Student Perceptions of Driverless Car Technology

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The subject of driverless cars is incredibly dynamic as evidenced by the great amount of emerging literature and news items about the topic. It touches disciplines such as technology, public policy, and auto-insurance. The purpose was to explore students' perceptions of driverless car technology. This research surveyed students using Qualtrics and was administered to both lower- and upper-level classes. Data was tabulated and broken down by attributes such as gender, age, and race. The survey results indicate the likelihood of someone buying a driverless car across these attributes. A list of both anticipated advantages and disadvantages were also tabulated.

Keywords: driverless, autonomous, car, user, perception, students

LITERATURE REVIEW

"Autonomous vehicles" drive tons of enthusiasm but also fuels skepticism. These solutions range from cars and trucks to trains and airplanes, but also have found their way into more serious and dangerous fields – military applications, weapons.

There are several aspects that need to be contemplated when considering "autonomous", "unmanned", and/or "driverless" solutions. They have at least technical, social, and human implications when it comes to introducing and using any of these solutions.

Technical Components

There were early predictions that by 2020 millions of self-driving cars would be in use. But engineering teams of major car makers were cautious saying that fully automated and independent cars are fairly hard to develop, and deadlines and predictions were pushed back by years (Piper, 2020). The technical field has several components that need to work seamlessly together. They include the "vehicles" (cars, trucks, trains, UAVs, UASs, airplanes, intelligent weapons etc.), control systems/software, infrastructure (including communication networks and standards), compatibility requirements etc. These solutions integrate cameras, sensors, radar technology, laser, and 3D mapping and GSP features. On the hardware side base technologies are supported by chip makers (Intel, 2017). Several carmakers have

invested into these technologies and predict that they will enter the general market with intelligent cars by 2022-2024. These include solutions similar to Drive Me from Volvo (Volvo, 2018), Autopilot from Tesla (Tesla, 2018), Cruise Automation from GM (Cruise Automation, 2108), Autonomous Driving from BMW (BMW, 2018), Traffic Jam Pilot from Audi (Audi, 2017), Drive Pilot from Mercedes (Mercedes, 2017), ford Smart Mobility (Ford, 2018) and others. The list is continuously expanding as research and developer teams add solutions and enrich features (Vincent, 2018).

Truck developers have slightly different goals and challenges. MAN works on automated driving systems (MAN, 2018), Daimler promotes an assistance and connectivity system (Daimler, 2018). Embark provides technology to navigate commercial vehicles on the roads (Embark, 2018).

Automated urban metro subway system has been tested with self-driving trains in London (Burgess, 2018), freight trains are traveling without humans on board in Australia (Thompson, 2017), Siemens developed an autonomous tram and demonstrated it in Potsdam (Germany) in traffic (Grossman, 2018). Boing is set to test self-flying airplanes and Airbus unveiled the PopUp project (run with Italdesign) that is based on a modular concept combining cars with wings and flights (Pop.Up, 2017).

Social Components

Social aspects and general technology applications are related to controls, regulations, legal issues, governance, insurance considerations, commercial applications etc. Several studies have been published reviewing different aspects of consumer acceptance of driverless cars (RBR Staff, 2019). Researches argue that such acceptance research "… must go beyond opinions and attitudes …" and shall also " … identify requirements, ideas, desires, hopes, fears and anxieties, and classify these in the context of a socio-technical system. " (Fraedrich & Lenz, 2016)

Government agencies are working with experts in the field (e.g. Society of Automotive Engineers) to provide common frameworks for technology evaluation and assure public that safety is the number one concern of regulations (NHTSA). Regulations are being developed regarding developing, testing and deploying vehicles with autonomous technology (CA-DMV, 2018). These technologies are changing state laws and regulations. Washington D. C. and 29 states have passed legislation on self-driving cars at different levels. Ten states have standing executive orders regulating different aspects of self-driving technology governance.

Driverless vehicles were and are under testing for different purposes: taxis, public transportation, freight transportation, personal flights etc. Research shows that there are different perceptions and even requirement sets evolving when it comes to public vs. closed application of driverless cars (e.g. using them for transportation at a university campus). But most concerns arose around privacy, reliability, and trust issues (Kaur & Rampersad, 2018).

Human Components

Autonomous vehicles have generated serious debates about how they operate, how far they will be used, how safe they are, and what roles they might play in solving transportation problems and challenges. There were several traffic incidents (even fatal) that highlighted the limited capabilities of driverless cars. They also showed that despite of human presence the technology creates safety concerns. Human behavior also contributes to the problem since people cannot immediately take over and drive the car, and for them it takes some time to take control of the vehicle and the traffic situation (handoff problem) (Burns & Shulgan, 2018).

