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Sharing or owning autonomous vehicles? Comprehending the role of ideology in the adoption of autonomous vehicles in the society of automobility

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ABSTRACT

This article investigates the role of hegemonic ideology and the symbolic meaning of Autonomous Vehicle (AV) ownership in the society of automobility. Emerging mobility technologies, including connected shared platforms and automation, are disrupting urban transportation. There is a pervasive expectation that the utilisation of Shared Autonomous Vehicles (SAVs), by offering an efficient, flexible and affordable on-demand mobility, will eventually replace ubiquitous private car ownership. Researchers have mostly considered the transition of car ownership to SAVs based on positivist-empiricist approaches. The meaning of the car and its functions are not limited to the instrumental usage that facilitates mobility; instead, the car has other functions such as demonstrating the socio-economic status of its owner and symbolising his/her subjective identity, which is embedded in the dominant ideology and its symbolic structure. Automobility is a component of hegemonic ideology and its symbolic system that has shaped our car-dependent societies over the last century. The ideological and symbolic functions of car ownership have often been neglected when discussing AVs of the future. This research uses Reflexive Thematic Analysis (RTA) to analyse a mixed data set including 3 focus group interviews and 192 residents' responses to a questionnaire-based survey in Auckland. The results indicate that there was considerable heterogeneity in participants' preferences for using AVs, but relatively less heterogeneity in sharing mobility services. The research reveals that the provision of alternative smart shared mobility options does not subsequently reduce pervasive car ownership. The research concludes that the hegemonic ideology and its symbolic mechanism promote automobility that will significantly steer private car owners towards AV usage instead of the expected shared mobility. Therefore, in the context of the society of automobility, AVs should be considered as a technological transformation rather than a paradigm-shift towards shared mobility services.

1. Introduction

Smart innovative technologies are dramatically transforming cities and everyday life (Yigitcanlar and Kamruzzaman, 2019). "The history of innovation has shown that it is insufficient to consider the effects of technological efficiency improvements in isolation. Repeatedly, technological progress has fallen short of expectation as user behaviour is not considered in relevant research, and direct and indirect rebound effects, such as consumption shifting" (Pakusch et al., 2018, p. 2402). In particular, dominant ideology and pervasive social norms and values should be considered in the adoption of new technologies that seek to create behavioural changes in users.

Smart sharing mobility platforms and autonomous vehicles (AVs), among others, are perceived as the most disruptive technological advances of the century (Bansal and Kockelman, 2018). However, these technologies are a relatively nascent phenomena (Smith et al., 2018). Researchers are increasingly investigating the potential impacts of shared mobility platforms and automation on cities including, but not limited to, urban transportation (Litman, 2014; Meyer and Beiker, 2018; Zakharenko, 2016; Zhang and Guhathakurta, 2017), the built environment (Zhang and Guhathakurta, 2017), and society (Menon et al., 2019; Zhang et al., 2019). Researchers have mostly deployed empirical and positivistic approaches to conduct these investigations. Since empiricism and positivism are inherently unable to study ideology and its implications in society and people's behaviour (Abma and Schwandt, 2005; Flyvbjerg, 2001), the role of the hegemonic ideology and its symbolic mechanism in the adoption of these mobility technologies is often overlooked in academia and practice.

There is a pervasive expectation that smart sharing mobility and automation will offer convenient, flexible, reliable, affordable, and

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environmentally sustainable mobility in the future. The new modes of mobility will eventually replace existing private car ownership (Bansal and Kockelman, 2018; Mulley et al., 2018; Newman and Kenworthy, 2015). Researchers mostly consider the automobile as a functional object that facilitates movement. Yet, the car should be considered beyond its instrumental functionality (Heffner and Turrentine, 2006). Further investigations are required to examine the substantial transition from car ownership to shared mobility options within 'societies of automobility' in which the car "is a complex amalgam of interlocking [soft anf hard] machines, social practices and ways of dwelling" (Sheller and Urry, 2000, p. 739) that are shaped and supported based on the dominant ideology.

There has been an upsurge of interest in the identification of factors that will potentially inform the pervasive usage of AVs in the future. AVs, like other technologies, have technical, social, and ideological dimensions (Ontology, 2008). This paper investigates the ideological implications of AVs based on automobility theorists' works, such as those of Freudendal-Pedersen (2016), Heffner and Turrentine (2006), Featherstone (2004), Sheller and Urry (2000), and Urry (2012). Larsen and Urry (2016, p. 3) state that transport researchers, planners, and policymakers generally "have little understanding of how travel patterns are socially embedded and depend upon complex networks of family life, work and friendship" and the dominant ideology. Automobility theorists have considered the car as a component of hegemonic ideology with its discourse and symbolic mechanisms that have subjectively shaped individuals as well as generated forms of social life, norms, and values (Lutz, 2014). According to Althusser, ideology "is not usually defined as something that we as subjects do but as that in which we are immersed … ideology exists as real only as it is performed and enacted" (Lewis, 2005, p. 459). It is crucial to investigate the ideological dimension of AVs in the society of automobility in which "freedom of movement, as represented in popular media, politics and the public sphere, is the ideology and utopia of the twenty-first century" (Urry, 2016, p. 4). Following Schiffer (1992), I consider the ideofunction of AVs, that is, the ideological functions of general norms and values in the society of automobility. I challenge the linear causality theory that provision of new mobility services and required physical infrastructures will result in the pervasive sharing of AVs as a radical departure from hegemonic car ownership.

