Who's behind the wheel? Visioning the future users and urban contexts of CAVs

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Full abstract

Connected and Autonomous Vehicles (CAVs) are promised by their developers to transform mobilities, making travel accessible to all – including those unable to drive due to age, affordability or disability – and thereby widen the distribution of what Urry calls 'network capital'. This paper interrogates the role of promotional visualisations about CAVs in the imagining of future automated mobilities and in the scaling up of the technologies from relatively small trials to mass roll-out. It analyses a wide range of images from a CAV trial in the UK city of Milton Keynes and demonstrates that these images reinforce rather than disrupt traditional gendered associations of automobility. This study further develops this work and notes other ways in which visualisations of CAV-enabled network mobility reiterate existing network capital inequalities. It also pays careful attention to the background urban environment in which CAVS are pictured. There is a lack of people in these backgrounds, and the city pictured also lacks place-specific imagery. The paper argues that these absences enable CAV technology to be imagined as being used in other locations and contexts. Hence the visualisations of CAV that picture only specific forms corporeal mobility also work to envision the mobility of entrepreneurial capital, as the software and hardware behind the driverless vehicle is shown as transferable to, and profitable in, different contexts and situations. This visualisation of an uneven distribution of network capital and a smooth flow of entrepreneurial capital reflects critiques of smart city enterprises more widely and betrays the claimed inclusivity of the autonomous vehicles.

Keywords: CAVs; autonomous vehicles; network capital; mobility; visual methodologies; smart cities

Introduction

'Wow, absolutely no hands? Wow, amazing!'

(observer of the LUTZ Pathfinder trials, Milton Keynes, UK)

Excited reactions, such as the quotation above, to the sight of an autonomous vehicle navigating its way around the urban environment are common in many interviews with members of the public. In the last five to ten years, Connected and Autonomous Vehicles (CAVs) have been featured on news programmes, articles, social media and in the promotions of their financial backers – often multinational, tech-based corporations such as Tesla, Google and Uber and car manufacturers Nissan and Volvo, to name a few. CAVs are coming to a street near you is the message, and many governments in Europe and the USA are allowing their public roads to become testbeds for trialling the technology in the hope of investment in the local area and economies.

The UK Government has announced that fully driverless technology will be appearing on British roads from the mid-2020s onwards (Department for Transport, Centre for Connected and Autonomous Vehicles, and Department for Business, Innovation & Skills 2016). CAVs are seen not only as a solution to a set of challenges that mass car ownership has created – from safety of drivers, passengers and pedestrians to congestion in many cities – but additionally are forecast to be a market worth up to £28bn in the UK alone by 2035, 3% of a global market of £903bn according to Transport Systems Catapult (2017). To ensure the UK is a key player in the sector now and in the future, Innovate UK and the Centre for Connected and Autonomous Vehicles (2018) have initiated several rounds of funding for consortium-based projects to develop new driverless vehicles and technologies, including a £25m fund to boost pilot schemes of CAVs.

CAVs are also framed by government and developers as providing a social value in enabling more diverse social groups – including those with mobility or visual impairments – to access to high quality and personalised transport (Department for Transport 2015; UK Autodrive 2018). On this note, then UK Transport Secretary Chris Grayling (2017) boldly stated these groups will 'discover a new sense of freedom and independence'. There is an expectation that CAVs will extend and more equally distribute what John Urry (2007) refers to as 'network capital': the ability of individuals or groups to access different forms of mobility to improve their quality of life.

As well as policy statements and funding schemes, CAVs – like many other new urban technologies (Kinsley 2010; Wilson 2014; Rose 2017; Rose and Willis 2019) – are being framed by a plethora of visual communications. These promotional brochures, websites, tweets and so on are fundamental to how the uses and users of CAVs are imagined. How these technologies are visualised provides some indication as to how the manufacturers, governments and research organisations expect CAVs to extend social inclusion in mobility and who is expected to be the users of these vehicles, should they become widely available. Like 'corporate storytelling' about smart cities, this imagery 'shapes the imaginaries and practices of a myriad of actors concretely building the city through particular case studies or pilot projects, decisions and everyday action' (Söderström, Paasche, and Klauser 2014, 307). Visualisations are created which appear in brochures, on websites, in tweets, printed on billboards and expo stands, on YouTube and Pinterest, among other sites. Given this wide circulation of imagery, in so many formats to so many viewers, the idea that these images are targeted at any specific audience is difficult to sustain. Rather, it might be more accurate

to suggest these images circulate to create positive feelings about technological innovation and new urban futures (Rose and Willis 2019).

