Self-driving cars for tourists and consumers

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Abstract: When we would like to rent a car while traveling abroad and then explore the landscape or get to the sea, we could not look around while we are driving, nor read information on the site on what we are seeing, nor perhaps take a photo and send it to our friends about what we saw on the way. And after the evening party, it would be nice to get home as soon as possible, but it is not possible to sit behind the wheel with alcohol in the body, and taxis are expensive and take a long time to arrive. The system of self-driving cars can offer solutions to these set of problems. Self-driving cars are unlikely to replace public transport, but they can support mobility. Nowadays, more and more Artificial Intelligence Development Centers are designed to deal with traffic-awareness applications: how the pedestrian walks around the sidewalk, how the car going is moving along with us, etc. These new technologies have already been researched in the literature, but there is no evidence for a consumer-oriented approach. The purpose of our research is to identify the service systems in the scientific literature where the appearance of a self-driving car would change or increase the popularity and attendance of the elements, places. It would also increase the attractiveness of a tourist destination if it could be easier to discover effectively even through self-driving cars. This study summarizes relevant articles from high-prestige journals dealing with topics that provide the bases and questions for a prospective empirical research. We have identified different areas within tourism where the presence of self-driving cars can be useful. In the course of the research, we have seen that the appearance of self-driving cars in tourism could be very beneficial, as can be seen in the examples above.

   Key words: Self-driving cars, Community, Tourism, Services, Development, Mobility

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1. Introduction

In the last decade, Autonomous Vehicles (AV) have gained serious worldwide attention for their potential to solve various environmental as well as social problems modern societies are currently facing, from high pollution to car accidents due to stress, drunk driving and other negligence, especially in touristic places. AV is said to be a disruptive technology due to its ability to shape neighborhood and business districts as well their economy (Rosenzweig, Bartl, 2015; Crayton, Meier, 2017). Moreover, AV technology may come sooner than most people think and when the tech is available for mass consumption it will revolutionize many business sectors, including tourism industry and increase of competitiveness (Gyulavári, Kenesei, 2012) of cities and regions.

Autonomous Vehicles (AV) can be a part of the sharing economy which is increasingly popular among millennials. AV may contribute to the betterment of our environment through reduced car ownership hence reduced pollutions, traffic congestions and oil consumption (Woldeamanuel, Nguyen, 2018). AV technology can be one of the solutions to combat our common enemy that is global warming.

Despite some potential benefits a society can reap from the emergence of AVs, some challenges still exist to making them fully operational on the road. They mainly concern safety and legal and ethical issues, such as consumer privacy, ownership and maintenance, insurance and accountability in the event of manslaughter (Douma, Palodichuk, 2012; Rosenzweig, Bartl, 2015). The latter, which is basically a question about "who is responsible?" has been an ongoing debate within the AV literature (Liu, 2017). Delicate issues concerning morality and technology require policy-makers to have a holistic perspective and reform their current laws in order to enable the adoption of innovative technology, such as AV, in the future.

Beyond the scope of law and ethics, potential long-term health issues derived from automation are recently raised in the literature on AVs. For instance, while the emergence of AV technology can potentially help in stress relief due to driving, it can also become the source of Non-Communicable Diseases (NCDs), such as inactivity and obesity (Crayton, Meier, 2017). It is then a question to determine which types or what forms of car automation (semi vs full) in the future can bring about positive social implications to our society through a well-balanced lifestyle.

Although most – if not all – studies in AV presented what-if or hypothetical scenarios, it should be clear by now that AV possesses some potential benefits as well as potential harms. We, however, are inclined to step forward and progress in this topic by framing AV technology in the scope of tourism.

The literature of autonomous vehicles is widespread, but most of the main topics are related to technical and technological aspects. Only 6% is constituted

by social science literature (Cavoli, Phillips, Cohen and Jones, 2017). There is no research specifically targeting the relationship between autonomous vehicles and tourism at the international level.

A notable exception is the article of Tussyadiah, Zach and Wang (2017) about the attitudes of the public towards the concept of self-driving taxis. The authors studied 325 people in the USA in two different contexts, as residents and as tourists. Negative attitude towards technology is at a low level, and is triggered by the dehumanizing aspect of the technology. Confidence in self-driving taxis is high, people have expectations concerning reliability, functionality and helpfulness. Travellers who often use a taxi in tourism destinations and who are open to innovative technologies are also more likely to use self-driving taxis. So there is a potential impact of self-driving taxis for the tourism industry.