2. Literature review

The literature review includes two interconnected sections. The first section reviews existing knowledge about smart shared mobility platforms, AVs, and SAVs and their social implications. The second section covers theories of automobility to provide an understanding of the ideofunction of cars and AVs in the future. The literature review informs research objectives, research questions, a methodology of research, and subsequent discussion.

2.1. Emerging disruptive mobility technologies

This section reviews automation and app-based shared mobility platforms among other disruptive mobility technologies such as electrification, drones, and flying taxis. It also includes a review of existing literature on the adoption of AVs.

2.2. Smart sharing mobility platforms

During the last decade, the accretion of international and local sharing mobility platforms, including car sharing (e.g., Cityhop, mycaryourrental, and yourdrive), ride-sourcing (e.g., Uber, Green Cabs, and Zoomy), and ridesharing (e.g., UberPOOL), has provided affordable, diverse, and flexible on-demand mobility services (Automated and Retrieved, 2015; Bansal and Kockelman, 2018; Greenblatt and Shaheen, 2015; Shaheen et al., 2008). The triumph of smart sharing mobility platforms generates the prospect of the lessening importance of private car ownership if not the replacement of car ownership in future cities (Herrmann et al., 2018; Lyons et al., 2019; Martin et al., 2010; Menon et al., 2019; Sperling, 2018). Car sharing users globally increased from 0.35 to 4.94 million between 2006 and 2014 (Prieto et al., 2017). Nowman et al. (2017) observed that the percentage of private car ownership has gone down for the first time in history, particularly in the US. They conclude that smart shared mobility options are gradually changing people's travel mode choice, and subsequently, reducing the existing level of car ownership in cities.

The ubiquitous usage of smart sharing platforms has persuaded researchers to study the primary drivers of mobility platform adoption as opposed to car ownership. Researchers mostly believe that the economic benefits of car sharing will persuade people to relinquish car ownership (de Luca and Di Pace, 2015; Stocker and Shaheen, 2017). "Cars are among the most underused capital assets in our economy, sitting empty 95 per cent of the time and carrying only one individual much of the remaining time" (Shaheen, 2018, p. 56). Miramontes et al. (2017, p. 1326) observe that "a gradual change in the consumption culture towards more using and less owning, as well as the sharing economy supported by internet platforms and smartphone applications enable easy access to multiple options for daily mobility, especially in urban environments". Several research projects have shown that social factors such as social class, culture, and ethnicity influence people's willingness to use smart shared mobility. de Luca and Di Pace (2015) studied car sharing in four Italian cities and the outcomes revealed that social, demographic, and spatial characteristics such as age, gender, household income, and a general tendency to live in highly dense urban neighbourhoods, have a significant impact on people's intention to shift from car ownership to car sharing. Based on an extensive literature review, Le Vine et al. (2014) define the characteristics of car-sharing users, as young, well-educated, male, middle/upper income, single or a nuclear family, carless or single-car owner, living in an urban area and frequently using public transport, walking, and cycling.

However, the current proliferation of smart shared mobility services may not result in the mitigation of car ownership as generally perceived. In a society of automobility, car ownership has wide social symbolic meanings and functions, including being symbolic of adulthood, social status, liberty, independence, masculinity, professional accomplishment, and social group membership (Bardhi and Eckhardt, 2012; Lutz, 2014; Miller, 2001; Sheller and Urry, 2000). By analysing the 2012 California Household Travel Survey, Clewlow (2016) showed that many car-sharing users are carless households. Shaheen et al. (2016) conducted a survey in the San Francisco Bay Area and found that most casual carpool users were previously public transit riders. de Luca and Di Pace (2015) investigation on four Italian cities showed that car-sharing schemes mostly attracted public transport users instead of car users. Shaheen (2018) argues that economically disadvantaged groups who may not be able to afford car ownership are often eager to utilise car-sharing and ridesharing schemes. The convergence of these research outcomes emphasises the necessity of further investigations of the impacts of smart shared mobility on car ownership and public transport usage, particularly in car-dependent cities such as Auckland.

2.3. Autonomous vehicles (AVs) as a new mobility era

The progressive development of AVs promises several benefits such as improving traffic system efficiency, safety, reduction of parking space, better access to mobility, affordable mobility, and productive in-vehicle time use (Fagnant and Kockelman, 2015; Haboucha et al., 2017; Loeb et al., 2018; Sperling et al., 2018). "The widespread acceptance and adoption of autonomous vehicles hinges less on the techni-

cal challenge of creating self-driving cars and more on the attitudes and perceptions of the people the technology is meant to serve" (Coughlin et al., 2019, p. 293).