Schwartz discussed several legal and ethical issues related to AI (artificial intelligence), AVs (autonomous vehicles), communities, car makers, social environments, and criminal justice inequities detailing some concerns and potential outcomes. His main point is that in close global collaboration people need to be prioritized and not cars/vehicles. (Schwartz, 2018) Wallach described factors that may contribute and impact how far are system behaviors predictable – especially when it comes to weapons (LAWS – lethal autonomous weapon systems). (Wallach, 2017) He introduces the idea of meaningful human control which needs to be implemented and maintained. Certainly, at this point there are no exact definitions what that actually would mean. Seidel et.al. (Seidel et.al., 2019) cover some theoretical and

learning aspects of design processes where autonomous tools are used in designing computer hardware parts, or generating virtual environments for games using artificial intelligence-based methods simulating human design practices.

But there is evidence that consumers spend more money on vehicles that are equipped with advanced driver assistance systems. They are named to automated driving features, collision prevention systems, autopilots, content add-ons etc. which indicates that automation was pushed back to lower levels (Korosec, 2020).

On the human side acceptance is probably the most important factor that might be impacted by knowledge, expectations, trust, experience, environment etc. Research shows that education and helping potential users to establish reasonable expectations towards driverless cars might be an important aspect of wider acceptance. (Nees, 2016)

METHODOLOGY

The purpose of the study was to survey student perceptions of driverless cars. A survey, created in Qualtrics, asked students whether they would be likely to buy a driverless car, either with or without a steering wheel. Other questions addressed the perceived reliability, advantages, and disadvantages of these vehicles.

The survey was administered in the College of Business to both lower- and higher-level students taking classes in 2017 and 2018. Classes included a 1000-level CIS computer class, upper-level CIS courses, and an introductory MIS course that is required of all business students. A total of 705 responses were obtained and after cleaning the data, 637 responses remained. Data was tabulated and broken down by attributes such as gender, age, and race.

RESULTS

Students were asked how much they had read or heard about driverless car technology. Results are summarized in Table 1. Only 41% of the students had heard a moderate amount or great deal about the technology.

TABLE 1
STUDENTS' KNOWLEDGE ABOUT DRIVELESS CARS

Options	Answers	Percent
Nothing	20	3%
Very little	127	20%
A little	233	37%
A moderate amount	189	30%
A great deal	68	11%
Grand Total	**637**	

Table 2 shows the results of Question 4 - *How likely the student was to consider purchasing a driverless car that has no steering wheel so no option to drive yourself*, broken down by gender. Only 10 percent overall indicated likely or very likely. Male students were much more likely to accept this version of a driverless car – 14 % vs 5%. A Chi square test of independence on the Response vs Gender revealed that the two factors were not independent (p-value = .001).

TABLE 2
LIKELIHOOD OF BUYING A DRIVERLESS CAR WITH NO STEARING WHEEL

Gender	Very unlikely	Unlikely	Neutral	Likely	Very likely	Total	% Likely or very likely
No answer	2	2				4	
Female	121	109	37	11	2	280	5%
Male	140	110	54	35	14	353	14%
Grand Total	**263**	**221**	**91**	**46**	**16**	**637**	10%

Table 3 shows the results of Question 5 - *How likely the student was to consider purchasing a driverless car that has steering wheel and option to drive yourself*, again broken down by gender. Overall a much higher percentage of 59% indicated likely or very likely. Male and female students were very close on likely and very likely responses, combined (58% vs 60%). A Chi square test of independence again showed significance (p-value = .004).

TABLE 3
LIKELIHOOD OF BUYING A DRIVERLESS CAR WITH STEARING WHEEL

Gender	Very unlikely	Unlikely	Neutral	Likely	Very likely	Total	% Likely or very likely
No answer		2		2		4	
Female	23	31	64	133	29	280	58%
Male	32	41	69	134	77	353	60%
Grand Total	**55**	**74**	**133**	**269**	**106**	**637**	59%

Table 4 shows the *likelihood of students considering buying a car without an option for driving yourself* broken down by age group. Interestingly, students over 40 scored higher than students in the 22-30 age group as one would expect younger people to embrace new technologies.

TABLE 4
LIKELIHOOD OF BUYING A DRIVERLESS CAR WITH NO STEARING WHEEL BY AGE

Age	Very unlikely	Unlikely	Neutral	Likely	Very likely	Total	% Likely or Very Likely
No answer	2	2				4	
18-21	71	50	32	12	1	166	8%
22-30	129	132	44	26	11	342	11%
31-40	38	28	14	4	2	86	7%
Over 40	23	9	1	4	2	39	15%
Grand Total	**263**	**221**	**91**	**46**	**16**	**637**	10%

Table 5 shows the *likelihood of students considering buying a car with an option for driving yourself* broken down by age group. There appeared to be a gradual increase in acceptance of the technology as age increased. This is opposite what the researchers were expecting.