The first article on tourism was written by Cohen and Hopkins (2019). In their conceptual paper, they presented some opportunities and challenges of connected and autonomous vehicles (CAVs) related to urban tourism.

We will deepen our discussions in this study by examining the potential implications of the anthropomorphism features of AV for overall touristic experience. Previous studies have linked anthropomorphism features of AV to greater trust among passengers (Forster, Naujoks and Neukum, 2017) which may vary across cultures (Yerdon et al., 2017). This study is expected to offer policymakers a valuable insight into the tourism sector.

2. The theoretical background of technology acceptance models

The Technology Acceptance Model (TAM) and its subsequent enhancements have been called upon to consider, test, and assess critical influencing factors for potential innovative technologies. Nevertheless, most studies in the literature deal with technologies that have already been introduced. Therefore, in this study, we believe that it may be worthwhile to first examine technology adoption models for social acceptance of autonomous vehicles, which, on the one hand, supports more efficient consumer satisfaction and, on the other hand, Technology Acceptance Models may be explored in new areas of research. It is worth mentioning that autonomous vehicles are more or less on the roads today, but in many cases consumers may not even use the automatic parking system. Therefore it is important to understand not only fully autonomous vehicles but also semi-autonomous vehicles.

Research into the acceptance of technology is largely due to breakthroughs in new IT systems (most notably personal computers). More serious research on this topic can be dated back to the mid to late 1980s (Davis, 1986) and then modified and supplemented by Davis, Bagozzi and Warshaw (1989) to create the TAM 1

model *(Figure 1)*. The model focuses on the attitude toward the new technology, the behavioural intention to use, and the actual system/technology use. Among the independent variables in the model are the so-called external variables which do not directly influence consumer attitudes or behaviours; however, they directly affect perceived usefulness and perceived ease of use (Keszey, Zsukk, 2017). External variables are not explicitly listed and defined in the model (Davis et al., 1989). According to Davis et al. (1989), external variables can be, for example, technological innovations or user specificities, making TAM 1 a framework model that can be used flexibly by downstream users and researchers of the model, taking into account the characteristics of the technology being studied.
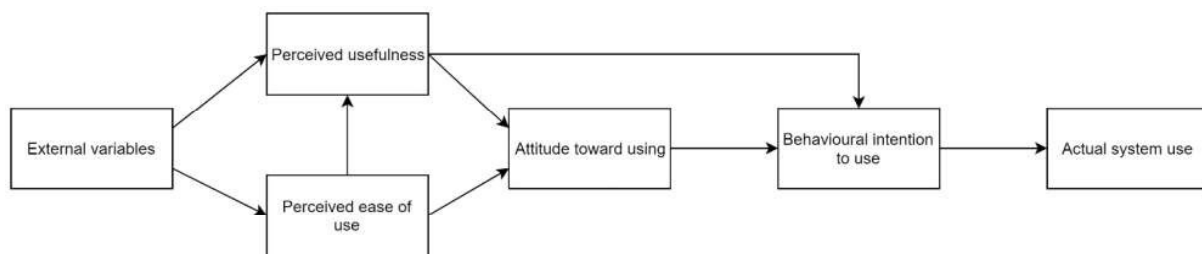
Figure 1. The first Technology Acceptance Model
Source: Keszey and Zsukk, 2017, Authors' own edition.

A more detailed description of previously undefined externalities was sought in the TAM 2 model (Venkatesh, Davis, 2000). At that time, these external factors were divided into two groups. One is social influence processes such as subjective norm, image and voluntariness. These elements primarily affect perceived usefulness, except for the factor of voluntariness, moderating influence through the subjective norm on the behavioural intention to use. The other group is constituted by cognitive instrumental processes such as job relevance, output quality, and result demonstrability. These elements also directly affect the perceived usefulness. In addition to these elements, the researchers also examined the experience factor in the model, which moderates the perceived usefulness and behavioural intention to use through the subjective norm. Experience is a very interesting element of the model through which we can see the differences between an introduced and an upcoming technology. Experience negatively modifies the effect of the subjective norm on perceived usefulness and behavioural intention to use. This means that if a technology system is not fully developed and users' knowledge and beliefs about the new device are still vague (i.e. they have no experience), they will be much more reliant on others' judgment of utility and intended use. After implementation, however, when much more is known about the strengths and weaknesses of the system or technology, and more experience is gained, the role of influence by others diminishes (Keszey, Zukk, 2017).