In response to the development of automation technologies, several researchers have investigated the widespread public acceptance of autonomous vehicles (AVs) (Buckley et al., 2018; Gkartzonikas and Gkritza, 2019; Kaur and Rampersad, 2018; Kyriakidis et al., 2015; Panagiotopoulos and Dimitrakopoulos, 2018). Since AVs are relatively costly, researchers have conducted several research projects to estimate potential users' willingness to pay (WPT) for AVs in different markets. For example, (2012), Bansal et al. (2016) and Daziano et al. (2017) studied willingness to pay (WPT) for AVs in the US. Liu et al. (2019b) conducted a questionnaire survey to study WPT in two cities in China. Ledger et al. (2018) study revealed that Australians and New Zealanders were willing to pay 43.1% more for a fully automated vehicle and 34.1% more for a partially automated vehicle. Kyriakidis et al. (2015) investigated public opinion, including WPT, on automated driving in the global context. They observed that 22% of respondents were not keen to pay for fully automated driving. However, understanding WPT is crucial to estimating future adoption of AVs. Social, demographic, and ideological factors should be considered in the pervasive usage of new technologies including AVs (Ontology, 2008; Schiffer and Skibo, 1987). Several research projects have investigated the demographic characteristics of potential AVs users such as their age cohorts, gender, education, and household income (Hulse et al., 2018; Liu et al., 2019a). Other researchers have studied the psychological factors influencing potential users' intentions to use and accept AVs, such as perceived benefit and risk (Kaur and Rampersad, 2018; Liu et al., 2019a). Further studies have considered the impacts of different demographic characteristics including, but not limited to, household size, age, gender, education, and household on potential users' intentions to use AVs in the future (Liu et al., 2019a), as well as psychological determinants, such as perceived benefit and risk, anticipated perceived dread riding, and trust in AVs. However, further research should be undertaken to determine the ideofunction of AVs and their potential symbolic functions in the society of automobility.

2.4. Shared autonomous vehicles

There are notable synergies existing between smart shared mobility and automation (Nikitas et al., 2017; McCarthy and O'Keeffe, 2018). Shared Autonomous Vehicles (SAVs) will potentially transform car ownership to on-demand mobility (Roemer et al., 2017; Sperling, 2018). SAVs will be more accessible, convenient, and flexible. Considering this, it may be conjectured that future urban mobility will likely be an on-demand service and AV private ownership will be unappealing (Fagnant and Kockelman, 2014; Greenblatt and Shaheen, 2015). "It is, however, still unclear what observable and unobservable factors will drive public interest in private and shared AVs, which may of course differ based on trip purpose" (Nazari et al., 2018, p. 456). Potential users' intention to adopt new technological motilities is dependent on their state of mind prior to the actual adoption as well as their level of information and perceptions at that time (Bansal and Kockelman, 2018; Cecere et al., 2018). A number of researchers have studied peoples' opinions about Shared Autonomous Vehicles (Bansal and Kockelman, 2018; Pakusch et al., 2018; Ho et al., 2018; Kamargianni et al., 2016; Lavieri et al., 2017; Lyons et al., 2019; Panagiotopoulos and Dimitrakopoulos, 2018; Polydoropoulou et al., 2018; Saeed et al., 2020; Sochor et al., 2018). Several research projects have revealed that public transport (PT) users have a strong future intention to use SAVs, while car owners would mostly prefer to privately own an AV (Pakusch et al., 2018; Krueger et al., 2016). Saeed et al. (2020) investigation of small- and medium-sized metropolitan areas of the US founds that potential consumers were more interested in privately owned AVs than in sharing or ride-hailing AV services. Krueger et al. (2016) considered the impacts of various social and demographic variables such as age, gender, ethnicity, income, and education on potential SAV users and concluded that these characteristics have little impact on people's intentions to replace car ownership with SAVs. Haboucha et al. (2017) compared users' preference for AVs over SAVs in Israel and the US and found that in both countries, even if SAV services were completely free, 25% of participants would not use them. In other studies, the socioeconomic characteristics of respondents, including their gender, age, employment, family size, education, and income have been shown to have a significant impact on future SAV usage. Based on a behavioural modelling framework, Lavieri et al. (2017) found that young, urban residents with a high level of education are more likely to adopt AVs and to have a greater proclivity toward the use of SAVs. The World Economic Forum and the Boston Consulting Group (2015) conducted an international survey that showed Chinese and Indian respondents were more eager to use SAVs in comparison to respondents from Japan, the US, the UK, and Australia.

The literature review thus demonstrates that there is no convergent agreement among researchers about how AVs will be adopted in the future. The literature review also reveals that the impact of the dominant ideology in shaping people's intentions to purchase or share AVs is largely overlooked in academia.

2.5. Society of automobility

Over the last century, mobility technologies have shaped our cities and everyday life (Newman and Kenworthy, 2015). Fordism has made car ownership affordable for a large number of people, and consequently, the car has become the dominant mode of mobility in modern society. Mass car ownership has reshaped and redefined social life and is associated with a set of discourses, a symbolic system, and norms and values. Hegemonic ideology and physical infrastructure have developed to promote a car-oriented social life, a 'society of automobility', that has increased our dependencies on car ownership and usage (Freudendal-Pedersen, 2016; Heffner and Turrentine, 2006).

People choose to own a car for its symbolic, experiential, and instrumental functions within the society of automobility. Transport researchers, transport engineers, planners, and geographers generally focus on the instrumental function of the car and its impacts on transportation, cities, land use, and the environment. Some empirical studies have found that people's motivations to purchase a car are beyond its instrumental mobility function (Beirão and Sarsfield Cabral, 2007; Handy et al., 2005; Mokhtarian and Salomon, 2001; Páez and Whalen, 2010). Symbolic and experiential functions of car ownership in the society of automobility include, but are not limited to, feelings of power, freedom, socio-economic status, superiority, and leisure (Freudendal-Pedersen, 2016; Gärling and Schuitema, 2007; Heffner and Turrentine, 2006; Sheller and Urry, 2000). These symbolic and experiential functions have subliminal impacts on people's motivations to purchase a car instead of using alternative mobility modes such as smart sharing mobility options. These symbolic and experiential functions emanate from ideology.