TABLE 5
LIKELIHOOD OF BUYING A DRIVERLESS CAR WITH STEARING WHEEL BY AGE

Age	Very unlikely	Unlikely	Neutral	Likely	Very likely	Total	% Likely or Very Likely
No answer		2		2		4	
18-21	11	22	40	67	28	168	57%
22-30	30	37	73	143	57	340	59%
31-40	9	6	18	38	15	86	62%
Over 40	5	7	2	19	6	39	64%
Grand Total	**55**	**74**	**133**	**269**	**106**	**637**	59%

Table 6 shows the *likelihood of a student buying a car with an option to drive* broken down by race. American Indians and Native Hawaiians had the highest percentage of acceptance.

TABLE 6
LIKELIHOOD OF BUYING A DRIVERLESS CAR WITH STEARING WHEEL BY RACE

Race	Very unlikely	Unlikely	Neutral	Likely	Very likely	Total	% Likely or Very Likely
No answer	2	3	5	10	5	25	
American Indian or Alaska Native		1	4	8	6	19	74%
Asian	6	6	18	29	11	70	57%
Black or African American	11	5	12	19	9	56	50%
Native Hawaiian or other Pacific Islander			2	5	2	9	78%
White	36	59	92	198	73	458	59%
Grand Total	**55**	**74**	**133**	**269**	**106**	**637**	59%

Students were also asked *how reliable they thought the driverless technology is*. Results are summarized in Table 7. Twenty three percent indicated they thought the technology was unreliable or very unreliable, while thirty two percent thought it was reliable or very reliable.

TABLE 7
PERCIEVED RELIABILITY OF DRIVERLESS CARS

Reliability	Answer	Percent
Very unreliable	23	4%
Unreliable	121	19%
Neutral	294	46%
Reliable	169	27%
Very reliable	30	5%
Grand Total	**637**	

Table 8 shows *how soon students think driverless cars will be available to the public*. The most frequent response was 5-10 years, followed by 10-20 years.

TABLE 8
AVAILABILITY OF DRIVERLESS CARS

Availability	Answer	Percent
No answer	3	
Within 5 years	89	14%
5-10 years	276	44%
10-20 years	217	34%
More than 20 years	52	8%
Grand Total	**634**	

Students were also asked to check what they thought the key disadvantages and advantages of driverless car technology would be. Table 9 shows a summary of *what students thought would be disadvantages of driverless cars*, sorted in descending order.

TABLE 9
DISADVANTAGES OF DRIVERLESS CARS

Disadvantages of driverless cars		
Hackers	540	84%
Software bugs	496	77%
Security	487	76%
High cost	469	73%
Insurance headaches	396	62%
Data Privacy	337	53%
Enjoy Driving	303	47%
Cannot Speed	245	38%
Accidents more likely	196	31%

Table 10 shows a summary of *what students thought would be advantages of driverless cars*, sorted in descending order.

TABLE 10
ADVANTAGES OF DRIVERLESS CARS

Advantages of driverless cars		
Less traffic violations	454	71%
Don't need to worry about DUIs	393	61%
Less accidents	371	58%
Cheaper insurance	336	52%
Can use phone	329	51%
Better gas mileage	308	48%
Can work	302	47%
Can sleep	292	46%
Less pollution	290	45%
Can eat	290	45%
Can Read	241	38%
Can Smoke Pot	241	38%
Can Watch Video	194	30%
Can Play Games	150	23%
Can Put on Makeup	138	22%

CONCLUSIONS AND FUTURE RESEARCH

The subjects of this study, students at a university, provided a potentially interesting insight into the public's view of driverless car technology. The subjects attended an urban institution with ages ranging from 18 to over 40, with 15% in the latter category. One would expect an educated population to know more about this new technology and be more enthused about adopting it.

The results of the survey showed a large percentage of students had not read or heard a lot about driverless car technology, at least at the time the survey was administered. It also showed very low acceptance of completely giving up control and purchasing a car with no option to drive yourself, but a general acceptance of driverless technology if steering was an option. When opinions were broken down by age group, the results were somewhat surprising as the "over 40" age group was the most willing to embrace the new technology.

From a list of perceived disadvantages, driverless car makers will need to make a strong effort to educate the public regarding the benefits and reliability of the technology. As the technology becomes closer to being publicly available and is much more in the news, it will be interesting to repeat this survey to see the changes in attitudes and perceptions.

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