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Trust in driverless cars: Investigating key factors influencing the adoption of driverless cars

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ABSTRACT

Driverless cars are seen as one of the key disruptors in the next technology revolution. However, the main barrier to adoption is the lack of public trust. The purpose of this study is to investigate the key factors influencing the adoption of driverless cars. Drawing on quantitative evidence, the study found that the ability of the driverless car to meet performance expectations and its reliability were important adoption determinants. Significant concerns included privacy (autonomy, location tracking and surveillance) and security (from hackers). The paper provides implications for firms developing the next generation of car features and early implementation sites.

1. Introduction

The World Health Organization has indicated that 1.2 million people die in accidents each year (WHO, 2015). Driverless cars have been deemed an important technology in reducing a portion of those deaths due to human error (Kyriakidis et al., 2015). A driverless car, otherwise termed a self-driving car or an autonomous car, broadly refers to a robotic vehicle that works without a human operator (Benenson et al., 2008; Paden et al., 2016). More specifically, it can be defined as 'those in which at least some aspects of a safety-critical control function (e.g. steering, throttle or braking) occur without direct driver input' (NHTSA, 2013, p. 7). There are various levels of automation of driverless cars and various classification systems exist (the widely adopted SAE standard, the National Highway Traffic Safety Administration (NHTSA) standard and the German Federal Highway Research Institute (BASt) standard). These systems generally encompass five levels of automation from no automation to various levels of partial automation to fully automated (Kyriakidis et al., 2015).

Since the Internet and smart phone revolutions, driverless cars have now been deemed as one of the key disruptors in the next technology revolution along with drones and the internet of things and have been recognized as a key area for future research (NHTSA, 2013). Google's self-driving car has become a hot topic in the media and governments around the world have begun to develop strategies to address the challenges that may result from self-driving vehicles (Schoettle and Sivak, 2014).

While driverless cars promise to provide many benefits, a key barrier to its adoption is the public trust in driverless cars (Bansal et al., 2016; Kyriakidis et al., 2015). As automobiles are becoming unsustainable, there has been many consequences such as the emission of carbon, high traffic and accidents (Paden et al., 2016). To control these, driverless cars have been proposed as a suitable alterative. Although this may potentially provide safety and efficiency benefits, there are major concerns around the public's willingness to adopt the technology. These concerns relate to security, trust, privacy, reliability and liability (Fagnant and Kockelman, 2015). Additionally, there are certain situations in which users may be more willing to adopt driverless cars, compared to others. Further research in understanding the scenarios when users are most willing to adopt driverless cars will assist in early

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implementation programs among adopting target groups and settings.

Consequently, this study will attempt to answer the following research question: ‘What are the key factors influencing trust in driverless cars’? It will investigate perceptions of benefits, concerns, trust and importantly, situations when users are more willing to adopt driverless cars.

It is widely accepted that driverless cars will not become mainstream on the majority of roads globally in the immediate future (Benenson et al., 2008; Godoy et al., 2015). The most likely adoption settings may be in closed environments such as university campuses, airports, golf courses, holiday parks and retirement villages (Miralles-Guasch and Domene, 2010). However, the majority of existing studies have collected data in broad brushed random approaches internationally or nationally rather than focus on closed environments. For instance, a study by Kyriakidis et al. (2015) obtained 5,000 broad responses from 109 countries with only 40 countries having at least 25 responses. Similarly, a study by Schoettle and Sivak (2014) collected 1533 responses from the US, UK and Australia. However, as the mass consumer market would not be the first ones to adopt the technology, research is needed that is more nuanced in terms of the groups and situations when people will most likely adopt the technology. For instance, prior studies did not indicate who may be willing to use driverless vehicles for public transportation. In fact, prior research makes little mention of public transport, although government transport departments and those providing transport services in certain closed precincts will be interested in attitudes towards driverless cars (Lam et al., 2016).

Given the need to focus on early adoption settings of closed environments as a public transportation service, the scope of this study will focus on obtaining responses from a closed environment of a university setting, where driverless cars will soon be launched as a free service to transport passengers around the campus. This has important implications for the implementation of driverless cars in closed settings.