People's identification with cars is constructed through their interactions with others in the society of automobility (Gunder and Hillier, 2009). Society's hegemonic ideology and its symbolic system informs people of who they are, who they want to be, and how want to be seen by others. People may not fully be aware of the impact of the hegemonic ideology and its discourses on their interest in car ownership or their decisions to change to alternative mobility options (Freudendal-Pedersen, 2016; Gunder, 2002). As Flyvbjerg indicates (2001), positivistic approaches are unable to inherently provide a good understanding of the ideology and its impact on people and their intentions such as owning/sharing AVs or using alternative mobility options. Therefore, this research uses reflexive thematic analysis

(RTA) to investigate how the hegemonic ideology and its symbolic system inform AVs usage.

2.6. Case study

Auckland is the main trade and education hub of New Zealand. According to Stats NZ (2020a), almost one-third of New Zealand's population live in the Auckland region. Auckland has one of the highest per-capita car ownership ratios and the lowest patronage of public transport (PT) usage in the world (Imran et al., 2015; Mees and Dodson, 2006). According to the New Zealand census of 2018, 70% of all trips were made by private or company car, and only 30% by PT, sharing mobility, and active modes in the Auckland region (Stats NZ, 2020a). Auckland (2012) perceives pervasive car-dependency as a threat to liveability because it causes traffic congestion and social, economic, and environmental problems. Auckland Transport (AT) is an Auckland Council-Controlled Organisation (CCO) that is responsible for managing mobility services in the region. Over the last decade, AT has advocated PT, active modes, and sharing mobility (Chowdhury et al., 2018). It has implemented several projects to promote carpooling such as the Smart Carpooling Travel app and examined ridesharing trials such as an electric rideshare service in Devonport (Auckland Transport, 2019a, 2019b). Various companies such as Uber, Ola, Zoomy, and Cityhop have provided different sharing mobility services. Imran et al. (2015) found that most stakeholders in Auckland primarily support the provision of the infrastructure required for active modes, including the expansion and improvement of PT services around the region. AT has continued to report an increasing number of PT users and active modes over the last decade. However, according to the International Transport Forum (2017) report, shared mobility is not yet perceived as a compelling alternative mobility option for car usage. The low interest in using shared mobility services will potentially inform Aucklanders' adoption of AVs in the future. In the Auckland region, 92% of households own at least one car (Stats NZ, 2020b). In his study of car ownership, McArthur (2019, p. 54) found that "car ownership in Auckland held strong social importance, and residents thought it unimaginable to manage their everyday lives without a car."

This research focuses on the residents of Hobsonville Point (HP) as the largest planned urban development in New Zealand. According to the (HLC) report (2017, p. 4), "Hobsonville Point will have over 4,000 homes and will be home to more than 10,000 people." HP accommodates different income groups by offering a range of standalone houses, two- to three-storey terraces, up to six storey apartments, and duplexes. HP is located 25 km northwest of Auckland's Central Business District (CBD). The Upper Harbour Motorway (SH18) connects HP to the Auckland motorway network. HP is designed as a sustainable urban development model that aims to reduce "car dependency through increased local accessibility to services, excellent public transport and enhanced provision for walking and cycling" (Haarhoff et al., 2016, p. 21). Public bus services run through HP to two main public transport stations: Constellation Drive bus station on the Northern Busway and Westgate town centre. Ferries sail to Auckland's CBD ferry terminal daily (Fig. 1).

There are at least two reasons that delineate HP as suitable for this study. First, the neighbourhood has been developed to mitigate residents' car ownership by limiting the number of parking spaces, promoting active modes, and facilitating access to public transport in a reasonable catchment area (400 m). Second, the diversity of housing typology accommodates different household income groups.

2.7. Research methodology

The literature review framed the defining research aim, question, and the research methodology. The literature review revealed the hidden but generally accepted assumption that shared AVs will inevitably replace owned AVs in the future. The literature suggests at least two ontological (view of reality) and epistemological (view of knowing and the relationship between the knower and the to-be-known) issues regarding the shift from pervasive car ownership to a shared autonomous mobility system. From an ontological perspective, car ownership has been at the centre of our modern civilisation and it cannot be considered as a generic good or service that can be easily replaced by another service (Sheller and Urry, 2000). From an epistemological perspective, smart sharing platforms and AVs are emerging technologies around which there is still a lack of experience and knowledge. This research undertook to explore the attitudes of Hobsonville Point residents towards collective alternative services, including smart shared mobility platforms such as Uber, Ola, and Zoomy, to assist in predicting the future preference of residents to either share or own AVs. To answer the research question – What are the ideological implications of AVs in the future? – a literature review was undertaken that supported the use of Reflexive Thematic Analysis (RTA) as the methodology of this research. The literature review, data collection, analysis of the mixed data set, and discussion writing were developed based on RTA.

Utilising Thematic Analysis (TA) assists to identify patterned meaning across a dataset, including concepts and assumptions underpinning the collected data. TA assists in 'bridging the divide' between qualitative and quantitative methods (Braun et al., 2019). Among different TA approaches, Reflexive Thematic Analysis (RTA) provides theoretical flexibility that can be used within different frameworks to answer quite different types of research questions and to provide a coherent and compelling interpretation of the collected data set. RTA assists the researcher to traverse beyond the surface of the data, through the consideration of the dominant ideology and its norms and values (Braun et al., 2019). This advantage makes RTA an appropriate approach to investigating the ideological implications of AVs, particularly in the context of the 'civil society of automobility' (Sheller and Urry, 2000).