It can be seen that the TAM 2 model only addresses the factors affecting perceived usefulness, not the perceived ease of use. TAM 3, the latest TAM model extension to date, has identified new variables. According to Venkatesh and Bala (2008), variables can be grouped here as well into two categories. One group is the anchor of general experience from previous experiences, which mainly helps to form opinions before gaining personal experience with technology. These include computer self-efficacy, perception of external control, computer anxiety, and computer playfulness. The other group is adjustments, which modify prior perception in the light of direct experience with technology, such as perceived enjoyment and objective usability.

Along with the development of the TAM 3 model, the researchers began to investigate (Venkatesh et al., 2003) the factors that directly influence the behavioural intention to use. The Unified Theory of Acceptance and Utilization of Technology (UTAUT) was born after reviewing eight different theories. The purpose of the UTAUT model is to provide a useful tool for managers to assess the likelihood of success in introducing a new technology and to understand the additional influencing factors during adoption. The authors distinguish four direct influencing elements: expected performance, expected required effort, social impact, facilitating conditions. In addition, four other variables moderating these direct relationships were identified: gender, age, experience, voluntariness.

Extending previous facilitation conditions, they created the UTAUT 2 model (Venkatesh, Thong and Xu, 2012), which can already measure the expected adoption of technologies that are suitable for everyday use. As a result, the element of voluntariness in the UTAUT model has disappeared because, in everyday technology, the authors assume that it will not be used involuntarily. As a result, three new elements have been added: hedonic motivation, price value, and habit.

From the point of view of our research, the UTAUT models, which already take into account the social effects, can be really relevant, especially the UTAUT 2 model, where the authors have already adopted the acceptance of the technologies used in everyday life. All in all, the factors affecting the primary latent variables of TAM models (perceived usefulness, perceived ease of use, and behavioural intention to use) should not be overlooked.

3. The impact of autonomous vehicles in tourism

Autonomous vehicles will have travel implications in three categories: individual travel decisions, transportation system impacts, and industrial and logistic impact (Henderson, Spencer, 2016). While all of them are somehow connected to tourism

industry, we primarily focus on how autonomous vehicles may influence the individual travel decisions of tourists.

There are also some examples which show that tourists might be the first to experience autonomous vehicles. Heathrow Airport tested autonomous vehicles and reduced travel time at Terminal 5 and also saved carbon. Gatwick airport also used autonomous shuttles as transfers (Cohen, Hopkins, 2019). England's Lake District national park used autonomous vehicles as a sustainable transport solution to reduce congestions and pollution (Mogg, 2018).

In this article, our aim was to discuss as many impacts (positive and negative) as possible of autonomous vehicles in relation to tourism industry.

3.1 Travel distance of tourists might be longer

There are also multiplication impacts of autonomous vehicles, since as the travel speed increases, travel time will reduce (Yokota et al., 1998), so tourists could travel to a greater distance in the same period of time. They could reach destinations which they would not have chosen due to the long travel time. Thus, autonomous vehicles could also foster longer travel distances (ITF, 2015). The reduction in the value of time could also change the preferences in travel mode, as autonomous vehicles might become more attractive than other transport options such as train or flight (IFMO, 2016).

People in autonomous vehicles favor activities that they can perform while travelling such as gazing out of the window and talking to fellow travelers, but they rarely mentioned work (Cyganski et al., 2015).

All passengers may sleep in an autonomous vehicle while travelling to a destination, so they can book less accommodations (Bainbridge, 2018).

Door-to-door mobility could also reduce travel time compared to public transport and it might also enable tourists to access attractions that they could not reach on foot alone (IFMO, 2016).