The study is significant for many reasons. First, it provides an understanding of key factors influencing the adoption of driverless cars in closed settings such as university campuses. Second, it may also have implications for the implementation of driverless solutions in other closed settings such as airports, golf courses, holiday parks and retirement villages. The Royal Automobile Association (RAA) in Australia offers mobility options for the elderly. For the RAA, cars and their drivers may increasingly be less of their business model with an aging population as the members with valid driver’s licenses decrease (Gifford, 2017). Therefore, understanding key factors in closed environments will be helpful. Third, the research will be helpful to car manufacturers as they will be interested in offering the next generation of convenience features for early adopting target markets which will be known to us through the survey.

2. Literature review

In understanding key factors in the adoption of driverless cars, two key bodies of literature have been drawn upon, namely technology adoption and driverless cars. Fig. 1 illustrates these two key streams and associated factors which will be discussed further in this paper.

2.1. Technology adoption

Pertinent technology adoption theories include the technology adoption model (TAM) (Davis, 1989) and the unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al., 2003). From these theories, relevant factors include reliability, performance expectancy, trust, security and privacy. The latter three factors also feature in the driverless cars literature, which also uncovers a range of factors as per Fig. 1.

TAM was developed by Davis (1989) in which acceptance was defined as the decision by users to use technology. It helped to explore the reasons behind the adoption of technology among individuals and cultures exploring behavioral intentions or external

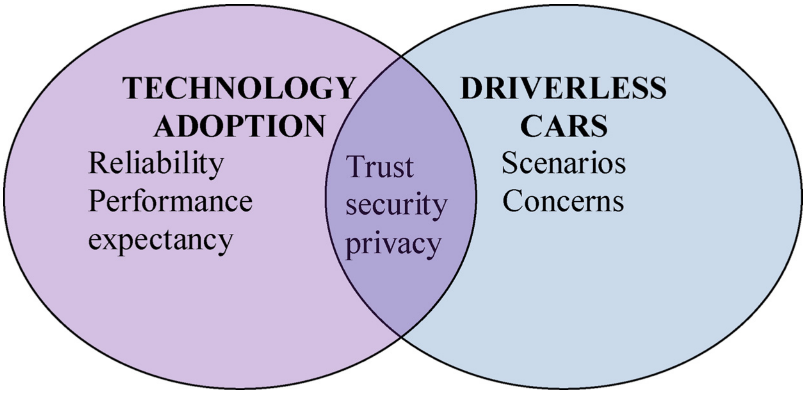

Fig. 1. Key literature and factors influencing the adoption of driverless cars.

challenges influenced by attitudes towards use (Rampersad et al., 2012). However it was later believed that the above two motives are not the only ones responsible for users' acceptance of technology: the motives can be evolve (Martínez-Torres et al., 2008) due to a number of reasons such as moral, ethical or value-driven concerns, the relative advantage of the technology, compatibility with norms and social practices, difficulties in the ease of use and learning and trialability of the technology (Rogers Everett, 1995). Consequently, these considerations were then integrated in a later model by Venkatesh et al. (2003), known as the Unified Theory of Acceptance and Use of Technology (UTAUT).

UTAUT is a technology acceptance model that was developed after comprehensive review of eight of the most significant acceptance models that existed in practice prior to it (Venkatesh et al., 2003). UTAUT theory outperformed the previous models on technology acceptance by accounting for about 70% of the variance in use in the previously used models of technology acceptance. It uses determinants of user acceptance. The four user acceptance criteria are performance expectancy, effort expectancy, social influence and facilitating conditions.

Various factors have been stemmed from the technology adoption literature and integrated with TAM and UTAUT that can be applicable to the driverless car context. Primarily, trust has been widely incorporated into the technology adoption literature in various contexts such as e-commerce (Gefen et al., 2003; Srivastava et al., 2010), internet banking (Kesharwani and Singh Bisht, 2012), e-government (Bélanger and Carter, 2008; Horst et al., 2007; Lee et al., 2011) and social networking sites (Bandiera and Rasul, 2006; Shin, 2010). Similarly, performance expectancy has been a core factor within UTAUT theory and has been explored in internet banking (Foon and Fah, 2011), e-learning (Marchewka and Kostiwa, 2007) and health information systems (Kijsanayotin et al., 2009; Wills et al., 2008). Additionally, reliability has been integrated within technology adoption research in contexts such as e-learning (Butler and Sellbom, 2002).