This paper presents an analysis of the visual promotional material made for a CAV project in Milton Keynes, UK, supplemented with interviews with key stakeholders in the project. The paper analyses how the network capital created by CAVs is visualised as distributed across different social groups. By drawing on promotional material and interviews around the LUTZ Pathfinder public trials of an autonomous 'pod' vehicle, it will argue that these visualisations privilege those demographics who traditionally have high levels of network capital. The paper thus confirms and develops existing studies which show that many images of future urban transport reinforce rather than disrupt traditional gendered associations of personal automobility (Hildebrand and Sheller 2018; Bergman, Schwanen, and Sovacool 2017). However, the paper also extends that work by exploring the urban environment in which CAVs are pictured. There is a lack of people in these environments, and the city pictured also lacks place-specific imagery. The paper argues that these absences enable CAV technology to be imagined as being used in other locations and contexts. Hence the visualisations of CAVs also work to envision a mobility of entrepreneurial capital, as the software and hardware behind the driverless vehicle is shown as transferable to, and profitable in, different contexts and situations.

The next section discusses our conceptual framework, which emerged in an iterative process as we examined the images. First, we briefly review existing work on CAVs, which has paid some attention to the way they are pictured. We then discuss the notion of 'network capital' in greater depth and suggest how its distribution becomes visible in

visualisations of CAVs. We then explore the notion of the 'smart city' as an urban environment full of digital technologies but also as a testbed of urban innovation and entrepreneurship, before reflecting on how that might be part of CAV imagery. The paper then moves on to discuss its case study and methods, before presenting its analysis.

Conceptualising visualisations of CAV: personal mobility and CAV mobility

Academic attention to CAVs has thus far paid rather little attention to their association with particular social identities. For the most part, it has focussed on the technical development of the cars, the on-board technology of sensors, radar, lasers, cameras and the software that drive the vehicles. Work in transport studies has focussed on user preferences, travel time use and the compatibility of driverless cars with pre-existing and potential systems of mobility (for example Fagnant and Kockelmand 2014; Brown 2017; Haboucha, Ishaq, and Shiftan 2017; Wadud and Huda 2019; Hudson, Orviska, and Hunady 2019). These studies often focus on professionals who travel as part of their job and so comparisons are made with business people using travel time to work. For instance, Wadud and Huda (2019) examine travel time use of chauffeur-driven passengers to predict travel time intentions of CAV passengers.

An intervention from Transport Systems Catapult and University College London in the form of a workshop led to a report encouraging engagement with the social sciences to better understand CAVs (Eriksson and McConnachie 2018). Such work may focus on the lack of regulation in the public trials of CAVs, particularly in relation to their data use. For example, STS scholar and *Guardian* blogger Jack Stilgoe has lamented the underlying neoliberal ideology of the organisations developing the vehicles. The issue of data-sharing is critical for

Stilgoe because, unlike publicly-regulated industries, Google, Uber and Tesla investigate their own accidents and closely guard their 'big data' thus limiting the ability for learning from this data across the sector (Stilgoe 2017a; 2017b). Cohen and Hopkins (2019) have also drawn attention to the possible consequences of CAVs for tourism, expressing concern that algorithm-generated tourist routes will prioritise sponsored commercial locations (shopping, restaurants, attractions) over non-sponsoring sites. Another body of work in social sciences has started to examine subjective experiences and power relations in the context of CAVs. For example, in their introduction to a *Transfers* special issue, Weber and Kroger (2018) draw attention to the ways in which mobilities may be reconfigured through driverless technology and they pay particular attention to how issues of mastery, pleasure, identity and control may be transformed by autonomous vehicles.

