see other vehicles or pedestrians around you, some help you avoid a crash, and some help you drive the vehicle. This survey is about technologies that help you drive the vehicle.

1. How old are you?
    - _____
        i. [If 21 years or older, proceed]
        ii. [If younger than 21 years, **STOP**]

2. What is your gender?
    - Male
    - Female
    - Other

3. In a typical week, how often do you drive a car, SUV, pickup truck, or van?
    - 7 days a week
    - 6 days a week
    - 5 days a week
    - 4 days a week
    - 3 days a week
    - 2 days a week
    - 1 day a week
    - Less than once a week [**STOP**]
    - I do not drive [**STOP**]

4. In a typical week, how often do you drive on highways, expressways, freeways, interstates, or other high-speed roads with few or no traffic lights?
    - 7 days a week
    - 6 days a week
    - 5 days a week
    - 4 days a week
    - 3 days a week
    - 2 days a week
    - 1 day a week
    - Less than once a week [**STOP**]

5. Please indicate the degree to which you agree with the following statement: I find driving enjoyable.
    - Strongly agree
    - Somewhat agree
    - Neither agree nor disagree
    - Somewhat disagree
    - Strongly disagree

You may have already heard about some vehicle technologies that you can buy today such as adaptive cruise control. Adaptive cruise control is similar to conventional cruise control, except that it can automatically adjust its speed to maintain a set distance from a vehicle in front. This technology is normally used in highway conditions.

6. Do you understand these definitions?
    - Yes
    - No
    - Not sure

Another technology that is growing in popularity is lane centering. It has various names, depending on the automaker, including "autosteering" or "lane-keeping assistance." This feature detects lane lines and continuously steers the vehicle to keep it within the center of the lane. This technology is typically used in highway conditions.

Lane centering is different from lane departure prevention.

Lane departure prevention temporarily intervenes when your vehicle drifts over the lane line or out of the lane. Sometimes it gives you an alert (a visual icon in the instrument panel, an audible beep, or a vibration through the steering wheel) as it automatically steers the vehicle back into its lane. In contrast to lane departure prevention, **lane centering** continuously steers the vehicle to keep it constantly in the center of the lane, not just when it is at risk of departing the lane.

In other words, **lane centering** provides continuous steering assistance, whereas lane departure prevention offers only temporary assistance.

7. Do you understand these definitions?
    - Yes
    - No
    - Not sure

In some vehicles, adaptive cruise control and lane centering can be activated together. This means that the vehicle can continuously help you maintain a set speed and distance to the vehicle in front of you and help you steer for long periods at the same time.

8. Do you understand these definitions?
    - Yes
    - No
    - Not sure
9. Have you ever used adaptive cruise control before?
    - Yes
        i. Yes, my personal vehicle has this feature
        ii. Yes, but only in a vehicle that was not my own
    - No
    - Not sure
10. Have you ever used lane centering before?
    - Yes
        i. Yes, my personal vehicle has this feature
        ii. Yes, but only in a vehicle that was not my own
    - No
    - Not sure

Some lane-centering systems are designed to automatically steer the vehicle within its lane without needing the driver to have his or her hands on the wheel. This is known as **hands-free** lane-centering assistance. Other lane-centering systems require the driver still have a hand on the wheel even when the vehicle is steering itself. This is known as **hands-on-wheel** lane-centering assistance.

Both hands-free and hands-on-wheel lane-centering assistance are normally activated with adaptive cruise control at the same time. Even though these hands-free and hands-on-wheel systems can continuously steer the vehicle, the vehicle is not self-driving. The driver is expected to watch the road in case the vehicle encounters conditions it cannot handle. When that happens, the driver has to resume steering immediately.