2.1.1. *Trust in technology*

The literature on technology adoption uncovers various factors impacting on trust in technology. First, studies on technology adoption have integrated trust in technology adoption models (Bahmanziari et al., 2003; Gefen et al., 2003; Wu et al., 2011) such as the impact of trust and a moderator on TAM (Wu et al., 2011). It has also focused on various factors impacting trust and adoption such as privacy (Angst and Agarwal, 2009; Xu and Gupta, 2009) and security (Carlos Roca et al., 2009; Shin, 2010). Trust will be further examined for its role in the driverless car literature in Section 2.2.3.

2.1.2. *Performance expectancy*

As fully autonomous vehicles have not been developed, their performance is difficult to predict. Since any failure of one of the components or sensors can cause a fatal accident or crash, automated driving needs to have high performance requirements.

Contemporary research predicts that autonomous vehicles will have improved performance over traditional non-autonomous vehicles (Paden et al., 2016). Such research is backed by vehicle tests conducted by driving thousands of miles under restricted conditions and human intervention when required (Benenson et al., 2008; Godoy et al., 2015).

Driverless cars may not only outperform the safety record of non-driverless cars, but also increase the performance of passengers (Kyriakidis et al., 2015). With the driverless cars commuting on their own, the commuter will have a lot of free time at his / her hand to dedicate to productive outcomes, most notably on longer trips (Bansal et al., 2016). Consequently, it is hypothesized

Hypothesis 1. Performance expectancy positively influences the adoption of driverless cars.

2.1.3. *Reliability*

With autonomous vehicles not far away, their reliability is only constrained by the technology and computing power that they carry. To demonstrate the reliability of these cars, the autonomous cars have demonstrated, driving a blind man in 2012, making it one of the most compelling cases for driverless cars created by Google. In the race to bring their cars to people, the manufactures are trying their best to convince people of the reliability of the autonomous vehicles by testing many kilometers of trips; yet questions still arise around reliability due to the car's ability to cope with unlikely events (Waldrop, 2015). Therefore, the following hypothesis is included

Hypothesis 2. Reliability positively influences the trust in driverless cars.

2.2. *Driverless cars*

In addition to reviewing the technology adoption literature, the driverless car literature will be reviewed to uncover pertinent factors which may influence the adoption of driverless cars.

2.2.1. *Security*

Certain measures will need to be undertaken, as self-driving cars will have security risks. A self-driving car may be vulnerable to traffic mishaps and disruptions, car-jacking, broken equipment, as well as software related security flaws as in car hacking, remote access, remote control of the vehicle, computer virus's malwares, spoofing, excessive targeted marketing and in car product endorsements (Ring, 2015).

However, large-scale infrastructure can be protected successfully over a long period of time as demonstrated by the US which secured large critical national infrastructure systems, like power grid air traffic control systems (Fagnant and Kockelman, 2015). The security measures require development of new critical security frameworks for the protection of the self-driving cars infrastructure. Consequently, it is hypothesized

Hypothesis 3. Security positively increases trust in driverless cars

2.2.2. Privacy

Inherited in the name "Autonomous Vehicles" is an idea of autonomy away from humans. This loss of autonomy extends to the loss of privacy. Autonomous vehicles could transmit "the present location of an autonomous vehicle user, that person's past travel patterns" and "his or her future travel plans", thus making the user susceptible to "targeted marketing", "law enforcement," or "surveillance" (Glancy, 2012). Autonomous vehicles that select routes on their own may limit human autonomy and compromise privacy in terms of the route they undertake (Fagnant and Kockelman, 2015). The Vehicle-to-Vehicle (V2V) technology that rely on vehicles communicating with one another have a "dynamic wireless exchange of data between nearby vehicles" (NHTSA, 2013) so as to "sense threats and hazards, calculate risk or take pre-emptive actions to avoid and mitigate crashes". V2V communications for safety can compromise privacy by controlling communication with other cars (Kyriakidis et al., 2015). To prevent privacy invasion, privacy protection, to some extent if not to fully, must be incorporated at the design stage for autonomous cars. Therefore, the following hypothesis in included:

Hypothesis 4. Privacy positively influences trust in driverless cars.