Looking at images of CAVs raises a somewhat different set of questions, which is about who CAV developers imagine to be the users of CAVs. Several studies have shown that many images of future urban transport reinforce rather than disrupt traditional gendered associations of personal automobility (Hildebrand and Sheller 2018; Bergman, Schwanen, and Sovacool 2017). We approach the depiction of personal mobility in relation to CAVs through the concept of 'network capital', which was developed by Urry (2007) as an extension to Bourdieu's theorisation of different forms of capital (social, economic and cultural). Since mobilities are central to contemporary life and power structures, Urry defines network capital as

[…] the capacity to engender and sustain social relations with those people

who are not necessarily proximate and which generates emotional,

financial and practical benefit. (2007, 197)

Drawing on Marx, Urry identifies the centrality of mobilities to maintaining capitalism.

Access to different forms of mobility extend social relations beyond the local and are

necessary to an individual's social, economic and cultural relations and wellbeing in society.

In relating to Marx, Urry links the requirement for capitalism to create new things (eg.

products, information or encounters) to the capacity of mobility to enable these creations.

Urry thus considers network capital as comprised of different elements that enable

movement and operations at a distance including access to: transport, information and

communications on the move, spaces to travel to and meet others within their networks.

High levels of network capital can therefore improve the actor's ability to prosper.

However, network capital is unevenly distributed amongst different groups: a minority of

people are responsible for the majority of travel (Cresswell 2010; Cohen and Gössling 2015).

Inequalities in network capital are not only key to individual prosperity and a politicised

issue (Cresswell 2010) but can also be essential to survive. When Hurricane Katrina hit New

Orleans in 2005, the racial divisions between who had – and who did not have – network

capital was sharply illustrated (Urry 2007). The more distances to travel become greater and

networks become ever more complex, the more greater levels of network capital are

required simply to 'stay still' (Urry 2007) in the network further sharpening social

inequalities.

Reflecting later, Urry notes the paradox that high levels of network capital enable freedoms

for the individual alongside greater dependency on the systems and infrastructure that

'strip away certain human powers, sense of self and abilities' (2007, 202). With this in mind

we turn our attention to the shift of control of vehicles from the human to the computer.

The Society for Automotive Engineers (SAE International 2018) classification taxonomy for

autonomous vehicles of six different levels (from 0 to 5) refers to a progressive shift of

control from the human driver to the computer driver. Levels 0 to 2 are human driven but

begin to incorporate some autonomous features; by level 5, the vehicle can drive itself

under all conditions and it is this level which this article focuses.

The network capital of different groups is in part manifested in the different modes of

mobilities with which they are associated. For example, motorised forms of transport, in

particular, become associated through advertising and popular culture with wealth and

status (Cohen and Gössling 2015). The association of cars with white masculinities has been

reinforced in visual cultures of art, cinema and advertising since the mid-20th century

(Sheller and Urry 2000; Cresswell 1993; Hildebrand and Sheller 2018), and women are still

less likely to own or access private transport than men (Hanson 2010). Social inclusion in

network capital is cited by proponents of CAVs as an issue which driverless technologies

could address enabling transport to those who are unable to drive due to impairment or do

not have access to local public transport services (UK Autodrive 2018; Department for

Transport 2015). However, questions about the cost of driverless vehicles – and

importantly, who pays – raise some doubts about their potential effectiveness in this area.

It is through visioning that an insight maybe found as to how the authors and imaginers of

the future expect network capital to be distributed amongst urban populations, and to

which we now discuss.

Visioning is central to how markets for CAVs are brought into being and a major instrument by which transport industries and regulators motivate expectation, engineering, funding support and stakeholders (Bergman, Schwanen, and Sovacool 2017; Wilkie and Michael 2009; Reese 2016). The images are instruments by which capital in terms of investment, public acceptance and incentivisation is created. The imaginings of new technologies as they are materialised in policy documents, presentations, guidance texts and, this case, visualisations of the technology therefore play an important role in constructing the future user-base of the technologies. Yet as Bergman, Schwanen and Sovacool (2017) argue, these future visions often present more continuities of existing social behaviour and values than disruption and genuine innovation, or at least are rooted in the realities of the contemporary (Kinsley 2010). Bergman, Schwanen and Sovacool's (2017) study of policy and promotional material visioning adoption of electric vehicles and Car Clubs finds that future consumers are imagined to be the same independent rational decision-making actors (see also Strengers 2014) as currently assumed today. Such consumers are decontextualized from responsibilities and affordances of family, gender, age, ethnicity, (dis)ability amongst other factors. In this way, we find particular visual cultures surrounding future mobilities foreground and reinforce certain values, people and behaviours as legitimate and desirable whilst marginalising or demoting others.