11. Do you understand these definitions?
    - Yes
    - No
    - Not sure

12. Would you want to use either type of lane-centering assistance?
    - Yes, but I prefer hands-free steering assistance
    - Yes, but I prefer hands-on-wheel steering assistance
    - Yes, and I have no preference between the two types
    - No, I would not use either feature
    - Not sure

Compared with using a lane-centering assistance feature that requires you to have your hands on the wheel, do you think taking your hands off the wheel while using a hands-free version would:

13. Make driving more or less stressful?
    - Much more
    - Somewhat more
    - Same as hands-on-wheel steering assistance
    - Somewhat less
    - Much less

14. Make you more or less comfortable?
    - Much more
    - Somewhat more
    - Same as hands-on-wheel steering assistance
    - Somewhat less
    - Much less

15. Make you more or less tired?
    - Much more
    - Somewhat more
    - Same as hands-on-wheel steering assistance
    - Somewhat less
    - Much less

16. Make driving more or less safe?
    - Much more
    - Somewhat more
    - Same as hands-on-wheel steering assistance
    - Somewhat less
    - Much less

17. Make driving more or less boring?
    - Much more
    - Somewhat more
    - Same as hands-on-wheel steering assistance
    - Somewhat less
    - Much less

18. Make you more or less distracted?
    - Much more
    - Somewhat more
    - Same as hands-on-wheel steering assistance
    - Somewhat less
    - Much less

19. Make you more or less likely to do non-driving-related activities, such as eat, drink, text, groom, converse with a passenger, etc.?
    - Much more
    - Somewhat more
    - Same as hands-on-wheel steering assistance
    - Somewhat less
    - Much less

Most vehicles that offer lane-centering assistance also monitor the driver to make sure the feature is being used as designed. Some vehicles monitor what the driver's hands are doing and others monitor where the driver is looking. A system can use this information to decide whether you are paying attention or getting sleepy. The system will give you warning alerts if it detects that you are no longer are paying attention or are getting sleepy.

20. Do you understand these definitions?
    - Yes
    - No
    - Not sure

21. In the case of **hands-on-wheel** lane-centering assistance, how comfortable would you be if your vehicle monitored you through sensors in the steering wheel to make sure your hands were on the wheel?
    - Extremely comfortable
    - Somewhat comfortable
    - Neither comfortable nor uncomfortable
    - Somewhat uncomfortable
    - Extremely uncomfortable

22. In the case of **hands-on-wheel** lane-centering assistance, how comfortable would you be if the vehicle monitored you through a camera to capture what your hands were doing?
    - Extremely comfortable
    - Somewhat comfortable
    - Neither comfortable nor uncomfortable
    - Somewhat uncomfortable
    - Extremely uncomfortable

23. In the case of **hands-on-wheel** lane-centering assistance, how comfortable would you be if the vehicle monitored your face through a camera to make sure you were looking at the road?
    - Extremely comfortable
    - Somewhat comfortable
    - Neither comfortable nor uncomfortable
    - Somewhat uncomfortable
    - Extremely uncomfortable

24. In the case of **hands-free** lane-centering assistance, how comfortable would you be if the vehicle monitored you through a camera to capture what your hands were doing?
    - Extremely comfortable
    - Somewhat comfortable
    - Neither comfortable nor uncomfortable
    - Somewhat uncomfortable
    - Extremely uncomfortable

25. In the case of **hands-free** lane-centering assistance, how comfortable would you be if the vehicle monitored your face through a camera to make sure you were looking at the road?
    - Extremely comfortable
    - Somewhat comfortable
    - Neither comfortable nor uncomfortable
    - Somewhat uncomfortable
    - Extremely uncomfortable

26. Would you feel safer knowing that the vehicle is monitoring you to make sure you are using the feature as it was designed to be used?
    - Much safer
    - Somewhat safer
    - Neither more nor less safe
    - Somewhat less safe
    - Much less safe

So far, we have been talking about driving with steering assistance within a single lane on a highway, but there are times when a driver has to change lanes to keep traveling at or near the desired speed.