2.2.3. Trust

Trust can be defined as one's willingness to place himself/ herself in a vulnerable position, with respect to a technology, with a positive expectation of an outcome or a positive nature of future behavior (Mayer et al., 1995). Such a definition can be disintegrated into three beliefs of ability, integrity and benevolence (Gefen et al., 2003), with ability meaning to have a skill and knowledge to accomplish a task; integrity meaning to keep a promise to fulfill a task; and benevolence meaning that the subject in question, an autonomous vehicle in this case to care for its user's interests. When a user develops trust, they believe in the ability of a vendor/ service provider to protect their information from potential misuse and problems.

Instinctively, users may find it "dehumanizing" to lose "choice and control" when behind the wheel (if there even is one) of a self-driving car (Glancy, 2012). Giving up control to an autonomous vehicle also means giving control to the autonomous vehicle that will monitor factors inside the car that includes the driving, the roads, the driving conditions, and monitor the commuter transmitting data, sharing it with the infrastructure or other cars in the vicinity or the government that may be involved in spying activities. Therefore, it is hypothesized

Hypothesis 5. Trust positively influences the adoption of driverless cars.

3. Methodology

3.1. Research design

The research design is a framework of data collection and analysis (Cooper et al., 2006; Ghauri and Grønhaug, 2005). It is a logical way of linking the data collected to the initial research questions (Yin, 2003, p 19). The research design in this study can be best described as being an embedded quantitative case study (Ghauri and Grønhaug, 2005) as it comprises of a quantitative survey conducted within the context of a case study (Yin, 2003) (See Fig. 1). The case study method is used as driverless cars will soon be launched at the Tonsley Innovation Precinct, a closed setting of a campus at Flinders University, a mid-sized university in Australia. The introduction of driverless cars will help students and staff in commuting around the campus and to and from the nearby bus stop and train station (Fig. 2).

3.2. Data collection method

For the survey instrument, a questionnaire was deemed appropriate. Firstly, it facilitates the quantification of data (Ticehurst and Veal, 2000). There are several existing studies on driverless cars, albeit not in a closed environment context. Therefore, quantification will enhance theory development in this field. It also adds transparency and structure to the research in terms of the manner of data collection and analysis that may be replicated by other researchers (Ticehurst and Veal, 2000). Given the lack of constructs and measures at a closed environment level, the constructs and measures that are proposed in this study will be a major contribution to the literature. Furthermore, due to ease of replication, the questionnaire survey can be applied to various industries, and thus, offer comparability in the methodology and the reliability of measurement (Blaxter et al., 2001). An online survey was conducted using the Survey monkey tool (www.surveymonkey.com), a free survey software for online questionnaires. This survey was conducted in August 2017. Respondents were asked 10 questions with various sub questions based on driverless car adoption.

The respondents in this research included Flinders University's staff and students based at Tonsley. The recruitment resulted in 101 replies from University's staff and students. There was no personal relation between the researcher and the respondents. The survey was conducted anonymously. The demographics of the respondents are shown in Table 1.

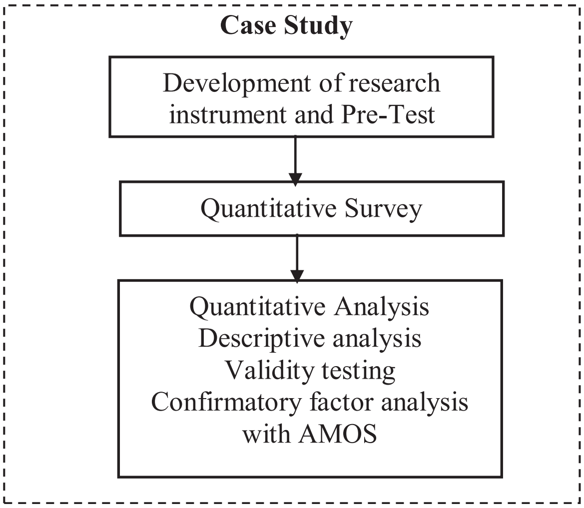

Fig. 2. Research design for the study.