CAVs visualisations also associated CAVs with particular social identities. The work of Hildebrand and Sheller (2018) makes this point clearly. In their important study, they explore how advertisements for CAV manufacturers Volvo and Nissan show particular relations between gendered differences and automobility. Advertising campaigns largely featured heteronormative and white or Japanese middle-class couples enjoying the benefits

of CAVs. Whilst men were not pictured as actively driving the vehicles, they were still predominantly in the driving seat of the car and 'delegating' driving to the CAV. Masculinity had been recast away from the active labour of driving the vehicle to directing its actions as the captain of the ship (Hildebrand and Sheller 2018). Further reinforcing gender stereotypes, the women in Hildebrand and Sheller's sample are depicted as passive, for instance, sleeping in the passenger seat. Exploring the visual content of images in this way is an effective method for understanding how new urban technologies envision not only the technologies but also the specific forms of social identities and relations (Apprich 2017; Vanolo 2014; 2016; Bergman, Schwanen, and Sovacool 2017; and see Rose 2016).   It is to how CAVs are visualised as future mobilities – and crucially who is afforded this particular domain of network capital and what and who is valued in the visual culture of CAVS – that this paper focuses. It is to these 'visions' and how they fit into wider socio-technological promotions of policy and industry that we next turn as we argue that CAVs also need to be understood in relation to 'smart cities'.

Pictures of CAVs in our case study were almost always pictured in urban environments, and visions of CAVs are often part of, or at least very similar to, prevalent depictions of the smart city as entrepreneurial, efficient and frictionless (Kitchin 2014; Goodspeed 2015; Luque-Ayala and Marvin 2016); and Milton Keynes is one of the UK's leading smart cities. There are many definitions of a smart city, but generally a 'smart city' is one where governmental, community, educational and commercial organisations gather and analyse large-scale, real-time, integrated datasets in order to increase efficiency, sustainability, citizen engagement and security (Willis and Aurigi 2018; Hollands 2008).

In the UK, under conditions of austerity (Joss, Cook, and Dayot 2017), local governments invite private companies to use their cities or towns to develop innovative digital technologies and systems in a bid to make existing urban processes more 'smart', or to gain external investment. This has led to a practice in many aspiring smart cities of continual testing and development in so-called 'urban laboratories' in order for the hardware and software systems be 'scaled up': that is, deterritorialized and reterritorialized in different places, thus increasing their profitability (Hollands 2008; Karvonen and Van Heur 2014; Halpern and Gunel 2017; Zandbergen 2017; Gardner and Hespanhol 2018).

Visioning also plays a significant part of the smart cities narrative in 'corporate storytelling' whereby technology and technology companies can provide the solution to 'problems' of contemporary urbanisation (Soderstrom, Paasche, and Klauser 2014). This narrative is reinforced, Vanolo (2014; 2016) argues, through visual depictions of the smart city as technology-dominated with visualised flows of data and transport, tall buildings and streets absent of people. The lack of human life signifying the political concealment and unconsciousness of urban citizens and residents as governments centralise the priorities of private industry over its constituents. In this sense, CAV testing on public roads fits in with a great deal of smart city activity: partnerships between local governments and private industry have led to a practice of continual testing and development on public spaces and infrastructure in cities to 'solve' the problems of urban mobility such as pollution, congestion, road safety and inclusion. The hardware and software systems are often trialled and developed in one place to be sold in other places and applications, increasing profitability. How do these images picture this entrepreneurial 'scaling up' of CAV

technologies, which is such an important part of their appeal to funders? Is that mobility visible in the image itself (Rose 2016a)? How, with what effects?

After the next section introduces its case study and methods, this paper brings these two approaches to bear on the images of CAVs created as part of a trial in Milton Keynes. It examines the visual content of the image and suggests that the uneven distribution of network capital in relation to personal mobility is very visible in what the images show. It also explores how the images itself signals the 'scaling up' of CAVs, and why. It suggests that although the CAV images were generated in a specific place – Milton Keynes – the CAV images have erased most of the place-specific content. We explain this in terms of the need for CAV technology to be mobile itself in order to be profitable for its stakeholders and investors.