Autonomous vehicles could replace transfer buses and taxis, so they could also be useful for transferring people from airport to hotel and return as hotel pickups (Bainbridge, 2018).

Due to the constant travel speed, the planning of the route and the travel time is more reliable and predictable (Guth et al., 2012).

3.2 Travel demand might increase

There are a large number of positive factors that could increase travel demand. For example, in autonomous cars people with age-related or medical constraints and teenagers could increase the travel demand (Kim et al., 2015; IFMO, 2016). They do not need a driving licence. They could become independent from others

and flexible in their mobility, their social isolation could decrease and they could easily access the services they demand (Anderson et al., 2014). This new travel demand might increase with about 11% (Sivak, Schoettle, 2015).

Tourists could share autonomous vehicles attaining the perfect speed for less energy consumption, so the travel would cost less for tourists (Sivak and Schoettle, 2015), which could also increase the travel demand.

Safety is another reason for tourists to use autonomous vehicles, as they do not have to know the driving rules of the destination, it does not matter that the driving direction is left or right, unfamiliar environments and tiredness will not be a problem anymore (Cohen, Hopkins, 2019).

3.3 Parking spaces might change

Parking might become easier (Pitcher, 2011). As autonomous vehicles could find the nearest free parking place and could park perfectly, more cars could park in the garage (Mitchell et al., 2010, Kowalewski, 2014) or a reduced space would be enough for vehicles, so cities could improve the livability of environments and there could be more spaces for pedestrians or bicycles (Alessandrini et al., 2015). According to Wiseman's study (2017), near the airports as in Um El Hamam, not far from Tel-Aviv, large parking lots could liberate free lands, which might be used for shopping malls, hotels or other services for tourist. All of these changes would increase the number of tourists, as they could use these new environments.

Many historical capital cities have parking difficulties. Wiseman (2017) analyzed the advantages of autonomous vehicles in parking in Israel. In Jerusalem and in Tel-Aviv, autonomous vehicles could solve the problem of parking in the city centre. Car parks might be less in demand near the attractions, but set down and pick up space will be necessary. Tickets could also be purchased on autonomous vehicles to shorten the time of waiting, so tourists could enter the attraction straightaway (Bainbridge, 2018). Tourists would not have to spend time on parking and they might have more time to spend on the destination.

Parking places near hotels located in rural locations or close to highway and major routes could be liberated for other usages, such as building more rooms or redesigning them for new services (Henderson, Spencer, 2016).

3.4 New tourism services could appear

Bainbridge (2018) mentioned some possibilities that autonomous vehicles could provide in the tourism industry. Notably, the creation of a new class of sight-seeing tours, which could be called an *auto-tour*. It could function as a hop on hop off bus tour in cities and it could also replace guided tours on foot. The authors collected all the characteristics making *auto-tours* advantageous:

- proximity does not matter anymore,
- itinerary could be easily re-configured and algorithmically generated,
- personalisation could happen in real time according to anybody's preferences,
- multiple topics could be organized in a single tour,
- door-to-door function,
- flexibility, as the tour can start and end anywhere and anytime, and it can take any duration in reliable timing,
- the travel mode could also be changed.

Independent tour guides could transform vehicle-based tour operator businesses, widening their business opportunities.

This type of transport might provide people private space, so if somebody does not like to travel with other tourists, he or she can go there alone or just with the preferred people (IFMO, 2016). The autonomous vehicle could also be used as an accommodation or a small meeting room. So hotels by the hour will not be needed anymore, as tourists could book an autonomous vehicle. Small meetings could also be organized in specially designed ones, impacting not just leisure tourism but also MICE tourism (Bainbridge, 2018).

3.5 New opportunities for tourists

Bainbridge (2018) also highlighted the positive impact of autonomous cars, whose advantages come from human delivery. As people will not drive, driving might become an experience, a leisure activity. Evening experiences could be longer, and people could also drink alcohol since they could travel by an autonomous vehicle, making evening tours more attractive.

As tourists can travel to the suburbs of cities, there will be more opportunities to have a dinner or book an accommodation, so not only the centrally located restaurants and hotels would suit tourists' preferences. Safety and reputation of the hotel might become less important, as the autonomous vehicle could pick up tourists in the pickup zone (Bainbridge, 2018).