Table 1
Demographics and driving details on respondents.

Category	Variable	Percentage (%)
Gender	Male Female	37
		62
Age	Under 20	30
	21–30	55
	31–40	13
	41–50	0
	51–60	2
	61–70	0
	Above 70	0
Valid driving licence	Yes	86
	No	14
Highest level of education	Less than a bachelor degree	51
	Bachelor degree	34
	Master degree	15
	Doctoral degree	0
Current level of employment	Employed full time	12
	Employed part time	23
	Not currently employed	9
	Retired	0
	Full time student	52
	Part time student	4
Vehicle most driven	Passenger car	64
	UV(utility vehicle)	3
	SUV(sport utility vehicle)	7
	Motorcycle/scooter	10
	I do not drive	13
	Other	3
Ever ridden in a driverless vehicle?	Yes	1
	No	99

3.3. Operationalization of constructs and questionnaire design

Different scales have different measurements in terms of classification, origin, distance and order (Cooper et al., 2006). The questionnaire is designed using matrix and 5-point Likert scales, with rows displaying the questions and columns displaying the answers from strongly agree to strongly disagree, strongly concerned to strongly unconcerned, very likely to very unlikely. Likert scales are simple, easy and straight forward in the collection of responses (Kinnear et al., 1993). Multiple choice scales were also used in collecting demographic information. Table 3 details the measurement items and their sources from the literature.

3.4. *Pre-test*

Pre-testing is the initial testing of the survey instrument. A pre-test was carried out by testing the questionnaire with 3 key informants, specifically civil engineering academics specializing in transport systems and driverless cars, thereby representing the views of key experts in the field. The head of civil engineering suggested that we exclude levels of automation. Instead he advised that we should ask about scenarios when people will be willing to adopt, for instance cars with no driver; shuttle buses with no driver - just a chaperone or no chaperone; driving on the highway but then the driver resumes control of the car; and finding a carpark. Regarding trucks, in Australia on country roads in a vast country, he mentioned that we should question whether people would trust a convoy or platoon of driverless trucks - trust them to disband so that a car could overtake them and then reconnect. Platooning was one of the early R&D efforts in the implementation of driverless vehicles in intelligent systems research (Godoy et al., 2015). Regarding trust in legal and technological structures - he suggested questions about whether people would trust the government to do the right thing or private industry to do the right thing with driverless cars. The other civil engineering academics suggested adoption scenarios such as areas with high pedestrian activities or closed area operations (e.g. University campuses).

3.5. *Case study of Tonsley*

This research was undertaken on the case study of Tonsley because Flinders University will be introducing driverless cars soon. Legal formalities are still on-going in order to enable the car to run on the road. This will help staff and students with drop offs and pickups from bus and train stations. Also, other organizations including large multinationals (such as Mitsubishi, Siemens and Zeiss Group) and small and medium enterprises (e.g. Micro-X, Sage Automation, Hydrix and Zen Energy) may lead to the adoption of driverless cars due to a broad cross section of people. The level of trust will increase with the passage of time as more reliable technologies are generated to make these cars adaptable in daily life.

3.6. *Data analysis*

Preliminary descriptive analysis was undertaken to determine situations when respondents were most willing to adopt driverless cars. These included finding a carpark and in closed area environments. Also people found driverless cars useful in situations such as driving on a freeway/highway and then the driver takes over control of the car followed by public transport with a chaperone. The most unwilling situations for adoption were driving a vehicle with no driver controls (no pedals or steering wheels), areas with high pedestrian traffic, drop-offs and pick-ups of children and public transport with no chaperone. Further details are provided in Fig. 3.

Once descriptive analysis was completed, data was then analysed statistically by applying confirmatory factor analysis (CFA) using software packages, AMOS and SPSS. CFA was deemed useful to determine the impact of various factors on the adoption of driverless cars. Prior to undertaking the CFA, data was checked for normality and constructs evaluated for validity and reliability. This was followed by hypothesis testing to determine the influence of each factor on the adoption of driverless cars. The results from the data analysis will be explained in Section 4.