Overview of case study and methods

The LUTZ Pathfinder project ran from 2016-2017 before morphing into the Aurrigo-operated pod trials that concluded in Autumn 2018. LUTZ (Low carbon Urban Transport Zone) was overseen by a consortium of industry, legal and governmental organisations, UK Autodrive, as part of a group of CAV trials in Greenwich, Coventry and Bristol as well as MK, funded by Innovate UK (2014). The LUTZ trials were co-ordinated by the Transport Systems Catapult (TSC), a government innovation agency based in Milton Keynes. The Oxford Robotics Institute (based at the University of Oxford, hereafter ORI) developed the Selenium software that drove the CAV to SAE level 5 autonomy, the RDM Group (later operating under the brand 'Aurrigo') built the 'pods' and Milton Keynes Council supported the trials with a £250,000 award (Milton Keynes Council 2017).

The CAVs used in the LUTZ trials differed from other driverless car trials by Uber and Google in that rather than modifying an existing road car, a new two-seater 'pod' was employed. Additionally, the pods were to use the pavements of Milton Keynes and interact with pedestrians and cyclists rather than drive on the roads with other motorised traffic. Milton Keynes was an ideal environment in this case. As the last of the British post-war new towns, it has wide pavements, a relatively flat topography and a network of underpasses which enable the pod to move along a traffic-free route.

Alongside the trialling of the vehicles, TSC additionally directed communications about the project to local and national audiences, informing and consulting to ensure (in their words, from the interviews) 'public acceptance' of the vehicles. At the beginning of the project, TSC commissioned an independent survey by YouGov, finding 'strong support' locally as 61% of adults stated they would be 'very' or 'fairly' interested in using the CAVs (Transport Systems Catapult 2016b). Of course, this still means that 39% were relatively unconvinced by the technology, a number reinforced by UK Autodrive's (2017) survey when 33% answered they would not use a fully driverless vehicles and further 38% answered they were unsure. Throughout the three-year lifespan of the project there has been regular local and national media coverage across social media, press and television. Regular monitoring by the authors of local and national news sources have found little negative coverage of the project in the press although an article for *The Institution of Engineering and Technology* gives voice to transport activist groups who criticise MK Council's allowance of vehicles on public pavements (Loeb 2017). The research presented here examines the images and

videos that have been created as part of the LUTZ communications as well as interviews with key figures within the TSC.

The visual promotions around the project, and especially who was pictured as included in the project and its outcomes, are important to understand. Not only because the viewer (and their values) is constructed through the image (Sturken and Cartwright 2001; Rose 2016b), but also because the assumed future users of CAVS are also constructed. Rose (2016b) outlines four sites of a critical visual methodology in which the meaning of an image is made: the site of production concerns the origins, processes and intentions of the making of the image; the site of image addresses the content and context of the image; the site of circulation concerns the movement, materialisation and control of the image; the site of audiencing considers the original and actual audiences and their positionality in relation to the image. Whilst the site of image is the focus for much the following analysis, sites of production and circulation are also taken into consideration. Methodologically the site of audience was out of the scope of this research.

The images used in this sample were selected by looking at all the images across websites and social media feeds that featured the LUTZ pod published by smart actors involved in the LUTZ project: TSC, MK Council, ORI, UK Autodrive and RDM Group, from January 2017 to June 2018. Content analysis of this images was then performed to determine the types of people shown in the images with the pod vehicle. There are, of course, limitations to content analysis notably the inability to record absence as well as presence of particular people, objects or entities (Rose 2016b). In response to this issue, the analysis framework included recording 'no people' alongside the estimated gender, age range, visible ethnicity,

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dis/ability, visible occupation and the type of image (photograph, CGI, data visualisation, mixed) of those who were pictured.

Similarly, videos were sourced from the same organisations' websites and *YouTube* channels and were also coded in accordance with the above factors. These sites of circulation (Rose 2016b) for the visuals also illustrate the 'spreadability' (Rose and Willis 2018) of digital images. The composition of the films was additionally noted: editing, pace and background music. In total, 64 still images and 13 videos were analysed along with a range of leaflets and reports from the UK Autodrive partners.