Tourists could visit other or new attractions, avoided previously because of their distance from the city centre. So autonomous vehicles give opportunities and popularity to new destinations and attractions (Cohen, Hopkins, 2019).

Autonomous vehicles could also impact shopping tourism, as shopping streets and specific shops outside shopping malls could be reached easily, so the shopping areas of cities might be reconfigured (Bainbridge, 2018).

3.6 The disadvantages of autonomous vehicles

Autonomous vehicles have also negative impacts on the tourism industry (Cohen, Hopkins, 2019). As more tourists reach more destinations, they can get off the car near the attractions, which would generate over-tourism. As tourists spend their time better, and can travel to more far destinations, public transport will be less attractive in cities, and people will be less likely to use trains, preferring to travel by autonomous cars instead. It also impacts employment as professional human drivers could be replaced by autonomous vehicles, so a lot of people will lose their job. There are also problems with passenger protection related to data privacy, security, and terrorism.

3.7 Anthropomorphism feature in tourist autonomous vehicles

Anthropomorphism describes the attribution of human-like characteristics, physical and emotional, to a nonhuman agent or a machine (Epley, Waytz and Cacioppo, 2007). Anthropomorphism in nonhuman agents, such as AVs, is motivated by the need to create a meaningful relationship between human and robotic systems (Duffy, 2003). Previous studies have linked anthropomorphism feature in AV to greater trust among passengers (Forster, Naujoks and Neukum, 2017) which may vary across cultures (Yerdon et al., 2017). Culture, which is a set of beliefs and values embraced by a group of people, is pivotal in explaining human behavior (Chairy and Syahrivar, 2019). This is especially true in the case of driving culture. The application of the anthropomorphism feature in tourist AV can be a potential solution to the shortage of experienced and multilingual tourist guides and historians, especially in growing tourist attractions, such as Budapest. Talking or interacting Artificial Intelligence (AI) embedded in AV can potentially improve the overall tourist experience and create a positive impression on solo tourists knowing that they are 'accompanied' and supplied with relevant information that they need during sightseeing. We contend that building a meaningful relationship between tourists and Tourist Autonomous Vehicles (TAV) can be one of the important research agendas in the future.

4. Conclusion

In overall, the value of the study is its special interest in tourism industry related to the development and implementation of autonomous vehicles. Since it was written before the widespread availability of literature on autonomous vehicles dealing mainly with its technological aspects, analyzing this topic from a consumer perspective could constitute a novelty. In addition, we examined the

social acceptance of autonomous vehicles in a theoretical framework that also contains new niche areas, as presented in Chapter 2. Technology acceptance models provide the theoretical framework of the study, and such a niche area may be the measurement of the attitude towards the technology that has not yet been introduced, which moreover, may be an everyday technology that does not necessarily have to be used. All of this is reinforced by the fact that we will be exploring the field of tourism, where the use of technology-based on hedonistic approaches will appear. It is important to emphasize that autonomous vehicles technology is not an innovation of the next 20–30 years, there are already cars on the road or in private ownership that already use some semi-autonomous vehicles technology (Parking Assistance, Lane Keeping Assistance, Pilot Assist etc.). In future research, it will also be important to measure the extent to which these technologies influence purchase and use intentions, and, if so, how they may provide a competitive advantage over vehicles that do not use such technologies. Tourists can plan their trips more freely thanks to the spread of autonomous vehicles. Door-to-door travel will be possible and it is a safer way than using a bike or a scooter. Evening mobility can be affected by autonomous vehicles, as tourists can return to their accommodation more comfortably and relaxed from the pub or after wine tasting. In addition, less time should be spent on scheduling or paying other travel costs.

The empirical measurement of the social acceptance of autonomous vehicles may be a critical point in our future research. For this reason, we consider it worthwhile to first systematize empirical research on technology acceptance models, taking into account the existing research methodology and relevant topics. Thus, we first presented the literature review and summary, and later focussed on our own empirical research and hypotheses. As already mentioned, this topic is under-researched in this respect, but with the inclusion of a few related areas, a more detailed literature analysis can be prepared.

All this can further support a deeper understanding of consumer behavior and the reasons for adopting new technologies such as autonomous vehicles.

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