4. Results

4.1. *Data Preparation and Screening*

Before data was analyzed statistically, it had to be screened. There was no missing data as respondents had to complete all questions in order to submit the survey online. However, normality was evaluated as is it important for distributions of data to exhibit this trait, to facilitate unbiased and consistent models (Anderson and Kumar, 2006). Normality was tested using checks for skewness and kurtosis. Skewness pertains to the symmetry while kurtosis refers to the peakedness of distributions (Hair et al., 2006). The data in this study exhibited acceptable levels of skewness (ranging from 0.045 to 1.162) and kurtosis (ranging from 0.017 to 1.564) which were well below the maximum acceptable levels of 2 and 7 for these two tests (West et al., 1995).

4.1. *Validity of measures*

Once the data was screened, checks for the reliability and validity of constructs were then undertaken. Reliability refers to the level of consistency and precision of measurement while validity pertains to the level of accuracy with which the scale represents and measures the variable intended (Nunnally, 1970). Table 2, provide details of the reliability and validity of our constructs.

Reliability was evaluated using coefficient alpha in SPSS 23.0. All constructs demonstrated acceptable values for coefficient alpha (ranging from 0.895 to 0.965), exceeding the minimum acceptable value of 0.7 (Kline, 2005). Construct reliabilities were also calculated using data outputted AMOS 23.0 on standardized item loadings and error measurement (Kline, 2005). Values for construct reliabilities for the factors ranged from 0.738 to 0.962 exceeding the minimum threshold of 0.7 (Hair et al., 2006). Convergent validity was also demonstrated for all factors as their item loadings were above the acceptable level of 0.5 (Steenkamp and van Trijp, 1991) as demonstrated in Table 3.