In order to gain important detail and context about the LUTZ project, we also interviewed five key personnel from Transport Systems Catapult and ORI involved in the management, public relations and execution of the trials. As the commissioners of many of the visuals, these interviewees provided insight from the site of production of the images. The semi-structured interviews were conducted both face-to-face and over the telephone ranging from 35 to 75 minutes in duration. Notably, due to the reluctance of several interviewees to be recorded, whilst some discussions were transcribed verbatim, others were recorded in notetaking. Discussion of the LUTZ Pathfinder and related CAV projects were central to the interviews, which were later thematically analysed, following guidelines set out in Braun and Clarke's (2006) framework. We also visited the TSC and were shown much of the technology being used in the project. This added qualitative insight into how the researchers and communications of the project were structured and motivated in finding their audiences.

Visualising network capital: who are the users of CAVs?

As discussed in the preceding sections, amongst the many promises of CAVs is wider access to transport beyond current social groups; those with mobility impairments, or social and economic barriers to independent travel, will be able to hail a CAV to ride when and where they like. The following sections explore the likelihood of the imagined future by drawing on the promotional literature around the LUTZ project. There is also consideration of the relationship between the LUTZ and Milton Keynes. Transport can be symbolic of cities such as London and its 'tube' network, New York and its yellow taxi cabs thronging the roads, or the choreography of tuk-tuks in Delhi, Bangkok or Jakarta. MK Council and Transport Systems Catapult (TSC, also based in Milton Keynes) have utilised the image of the LUTZ Pathfinder pod in literature surrounding the city, as the city's marketeers are keen link the experimental history of the planned city with a high-tech transport in the city's imaginary. The findings here are ordered to illustrate a narrative within the imagined network capital of the LUTZ Project and who is being privileged in the surrounding visual culture of this project; the first section discuss the diversity of the people visualised within the case study. The final section interrogate the withdrawal of people as the project reveals itself to be less about creating new forms of network capital and more about re-applying the technologies underlying this new mobility into industrial and commercial – non-transportation – contexts.

Business class? The diversity of imagined pod users

The LUTZ programme was framed by interviewees at the TSC as a possible solution to the long-discussed challenge in mobilities and transport studies of the 'first/last mile' of travel: the gap in many transport networks between the overall destination (for example a train

station) and specific destination (eg. office) or starting point (eg. home) of a journey. In this case, the traveller to Milton Keynes needs to navigate her or himself from MK Central railway station to another destination in the town centre, about 1 kilometre away. This focus on the 'first/last mile' solution may, in part, account for the emphasis in much of the visioning of ease of use, availability and efficiency, but in this section we argue that it must also be explained as a particular representation of network capital (Urry 2007).

Promotional videos for the project vary from CGI animations emphasising the seamlessness and convenience of travel to newsreel style interviews and footage of the pods in action. An early CGI video, *Driverless Pods* created by MK-based visualisation studio Virtual Viewing (2014), begins with a female voice inviting us to 'imagine' that a world of clean, quiet and comfortable transportation was at our fingertips as the site of the image opens to reveal a set of futuristic (single-seater) pods parked and waiting outside Network Rail offices (in Milton Keynes, although the town is never explicitly named). The clean, crisp lines of the CGI footage show a scene free of clutter, lightly coloured in beiges of modern building complexes and soft greens of manicured trees and hedges (see Figure 1). The bright spaciousness of the scene accentuates the desirability of this modernity.

[Figure 1 here]

From the perspective of the CAV user viewing the pods, a (white, male) hand lifts into vision holding smartphone (as in Figure 1) where a message arrives informing that the pod is ready. As part of overlapping circuits of network capital (Urry 2007), smartphones are central to the pods (as well as Mobility as a Service and smart cities more widely) and in the

videos are often used to demonstrate the convenience, ease and integration of different networks of transport, as well as indicative of a digital-literate professional. He presses a button on the screen of his smartphone and the fighter plane-like canopy of the pod lifts and invites him to sit. Inside, the calm-sounding female narrator informs us that as he is being chauffeured to his next destination, he may use his 'valuable extra time' the pod's inbuilt screen to catch up on emails, read newspapers or play games. The hand of the user is featured again as he points to and selects options from the on-screen menu. Travel time is classified here as economically valuable time. Although ethnographic studies and surveys show that this time is often used for window-gazing or non-economic activities ('productive-unproductivity') (Lyons, Jain, and Holley 2007; Jain and Lyons 2008), stated preferences amongst many professionals is for work and study, including CAV travel (Laurier 2004; Wadud and Huda 2019). The emphasis on travel time varies a little from that found in Hildebrand and Sheller's (2018) CAV research where time is used for recreational and relaxing activities. Here the focus is on work and information related activities: emailing or browsing the quality newspapers, or 'play games' as part of a break from intellectual activities. The emphasis on using travel time for personal and professional development – even the need to unwind with games – reinforces the narratives of corporate success that surround users of this pod as their layers of network capital allow for such benefits.