27. Do you find changing lanes on highways stressful?
    - Extremely
    - Moderately
    - Somewhat
    - Slightly
    - Not at all

28. Are you confident in your ability to change lanes on the highway?
    - Extremely
    - Moderately
    - Somewhat
    - Slightly
    - Not at all

29. Would you like to have the vehicle warn you if there is another vehicle in your blind spot when you want to change lanes?
    - Yes
    - No
    - Not sure

Some vehicles offer a feature that can automatically make the lane change for you. This feature first requires you to activate the turn signal to let the vehicle know that you would like to make a lane change. Using sensors and cameras, the vehicle then checks the flow of traffic in the adjacent lane that you have indicated you want to merge into. The vehicle will wait to make the lane change until it finds an appropriate gap between vehicles and then it will automatically merge into it. This type of automated-lane-change assistance is called **driver-initiated** automated-lane-change assistance.

30. Do you understand these definitions?
    - Yes
    - No
    - Not sure

Some automated-lane-change assistance features can make the lane change without any input from the driver, meaning that you do not have to do anything (not even use the turn signal because the vehicle will do that on its own). As long as you are on the highway and the adaptive cruise control and lane-centering features are switched on, the vehicle can automatically make the necessary lane changes to keep your vehicle traveling at or near its set speed. This type of automated-lane-change assistance is called **vehicle-initiated** automated-lane-change assistance.

31. Do you understand these definitions?
    - Yes
    - No
    - Not sure

Both **driver-initiated** and **vehicle-initiated** automated-lane-change-assistance features still require the driver to supervise what the vehicle is doing and the surrounding traffic to make sure the maneuver is safe to perform, because these vehicles are not self-driving.

These features are not designed to change lanes to exit the highway, meaning that they are not designed to take exit ramps, and they cannot navigate through an interchange.

These features are also not designed to perform emergency avoidance maneuvers if there is an obstacle in your path, such as a stopped vehicle.

32. Do you understand these definitions?
    - Yes
    - No
    - Not sure

33. Have you ever used automated-lane-change assistance before?
    - Yes
        i. Yes, my personal vehicle has this feature
        ii. Yes, but only in a vehicle that was not my own
    - No
    - Not sure

34. Would you want to use either type of automated-lane-change assistance (i.e., driver-initiated or vehicle-initiated)?
    - Yes, but I would prefer for the vehicle to wait for me to tell it when to make the lane change (i.e., **driver-initiated**)
    - Yes, but I would prefer for the vehicle to make the lane changes on its own (i.e., **vehicle-initiated**)
    - Yes, and I have no preference between the two types
    - No, I would not use either feature
    - Not sure

35. Would you prefer a **driver-initiated** automated-lane-change-assistance feature (i.e., the version where you must first use the turn signal before the feature activates) to require that you have your hands on the wheel the whole time or would you prefer it to be hands-free?
    - Prefer it to require you to keep your hands on the wheel [**PROCEED TO Q.36**]
    - Prefer it to allow you to have your hands off the wheel [**SKIP TO Q.37**]
    - Not sure [**SKIP TO Q.38**]

36. **[ONLY ASK IF RESPONDENT ANSWERS "Prefer it to require you to keep your hands on the wheel" TO Q.35, AND THEN SKIP TO Q.38]** Why would you prefer a **driver-initiated** automated-lane-change-assistance feature that requires you to keep your hands on the wheel over one that allows you to take your hands off the wheel? Please check all that apply:
    - Would make driving less stressful
    - Would make me more comfortable
    - Would make me less tired
    - Would make driving safer
    - Would make driving less boring
    - Would make me less distracted
    - Would give me more opportunity for non-driving-related activities, such as eating, texting , conversing with a passenger, etc.
    - None of the above

37. **[ONLY ASK IF RESPONDENT ANSWERS "Prefer it to allow you to have your hands off the wheel" TO Q.35]** Why would you prefer a **driver-initiated** automated-lane-change-assistance feature that allows you to have your hands off the wheel over one that requires you to have your hands on the wheel? Please check all that apply:
    - Would make driving less stressful
    - Would make me more comfortable
    - Would make me less tired
    - Would make driving safer
    - Would make driving less boring
    - Would make me less distracted
    - Would give me more opportunity for non-driving-related activities, such as eating, drinking, texting, grooming, conversing with a passenger, etc.
    - None of the above