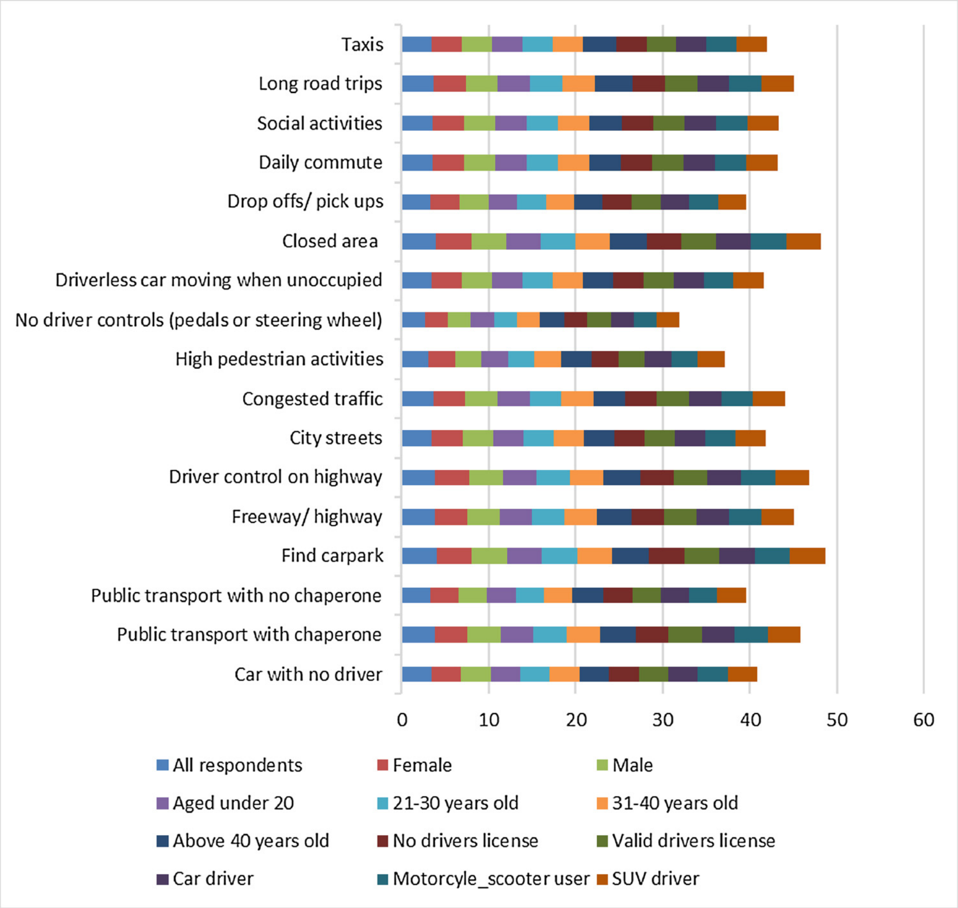

Fig. 3. Situation when most likely to adopt.

Table 2
Reliability and Validity of Constructs.

Construct	Coefficient Alpha (> 0.7)	Construct Reliability (> 0.7)
Reliability	.895	.903
Security	.875	.916
Privacy	.948	.962
Performance Expectancy	.930	.738
Trust	.933	.929
Adoption	.965	.953

4.2. Hypothesis testing

As shown in Table 4 and Fig. 4, all hypotheses were supported. Therefore, the results provide empirical evidence for the influence of performance expectation, reliability, trust, privacy and security on the adoption of driverless cars.

5. Discussion and conclusion

The research made an important theoretical contribution by informing understanding on the key factors impacting on trust in driverless cars. It does so by integrating the literatures on technology adoption and driverless cars. In so doing, it identified key factors influencing driverless car adoption including performance expectancy, reliability, security, privacy and trust.

The research identified the situations when people are most likely to adopt driverless cars. These included closed environments, finding a carpark, public transport with a chaperone and on highways where drivers can then take full control.

This research had a focus on closed environments. Specifically, it surveyed students and staff in a university campus where driverless cars will soon be implemented to transport passengers to the nearly train and bus stops. Unlike previous research which

Table 3
Measurement items and sources.

Factor	Measurement items	Loadings	Source/Literature
Security	Probability of software failure or software error incidents while an autonomous vehicle in in operation.	.646	(Schoettle and Sivak, 2014)
	Probability of hardware/electronic failure.	.687	
	System security (from hackers)	.946	
	Vehicle security (from hackers)	.962	
	Network security and connectivity with transport infrastructure and other cars	.758	
Privacy	Data privacy (location and destination tracking)	.914	(Glancy, 2012; Schoettle and Sivak, 2014)
	Personal autonomy privacy (privacy of making individual choices)	.923	
	Personal information privacy	.947	
	Targeted surveillance	.892	
	Mass surveillance	.893	
Reliability	Convoy of driverless trucks	.509	(Schoettle and Sivak, 2014)
	Cars to overtake then reconnect	.517	
	Self-driving cars getting confused by unexpected situations	.61	
	Self-driving cars not driving as well as human drivers in general	.576	
Performance expectancy	Using driverless vehicles can improve my living and working efficiency.	.706	(Venkatesh et al., 2003)
	Using driverless vehicles can increase my living and working productivity.	.749	
	I find that driverless vehicles are useful.	.739	
Trust/ Safety	Driverless cars have enough safeguards to make me feel comfortable using it	.917	(Venkatesh et al., 2003)
	I feel assured that the government will be protect me from problems from using driverless vehicles	.793	
	I feel assured that private industry will protect me from problems using driverless vehicles.	.812	
	In general driverless cars provide a robust and safe mode of transport	.963	
	Driverless cars can be trusted to carry out journeys effectively	.93	
	I trust driverless cars to keep my best interests in mind	.909	
	My trust in a driverless car will be based on the car manufacturer's reputation for safety and reliability.	0.646	
	My trust in driverless cars will be based on the reliability of the underlying technologies.	0.681	
Adoption Scenarios	Car with no driver	0.829	(Schoettle and Sivak, 2014)
	Public transportation or shuttle bus with 'driver' chaperone	0.563	
	Public transportation or shuttle bus with no 'driver' chaperone	0.761	
	Finding a carpark	0.797	
	Driving on a freeway/ highway	0.855	
	Driving on a freeway/ highway and then driver takes over control of the car	0.798	
	Along city streets	0.883	
	In congested traffic	0.848	
	Areas with high pedestrian activities	0.781	
	Riding in a vehicle with no driver controls available (no steering wheel, no brake pedal, and no gas pedal / accelerator	0.663	
	Self-driving vehicles moving by themselves from one location to another while unoccupied	0.773	
	Closed area, short trips (e.g. university campuses, airports or retirement villages)	0.667	
	Drop-offs and pick-ups of children for school and extra-curricular activities	0.82	
	Daily week day commute (e.g. to work, university)	0.906	
	Social activities (e.g. attend dinners, events, social gatherings)	0.88	
	Long road trips (e.g. get-always, holidays) on country roads	0.78	
	Taxis that are completely self-driving	0.856	