Researchers have increasingly mixed qualitative and quantitative methods to study social phenomena (Hesse-Biber, 2010; Sandelowski, 2000). However, qualitative and quantitative researches are often perceived as two different methods per se that embed in different epistemological paradigms. Some researchers pragmatically ask – What is needed to answer the research question? – to find the best method to answer complex social research questions (2015). Adherents of mixed-method researches argue that "the complexity of human phenomena mandates more complex research designs to capture them" (Sandelowski, 2000, p. 246). The mixed-method technique provides an "opportunity to compensate for inherent method weaknesses, capitalize on inherent method strengths, and offset inevitable method biases" (Greene, 2007, p. xiii). Mixed methods mitigate the inherent limitations of both qualitative and quantitative methods by expanding the scope of research and improving the analytic power of a study. Researchers often utilise a mixed-method approach at the 'technical level' (Sandelowski, 2000) that includes sampling, data collection, data analysis, and most often discussions. Combinations of research methods at the technical level make use of a range of innovative techniques for a variety of purposes, traversing beyond methodological limitations, and responding to complex research questions. To answer this study's research question, a mixed-method approach was utilised.

All residents of Hobsonville Point were invited to complete an on-line questionnaire survey and attend one of three semi-structured focus group discussions. The questionnaire was designed to collect household data, including the level at which residents used a private car, a smart-mobility shared platform, PT, and active modes as well as their perceptions of sharing or privately owning AVs. Invitations to participate in the survey were delivered by hand or by postal services to all occupied dwellings. The residents were able to complete the questionnaire on-line via a Survey Monkey link, or on the community Facebook page. In total, 177 completed questionnaires were collected by the end of February 2018. The survey respondents were

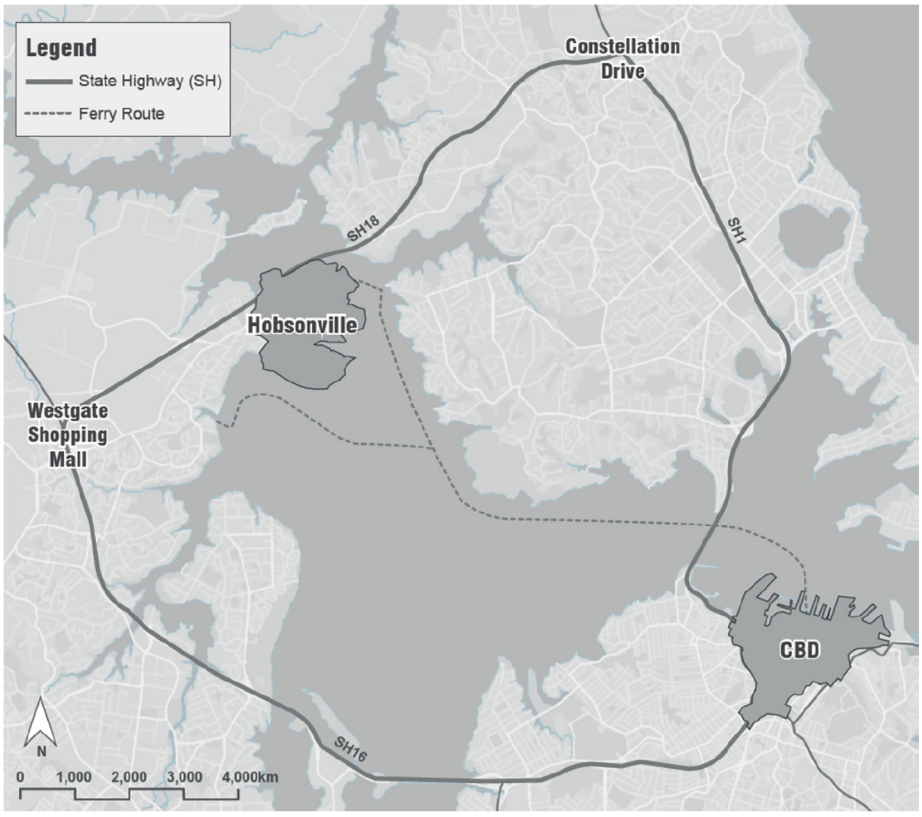

Fig. 1. Hobsonville Point's access to Auckland's CBD.

invited to participate in focus group discussions, and a call for participants was made via online social media. A total of 16 residents participated in three focus group discussions. The discussions provided a qualitative data set through which to investigate issues emerging from the questionnaire survey as well as predefined issues presented in the literature review.

The prevalent positivistic and empirical approaches in social science are often unable to understand the subjects' behaviour that is embedded in their unconscious (Flyvbjerg, 2001; Gunder and Hillier, 2009; Sheller, 2014; Urry, 2012). RTA assists in traversing beyond the positivist-empiricist limitations by including social, cultural, and ideological layers to the discussion instead of attempting to achieve a consensus between codes and themes (Braun and Clarke, 2019; Braun et al., 2019). The transcriptions of the discussions were coded under key headings and aligned with relevant information from the questionnaire responses. This involved identifying patterns within the survey and focus group interview responses in order to categorise the information for line-by-line coding. The identified codes and themes were deconstructed based on the ideology of the society of automobility. The wording and description of each category were critiqued and added to as the coding was reviewed and evaluated and the write-up of the findings developed.