38. Would you prefer a **vehicle-initiated** automated-lane-change-assistance feature (i.e., the version where it does not require you to use the turn signal at all as it will automatically perform the lane changes on its own) to require that you have your hands on the wheel the whole time or would you prefer it to be hands-free?
    - Prefer it to require you to keep your hands on the wheel [**PROCEED TO Q.39**]
    - Prefer it to allow you to have your hands off the wheel [**SKIP TO Q.40**]
    - Not sure [**SKIP TO Q.41**]

39. **[ONLY ASK IF RESPONDENT ANSWERS "Prefer it to require you to keep your hands on the wheel" TO Q.38, AND THEN SKIP TO Q.41]** Why would you prefer a **vehicle-initiated** automated-lane-change-assistance feature that requires you to keep your hands on the wheel over one that allows you to take your hands off the wheel? Please check all that apply:
    - Would make driving less stressful
    - Would make me more comfortable
    - Would make me less tired
    - Would make driving safer
    - Would make driving less boring
    - Would make me less distracted

- Would give me more opportunity for non-driving-related activities, such as eating, drinking, texting, grooming, conversing with a passenger, etc.
- None of the above

40. **[ONLY ASK IF RESPONDENT ANSWERS "Prefer it to allow you to have your hands off the wheel" TO Q.38]** Why would you prefer a **vehicle-initiated** automated-lane-change-assistance feature that allows you to have your hands off the wheel over one that requires you to have your hands on the wheel? Please check all that apply:
    - Would make driving less stressful
    - Would make me more comfortable
    - Would make me less tired
    - Would make driving safer
    - Would make driving less boring
    - Would make me less distracted
    - Would give me more opportunity for non-driving-related activities, such as eating, texting, conversing with a passenger, etc.
    - None of the above

41. If cost were not a problem, how likely would you be to buy or lease your next vehicle with any of the following features?

	Extremely	Moderately	Somewhat	Slightly	Not at all
Lane-centering assistance that allows you to take your hands off the wheel (**hands-free**)	○	○	○	○	○
Lane-centering assistance that requires you to keep your hands on the wheel (**hands-on-wheel**)	○	○	○	○	○
Driver-initiated automated-lane-change assistance that allows you to take your hands off the wheel (**hands-free**)	○	○	○	○	○
Driver-initiated automated-lane-change assistance that requires you to keep your hands on the wheel (**hands-on-wheel**)	○	○	○	○	○
Vehicle-initiated automated-lane-change assistance that allows you to take your hands off the wheel (**hands-free**)	○	○	○	○	○
Vehicle-initiated automated-lane-change assistance that requires you to keep your hands on the wheel (**hands-on-wheel**)	○	○	○	○	○

42. What is the make (i.e., what is the name of the automaker) of the vehicle that you have driven most in the last 12 months?

01	Acura
02	Alfa Romeo
03	AM General
04	AMC/Eagle
05	Aston Martin
06	Audi
07	Avanti
08	Bentley
09	Blue Bird
10	BMW
11	Bugatti
12	Buick
13	Cadillac
14	Capri/Merkur
15	Chevrolet/Geo
16	Chevrolet/Geo Truck
17	Chry/Plym Imports
18	Chry/Plym Truck
19	Chrysler
20	CODA
21	Daewoo
22	Daihatsu
23	Datsun/Nissan
24	Delorean
25	Dodge
26	Dodge Imports
27	Dodge Truck
28	Ferrari
29	Fiat
30	Fisker/Karma Automotive
31	Ford
32	Ford Truck
33	GEM
34	Genesis
35	GMC Truck
36	GMCA/Passport/Asuna
37	Honda
38	Hyundai
39	Infiniti
40	International
41	Jaguar
42	Jeep
43	Kia
44	Laforza
45	Lamborghini
46	Lancia
47	Land Rover
48	Lexus
49	Lincoln