Table 4
Hypothesis tests.

Hypothesis	Independent Variable	Dependent Variable	P Value	Support
1	Performance Expectancy	Adoption	***	Yes
1	Reliability	Trust	***	Yes
2	Security	Trust	.078	Yes
3	Privacy	Trust	.003	Yes
4	Trust	Adoption	.105	Yes

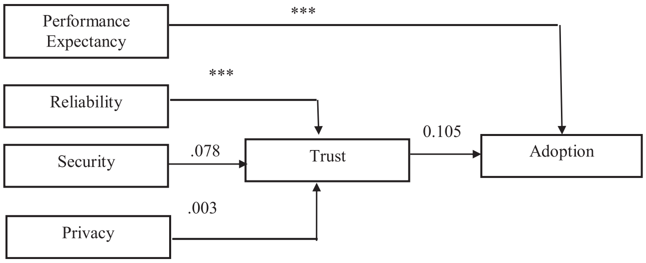

Fig. 4. Hypothesis support demonstrating p-values.

evaluated trust throughout an entire nation, this research makes an important contribution in focusing particularly on a closed environment. This has important implications for the implementation, messaging and strategies to boost the use of such cars in these closed environments.

5.1. Managerial implications

This study described the key factors leading to the adoption of driverless cars in closed environments. R&D managers using closed environments as test cases can use this study to understand key concerns and sentiments towards the adoption of driverless cars. Furthermore, in its launch and promotion of the car through websites, media releases and public information provided, it can proactively address and appease any concerns. For instance, as security, for instance software and hardware failure or reliability, for instance interacting with non-driverless cars, bicycles and pedestrians are concerns, it can stress that there will be a chaperone in the car at all times to take action as needed, in light of any unforeseen situations. Therefore, the study offers direct implications for the messaging and promotion around the launch of the car to foster uptake and acceptance.

Indeed the study offers in-depth insights into important considerations in closed environments. Unlike prior studies, it provided useful implications for closed environment scenarios, as there have been not much done about adoption of driverless cars in these settings.

5.2. Limitations and future research

While the research offers valuable insights, there are limitations and opportunities for future research. The study was based on a case study of one closed environment, a university campus. While this offers important implications for such campus environments as many universities are embarking on driverless initiatives, there are other closed environments that may be of interest. For instance, while the aged and disabled are seen as early adopters of driverless cars, few studies have actually surveyed these groups to ascertain their views on driverless cars. Future research is needed to give voice to these groups and obtain their views rather than make assumptions on what is best for them. Similarly, other closed environments such as airports can be associated with another set of situational factors such as time pressures and international safety and monitoring requirements that are increasingly associated with airports. Cyber-security and terrorism at airports through hacking of programmable systems needs more in-depth analysis in the context of airports in future studies.

Nevertheless, as previous studies have not focused on the adoption of driverless cars in closed environments, this study is unique and beneficial in providing preliminary insights in early test case environments. It will be of interest to government agencies in evaluating the benefits and risks associated with their transport investments in driverless technology and the development of such as the autonomous vehicle industry and associated policies and legislation, particularly related to regulation of vendors, liability, privacy and security. It will also be helpful to R&D managers in car manufacturing and related software firms who may view driverless technology as the next generation of safety or convenience features for more advanced cars. Also, there are opportunities for future research in terms of longitudinal studies to monitor changing sentiments through time. Overall, the study was an important first step in paving the way for future research in understanding trust in driverless cars in closed settings.

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