3. Discussion

Understanding the characteristics of participants who took part in the survey and focus group interviews was crucial to identifying the motivations that informed the participants' future intentions for purchasing or sharing cars, including AVs. The survey revealed that most respondents were female (64%), New Zealand European (84%), and aged between 25 and 65 years (83%). Most of the respondents were from middle and upper-middle-class households (85%) (Table 1). All participants in the interviews confirmed that they had participated

Table 1
Characteristics of the Participants in the Survey.

		Frequency	Per cent
Gender	Male	51	34.7
	Female	94	63.9
	Other	2	1.4
	Total	147	100.0
Ethnic group	NZ European	115	89.8
	Maori	5	3.9
	Pacific	1	0.8
	Asian	2	1.6
	Indian	5	3.9
	Total	128	100.0
Education	No formal qualifications	7	4.8
	High school qualifications	25	17.1
	Post-school qualifications	67	45.9
	Post-graduate qualifications	47	32.2
	Total	146	100.0
Age Cohorts	18–24	4	2.7
	25–34	23	15.6
	35–44	47	32.0
	45–54	28	19.0
	55–64	24	16.3
	65–74	13	8.8
	75–84	8	5.4
	Total	147	100.0
Household income	$0–15,000	1	0.7
	$15,001–25,000	3	2.1
	$25,001–35,000	4	2.8
	$35,001–50,000	5	3.5
	$50,001–70,000	9	6.3
	$70,001–100,000	24	16.8
	$100,001–150,000	44	30.8
	$150,001–200,000	29	20.3
	$200,001 or more	24	16.8
	Total	143	100.0

in the survey. Automobility with its symbolic mechanisms is hegemonic in contemporary society (Freudendal-Pedersen, 2016; Newman and Kenworthy, 2015; Urry, 2012). Car ownership and usage have different ideological meanings and symbolic functions for different people based on their social class, gender, education, age, and ethnicity among others. Based on RTA, I consider these characteristics as factors that consciously and unconsciously constitute and, consequently, shape people's self-identifications and their expectations of themselves and others. Self-identification has two dimensions: who we are and how others see us (Heffner and Turrentine, 2006).

Hobsonville Point (HP) was designed as a sustainable neighbourhood that encourages sustainable travel modes including active modes and public transport. 80% of respondents to the survey were satisfied with access to public transport involving 10 min walking, and 70% were able to easily satisfy most of their daily needs within a 15-minute walk from their homes. Table 2 shows that two-thirds of respondents (66%) indicated that they used their private vehicle as a main mode of travel over a typical week. Only 30% used sustainable travel modes.

Interviewees considered HP as a "car-oriented development", in part because its "access to the motorway is brilliant", referring to its close proximity to SH18. In terms of active transport modes, the focus group referred to the use of bicycles and walking but saw these as largely for recreational purposes. However, buses and ferry were often used for commuting purposes, with interviewees mostly using their cars to reach the 'park and ride' at Constellation Drive. The interviewees argued that car ownership is primarily a utilitarian need. The deconstruction of interviews revealed the concealed ideofunction of car ownership in HP.

3.1. Car ownership as an exigency for middle-class families

Car ownership functions are not limited to instrumental usage; rather, they include social, symbolic, and ideological functions (Krueger et al., 2016). The ideological and symbolic functions of car ownership are embedded in the dominant hegemonic ideology and its discourse. A car "can symbolize nearly any aspect of its owner's identity and can reflect who the owner is as well as who he [or she] aspires to be" (Heffner and Turrentine, 2006, p. 1).

From a post-structural perspective, people's identity is constituted and reshaped through living and interacting with others in society (Gunder and Hillier, 2009). Subject identities "are constituted not simply as abstract moments of communication, nor in the assumed form within sociological research as 'public opinion' to be measured by surveys, but are part of deeply embedded social and machinic complexes involving the infrastructures that allow for the mobilities and coming together of people, objects, and information" [SIC] (Sheller, 2014, p. 48). Over the last century, soft and hard automobility infrastructures have been developed and expanded, which has increased people's reliance on car ownership for mobility as well as subjectively informing them that car ownership is an exigency for a decent and enjoyable lifestyle. Thus, car ownership has become a symbol of social class and status.

"The ideal of the modern family is closely linked to perceptions of the car as (the only) suitable family vehicle" (Sattlegger and Rau, 2016, p. 29). Thorstein Veblen, a Norwegian-American economist and sociologist, argues that ownership of goods such as cars serves people's status in their own eyes and in the opinions of others, which generates respect and admiration from other people and "therefore becomes the conventional basis of esteem" (2017, p. 12). Bean et al. (2008, p. 2833) argue that car ownership "enables people to juggle their family life, commitments and leisure through time and space – but, in so doing, contributes to an environment in which stretched socialities are also required, or at least expected". In HP, there is a pervasive expectation that middle-class households should have at least two cars. The survey demonstrated that almost all participants owned a car: 82% of households owned two or more cars, including vans and utes. The focus group interviews revealed that the utilitarian function of cars was one of the main drivers of car ownership. Furthermore, they felt compelled to have at least two cars. The symbolic functions of middle-class ownership of cars complements the practical necessity of car usage. Car ownership acts "out a pre-scripted part according to class categories, social stereotypes, or social roles" (Heffner and Turrentine, 2006, p. 12). One of the interviewees who lived an in an inner suburb before moving to HP argued that,

[A] key difference between Ponsonby and here [HP] is that we're 20 km from the city [CBD]. Ponsonby, you can almost walk into the city and so if what you're trying to achieve is a household with only one or two cars. You don't need to have four cars in a household … [here] you're relying on your car, so each household has to have three cars.