50 Lotus
51 Maserati
52 Maybach
53 Mazda
54 McLaren
55 Mercedes-Benz
56 Mercury
57 MG
58 Mini
59 Mitsubishi
60 Oldsmobile
61 Opel/Isuzu
62 Panther
63 Peugeot
64 Plymouth
65 Polestar
66 Pontiac
67 Porsche
68 RAM
69 Renault/Eagle
70 Rivian
71 Rolls Royce
72 Saab
73 Saturn
74 Scion
75 Smart
76 Sterling
77 Subaru
78 Suzuki
79 Tesla
80 THINK
81 Toyota
82 Triumph
83 TVR
84 Volkswagen
85 Volvo
86 VPG/Mobility Ventures
87 Wheego
88 Yugo
89 Nissan
97 Other (Please Specify)
98 Don't know

43. What is the model name of that vehicle?

_____
Don’t know

44. What is the model year of that vehicle?

_____
Don’t know

45. How appealing would it be for you to own or regularly use a self-driving vehicle in the future? Self-driving means that the vehicle itself would control all the safety-critical functions, even allowing the vehicle to travel without a passenger if required. In other words, the vehicle would be able to drive itself anytime, anywhere, and under any conditions. You would be able to get into the vehicle, instruct it where you would like to travel to, and the vehicle would then carry out your desired route with no further intervention required from you. There might not even be a steering wheel or speed controls in the vehicle.
    - Extremely appealing
    - Moderately appealing
    - Somewhat appealing
    - Slightly appealing
    - Not at all appealing

46. What is the highest level of education that you have completed?
    - High school diploma or less
    - Some college education, associate degree, or trade school
    - Bachelor's degree
    - Some graduate education
    - Graduate or professional degree

47. What is your household gross annual income in U.S. dollars?
    - Less than $50,000
    - $50,000 to $74,999
    - $75,000 to $99,999
    - $100,000 to $149,999
    - $150,000 to $199,999
    - $200,000 or more

48. Please provide any comments or feedback you may have about the survey or about any of the vehicle technologies that were discussed.
    - _____
    - I have no additional feedback

10. Appendix B: Supplemental analyses

Table B1

Percent of respondents by lane-centering preference group for various outcomes that would be expected to occur when using hands-free compared with hands-on-wheel lane centering

Compared with hands-on-wheel lane centering, hands-free lane centering would:		Would you want to use either type of lane-centering assistance?					
		Yes, but I prefer hands-free	Yes, but I prefer hands-on-wheel	Yes, and I have no preference between the two types	No, I would not use either feature	Unsure	Total
		(*n* = 268)	(*n* = 364)	(*n* = 177)	(*n* = 158)	(*n* = 43)	(*n* = 1,010)
Make driving more or less stressful	Much more	50	27	10	37	23	32
	Somewhat more	22	38	26	32	26	30
	Same as hands-on-wheel	7	18	36	20	40	20
	Somewhat less	10	14	20	9	9	13
	Much less	10	3	7	1	2	5
Make you more or less comfortable	Much more	45	13	14	13	2	21
	Somewhat more	34	33	27	11	35	29
	Same as hands-on-wheel	11	19	34	16	28	20
	Somewhat less	6	25	21	26	19	19
	Much less	4	9	3	33	16	11
Make you more or less tired	Much more	32	12	6	13	14	17
	Somewhat more	25	26	19	25	21	24
	Same as hands-on-wheel	19	36	41	46	42	34
	Somewhat less	13	19	24	11	16	17
	Much less	11	7	10	4	7	8