The primary intention for car ownership was not limited to the utilitarian function of cars and access to urban facilities and the workplace; rather, it expressed a pervasive character of middle-class New Zealand families whereby cars are a component of their identity. "Making judgments about someone based on a product they use (in this case, a car) is known as consumption stereotyping……. People evaluate themselves and others based on the vehicles they own" (Heffner et al., 2007, p. 24). The middle class, therefore, often consider cars in terms of their utilitarian and symbolic functions.

3.2. Car ownership and a sense of autonomy and freedom

Sheller and Urry (2000, p. 739) argue that "[a]utomobility is a complex amalgam" of intertwined humanist and technological dimensions. The term 'auto' is often used to refer to the technological capability of self-movement/function such as through automobiles, automation, and autonomous vehicles (AVs). 'Auto' also refers to 'self' and reflects individuality, independence, and sense of proprietorship. These symbolic functions of 'auto' suggest that the functions of autonomous vehicles (AVs) will not be limited to technological advancements but will also symbolically entail autonomous humans.

Car ownership generates a sense of autonomy and control within owners that is witnessed when people talk about their cars (Heffner et al., 2007; Kopnina, 2011). A society of automobility promotes car ownership by promising owners a sense of autonomy, power, and control over time, distance, and space. "Many countries have introduced

Table 2
The main modes of travel over a typical week (rank from most frequent 7 to least frequent or not at all 1).

	1 (Lowest)	2	3	4	5	6	7 (Highest)	Total
Private car	17	6	1	3	6	12	88	133
Car shared with others	3	12	15	7	16	15	3	71
Motorbike/ motor	33	7	4	5	2	2	3	56
Public Transport Bus	11	11	18	11	9	9	1	70
Public Transport Ferry	13	14	10	13	14	2	13	79
Walking	6	7	16	17	18	32	11	107
Cycling	26	21	14	13	6	5	2	87

the temporal withdrawal of a driver's license as a substitute for imprisonment in cases of minor crimes or offences, which expresses concretely the construction of the free citizen as a car driver" (Cass, 2010, p. 5). A car is often perceived as an extended home, or "a moving private capsule" (Sheller and Urry, 2003, p. 116) in which the owner has a sense of control and authority over time and space. In contrast, collective mobility such as PT and shared mobility are often perceived as restrictive options that limit commuters' freedom and autonomy based on fixed timetables, predefined service routes, and lack of control over space.

The symbolism of car ownership is aligned with the historic prioritisation of car movement in planning and transportation. For example, Gunder (2002) and Mees and Dodson (2006) observe that the implementation of car-oriented transport policies and urban development since the 1950 s has adversely impacted the quality, frequency, and coverage of public transport services in Auckland. The interviewees often expressed their sense of autonomy as car owners and the limitations of public transport. One interviewee indicated that when using a car, "you can go to Westgate and you can go North-West and you're there in 10 min". The interviewee's challenge to Auckland's radical public transport network reinforces the perception of car ownership as a necessity. Another interviewee shared that, "I think that the transport thing is not just about going to the city. We all go in different directions for everything. You might do it all in one day." According to a further interviewee, "public transport does not allow us to go everywhere that we want to go, and therefore we do still have cars" which promise freedom. Most interviewees perceived the collective mobility timetable options as a constraint on their autonomy and schedules. "If you want to catch a bus home from town, you've got to be on a bus at 9.30 pm.… For teenage kids, they don't want to come home at 9.30 at night. They're just going out. They've just started." If the automobile symbolises and empowers a sense of autonomy, public transport represents collective mobility and collective control which limits people's autonomy.

3.3. Car ownership beyond physical infrastructure

Over the last century, most physical and symbolic infrastructures have been developed to promote car ownership within the society of automobility (Sheller and Urry, 2000). Transport planners and policymakers often endeavour to improve the quality of service, reliability, and affordability of alternative mobility options, such as PT, which are expected to eventually result in the mitigation of car ownership. Yet, understanding the role of social infrastructure in car ownership is mostly a neglected area of research.

Over the last decade, app-based shared mobility services have grown swiftly around the world. Some have argued that these emerging app-based services will gradually make car ownership meaningless by providing affordable, flexible, and on-demand mobility services. The International Transport Forum (2017, p. 7) suggested that,

Shared mobility services can provide significant benefits to the Auckland region. On-demand Taxi-Bus and Shared Taxi services could replace private car trips and thus reduce emissions, congestion and the need for parking space. Shared mobility would also result in better access to opportunities for citizens, and make access more equitable for inhabitants of areas not well-connected to public transport.

Although the required physical infrastructure for app-based mobility has been developed in Hobsonville Point, the results of the survey and focus group interviews revealed that most participants preferred to maintain their car ownership. The survey revealed that although 91% of respondents were familiar with shared mobility services such as Uber, Ola, and Zoomy, only 41% of respondents used the available app-based mobility services.

Most adherents of shared mobility argue the need for lower travel costs as one of the main incentives for people to shift from car ownership to shared mobility in the future. However, most of the respondents (63%) indicated that they would prefer to own an AV even if the sharing option was significantly cheaper than ownership. The focus group results demonstrated that emerging sharing mobility services are not perceived as an alternative to car ownership. The interviewees used ridesharing companies as complementary to public transport and most interviewees believed that app-based mobility services were more affordable than car ownership. However, they did not consider app-based services as alternatives for car ownership; rather, they indicated that they would use these services if more cars were required in their household. According to one interviewee, "We have got two cars here [and] that's more than adequate, and round the corner here we've got… what are they called, Cityhop… if we need more cars."

Smart sharing mobility services, including car-sharing, ridesharing, and ride-sourcing, may respond to most, if not all, residents' utilitarian needs by offering on-demand and affordable mobility services. The required physical infrastructures such as the internet, smart mobility apps, and services are well developed in Hobsonville Point. For example, 98% of participants had access to the internet in their homes and 97% used smartphones and tablets. However, the provision of physical infrastructures that include app-based sharing mobility services has not resulted in the mitigation of car ownership in HP. The dominant symbolic infrastructure continues to significantly inform the residents' decisions to own cars (Steg, 2005).

4. Conclusion

This research investigated the potential adoption of AVs in Hobsonville Point as a society of automobility. The investigation demonstrates that any investigation of AV adoption in the future should include the potential utilitarian, economic, and ideofunctional benefits of AV usage. The society of automobility, with its dominant ideology, norms, and values, provides a framework for "the use and meanings of objects and practices related to them which are part of the background of everyday life" (Redshaw et al., 2008, p. 33). The neglect of the socio- and ideofunctions of car ownership will result in unexpected and undesirable outcomes in the utilisation of AVs as an emerging mobility technology. However, these socio- and ideofunctions are not perpetual, but rather are changing in society. Nolan (2010) found that an increasing preference for sustainable transportation as a new socio-cultural norm and value has decreased car ownership in Ireland. However, regardless of the New Zealand government's campaigns to promote sustainability since 2007 (the MfE., 2007), car ownership has continued to increase in the Auckland region. Despite this, campaigns have mitigated car usage and PT usage increased to 10.7% of journeys to work in 2018 (Stats NZ, 2020b). As a sustainable neighbourhood, most residents of Hobsonville Point have good access to PT and active modes and the research shows that some residents use these modes often. However, at the same time, most residents own two or more cars per household. Car ownership is not limited to a car's technofunction; rather, it includes ideofunctions which emanate from the dominant ideology of automobility. Individuals perceive car ownership as a necessity because it reflects the way they want to perceive themselves as well as to be seen by others.

The residents of HP were familiar with smart sharing mobility platforms and their economic benefits, and study participants mostly had good access to the internet and smart devices. An important target group for sharing mobility schemes is economically disadvantaged groups who may not be able to afford car ownership (Shaheen, 2018). Among the middle-class residents of HP, sharing mobility services were perceived as a complementary option should they need access to more cars or to travel to public transport stops. One may conclude that car ownership will remain dominant since the society of automobility, its ideology and its symbolic mechanism, supports ownership over sharing options. This research also found that most study

participants would prefer to own AVs instead of using sharing options. While "[t]hese preferences regarding AV modes might change over time when a substantial majority of vehicles on road network are SAVs" (Saeed et al., 2020, p. 9), deploying RTA assists to show that the ideofunction of car ownership should be taken into account when analysing AV usage in the future. Ultimately, the pervasive adoption of SAVs requires a new set of norms, values, and discourse to challenge the hegemonic ideofunction of car ownership in the society of automobility.

The research outcomes reflect the research methodology and the case study. HP as a new urban development is categorised as a relatively outer suburb. It would be useful for future research to focus on the preferences of residents of inner suburbs. Further, the survey shows that HP residents are mostly middle and upper-middle income groups. According to Shaheen (2018), disadvantaged groups are more likely to use sharing mobility. Future research could investigate the ideofunction of car ownership amongst lower income groups. Additionally, most of the study's survey and interview participants were NZ Europeans. The World Economic Forum and the Boston Consulting Group (2015) identified ethnic groups that are more frequent users of shared mobility platforms. Further investigations are required to consider the adoption AVs by different ethnicities, particularly Maori, Pacific, Asian and South Asian in the Auckland context. Gazzola et al. (2020) argue that millennials are often more willing to use sharing mobility services. The ideofunction of car ownership, therefore, may be generation dependent. Future research could investigate the likelihood of AV adoption among younger Aucklanders.

As a result of the COVID-19 pandemic, a number of researchers have begun to investigate the potential impacts of the pandemic on urban transport, particularly sharing mobility and public transportation (Hensher, 2020; Koehl, 2020; Wiseman, 2020). A post-COVID-19 city "could experience a behavioural shift with regard to crowded spaces, and public transport in particular" (Koehl, 2020, p. 1). Wiseman (2020, p 1) argues that "[e]ven when a vaccine for COVID-19 is available, a significant percentage of the population will still be afraid to travel in crowded buses" or use sharing mobility platforms. The pandemic may potentially inform people's decisions in terms of owning or sharing AVs in the future. Further investigations are required to provide a better understanding of how the pandemic could impact the society of automobility, particularly the future use of AVs and SAVs.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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