Compared with hands-on-wheel lane centering, hands-free lane centering would:		Would you want to use either type of lane-centering assistance?					
		Yes, but I prefer hands-free	Yes, but I prefer hands-on-wheel	Yes, and I have no preference between the two types	No, I would not use either feature	Unsure	Total
		(*n* = 268)	(*n* = 364)	(*n* = 177)	(*n* = 158)	(*n* = 43)	(*n* = 1,010)
Make driving more or less safe	Much more	43	16	13	5	7	21
	Somewhat more	31	30	30	12	12	27
	Same as hands-on-wheel	15	24	33	27	47	25
	Somewhat less	8	23	23	28	28	20
	Much less	3	8	2	27	7	8
Make driving more of less boring	Much more	33	14	8	18	14	19
	Somewhat more	27	31	25	22	21	27
	Same as hands-on-wheel	15	30	39	40	49	30
	Somewhat less	12	20	19	13	9	16
	Much less	13	5	8	7	7	8
Make you more or less distracted	Much more	33	20	8	34	21	24
	Somewhat more	28	39	36	23	28	33
	Same as hands-on-wheel	17	22	27	32	40	24
	Somewhat less	10	15	22	7	9	13
	Much less	11	5	7	4	2	7
Make you more or less likely to do non-driving-related activities	Much more	46	23	18	23	16	28
	Somewhat more	32	34	37	25	33	33
	Same as hands-on-wheel	14	28	33	34	37	26
	Somewhat less	4	9	7	6	7	7
	Much less	4	6	5	12	7	6

Note. Percentages may not sum to 100 due to rounding.

Table B2

Percent of respondents likely or unlikely to buy or lease a vehicle with hands-free or hands-on-wheel lane centering per lane-centering preference group

If cost were not a problem, how likely would you be to buy or lease your next vehicle with:		Would you want to use either type of lane-centering assistance?					
		Yes, but I prefer hands-free	Yes, but I prefer hands-on-wheel	Yes, and I have no preference between the two types	No, I would not use either feature	Unsure	Total
		(*n* = 268)	(*n* = 364)	(*n* = 177)	(*n* = 158)	(*n* = 43)	(*n* = 1,010)
Hands-free lane centering	Extremely	61	19	21	6	9	28
	Moderately	24	23	27	8	19	21
	Somewhat	12	21	33	13	28	20
	Slightly	3	18	10	9	16	11
	Not at all	< 1	19	10	65	28	20
Hands-on-wheel lane centering	Extremely	49	34	34	6	7	32
	Moderately	32	34	33	15	33	31
	Somewhat	16	19	24	14	33	19
	Slightly	3	9	5	18	14	8
	Not at all	< 1	4	3	47	14	10

Note. Percentages may not sum to 100 due to rounding.

Table B3

Percent of respondents per lane-centering preference group reporting to be comfortable or uncomfortable with driver monitoring strategies for hands-free and hands-on-wheel lane centering.

		Would you want to use either type of lane-centering assistance?					
		Yes, but I prefer hands-free	Yes, but I prefer hands-on-wheel	Yes, and I have no preference between the two types	No, I would not use either feature	Unsure	Total
		(*n* = 268)	(*n* = 364)	(*n* = 177)	(*n* = 158)	(*n* = 43)	(*n* = 1,010)
In the case of **hands-on-wheel** lane-centering assistance, how comfortable would you be if the vehicle monitored you through:							
Sensors in the steering wheel to make sure your hands were on the wheel	Extremely comfortable	69	35	38	11	12	40
	Somewhat comfortable	24	40	37	14	28	30
	Neither comfortable nor uncomfortable	4	13	18	26	40	15
	Somewhat uncomfortable	2	9	6	23	16	9
	Extremely uncomfortable	1	2	2	25	5	6
A camera to capture what your hands were doing	Extremely comfortable	56	26	29	8	7	31
	Somewhat comfortable	29	37	29	8	26	28
	Neither comfortable nor uncomfortable	9	14	16	22	37	15
	Somewhat uncomfortable	4	17	19	27	16	15
	Extremely uncomfortable	2	7	7	34	14	10
A camera to make sure you were looking at the road	Extremely comfortable	59	27	25	11	5	32
	Somewhat comfortable	24	32	26	8	28	25
	Neither comfortable nor uncomfortable	9	15	17	18	37	15
	Somewhat uncomfortable	4	14	23	25	16	15
	Extremely uncomfortable	3	11	9	38	14	13

		Would you want to use either type of lane-centering assistance?					
		Yes, but I prefer hands-free	Yes, but I prefer hands-on-wheel	Yes, and I have no preference between the two types	No, I would not use either feature	Unsure	Total
		(*n* = 268)	(*n* = 364)	(*n* = 177)	(*n* = 158)	(*n* = 43)	(*n* = 1,010)
In the case of **hands-free** lane-centering assistance, how comfortable would you be if the vehicle monitored you through:							
A camera to capture what your hands were doing	Extremely comfortable	54	25	28	8	5	30
	Somewhat comfortable	28	34	29	10	30	28
	Neither comfortable nor uncomfortable	10	16	16	21	30	16
	Somewhat uncomfortable	4	15	18	24	26	14
	Extremely uncomfortable	3	10	9	37	9	12
A camera to make sure you were looking at the road	Extremely comfortable	57	26	28	11	12	31
	Somewhat comfortable	27	33	27	6	26	26
	Neither comfortable nor uncomfortable	8	12	15	21	33	14
	Somewhat uncomfortable	3	16	20	19	16	14
	Extremely uncomfortable	5	13	11	44	14	15

Note. Percentages may not sum to 100 due to rounding.

Table B4

Percent of respondents likely or unlikely to buy or lease a vehicle with hands-free or hands-on-wheel versions of driver-initiated and vehicle-initiated auto lane change per auto-lane-change preference group

If cost were not a problem, how likely would you be to buy or lease your next vehicle with:		Would you want to use either type of automated-lane-change assistance?					
		Yes, but I would prefer for the vehicle to wait for me to tell it when to make the lane change (i.e., driver-initiated)	Yes, but I would prefer for the vehicle to make the lane changes on its own (i.e., vehicle-initiated)	Yes, and I have no preference between the two types	No, I would not use either feature	Unsure	Total
		(*n* = 268)	(*n* = 364)	(*n* = 177)	(*n* = 158)	(*n* = 43)	(*n* = 1,010)
Hands-free driver-initiated auto lane change	Extremely	32	32	34	3	4	25
	Moderately	27	44	24	5	15	23
	Somewhat	19	20	27	12	30	19
	Slightly	10	4	13	19	22	12
	Not at all	11	< 1	3	60	28	20
Hands-free vehicle-initiated auto lane change	Extremely	30	29	30	4	2	23
	Moderately	25	43	28	3	13	22
	Somewhat	18	20	27	14	33	19
	Slightly	12	6	10	15	17	12
	Not at all	16	2	4	63	35	24
Hands-on-wheel driver-initiated auto lane change	Extremely	44	35	38	8	7	32
	Moderately	32	37	29	15	17	28
	Somewhat	20	23	28	18	41	22
	Slightly	3	6	3	18	20	8
	Not at all	< 1	< 1	2	40	15	11

If cost were not a problem, how likely would you be to buy or lease your next vehicle with:		Would you want to use either type of automated-lane-change assistance?					
		Yes, but I would prefer for the vehicle to wait for me to tell it when to make the lane change (i.e., driver-initiated)	Yes, but I would prefer for the vehicle to make the lane changes on its own (i.e., vehicle-initiated)	Yes, and I have no preference between the two types	No, I would not use either feature	Unsure	Total
		(*n* = 268)	(*n* = 364)	(*n* = 177)	(*n* = 158)	(*n* = 43)	(*n* = 1,010)
Hands-on-wheel vehicle-initiated auto lane change	Extremely	43	31	38	8	7	31
	Moderately	32	42	33	11	20	28
	Somewhat	16	18	24	17	39	19
	Slightly	6	8	4	18	17	9
	Not at all	3	< 1	1	45	17	13

Note. Percentages may not sum to 100 due to rounding.