The pod moves in a fluid and smooth action without stopping for either foot or wheeled traffic – a seamless momentum unlikely to happen in a real city of people and objects – synchronised and naturalised within the urban environment. Here though, the world is separated from the businessman and he is free to concentrate on more 'important' tasks. The viewer is informed that the pod can take him to appropriate shops, allowing integration

with retail and leisure industries (Sheller and Urry 2000; see also Cohen and Hopkins 2019 for algorithm-generated tourist routes for commercial opportunities). The cross-commercial possibilities of the pod are further evidenced in a RDM Group brand Aurrigo's (2018) pamphlet listing one of the key benefits of pods as the ability 'to provide advertising opportunities with external graphics and internal display screens'. As part of the enhanced network capital afforded by the pods they align with capitalist agendas of creating new opportunities for exchange of goods and information (Urry 2007; see also Cohen and Hopkins 2019). Having selected the option to take him shopping, the pod arrives at (recognisably, although again unspecified) Milton Keynes shopping centre. The point of view shifts to the outside of the pod as the canopy of the CAV lifts to reveal a young, white and business-suited man.

Despite the suggestions of widening access to urban mobilities, as other studies have found (Bergman, Schwanen, and Sovacool 2017; Hildebrand and Sheller 2018; Cohen and Hopkins 2019), those with already high levels of network capital are privileged within this 'new' vision of future technologies. In the previous video and *Realising Intelligent Mobility* (Transport Systems Catapult 2016a), we see the emergence of 'resource man' (Strengers 2014) in this visions of CAV users. Strengers uses this term to describe an imagined user of smart technologies: an individual (usually male) interested in (and has time for) using data and analysis tools to best understand and rationally control his use of energy, water, transport and so on. 'Resource man' is typically middle class and this is reflected in the video *Realising Intelligent Mobility* (Transport Systems Catapult 2016a) where the pod user, this time a young businesswoman on her way to Milton Keynes from King's Cross, London (a mistake as trains to MK leave from Euston, London) books her pod from the luxury of a

First-Class train carriage. The video showcases the possibility of 'intelligent mobility',

contrasting her seamless MaaS-style journey integrating taxi, train and pod all booked and

paid for using her smartphone whilst her bumbling middle-aged male colleague (in itself an

advertising stereotype) drives and consequently is stressed by traffic lights and parking.

Given that the cost of First-Class rail tickets is roughly double that of Standard Class tickets,

there is an indication here of our female protagonist's spending potential - or the size of her

expense account. The female character also arrives at the meeting with plenty of time and

relaxed in comparison to her male colleague who arrives late and looking anything but

prepared. Transport is incorporated into professional life as a crucial part of ensuring the

user is prepared and ready for work. Notably, studies predicting demand and travel-time

use draw on professional and executive respondents who already travel in premium class

(Hudson, Orviska, and Hunady 2019; Wadud and Huda 2019). MaaS and the pods here is

targeted at a middle-class professional audience, money-rich and time-poor, who make

'smart' decisions to improve their productivity.

A later CGI animation, *Driverless pods commissioned by Transport Catapult* (Virtual Viewing

2015) begins the single shot sequence with a close-up of Milton Keynes Central station,

(highlighting the integration of different domains of network capital) before tracking

backwards until a pod comes into view, waiting patiently. The camera then rotates around

the pod before the CAV slowly drives off, past a family and a businessman talking on a

mobile phone, disappearing through an underpass. Like other videos here, the scene is

bright and sunny, emphasising the modern city landscape (in this case, an uncluttered

Station Square, Milton Keynes) and smooth, friction-free travel of the pod and other

vehicles around it. These videos blend a range of greys, beiges, greens and blues of

buildings, concrete boulevards and pavements, and sunny skies that underline the bright future ahead, as seen in Figure 2 (on the colouring of smart cities, see Rose and Willis (2018)). Station Square accentuates this vision as civic space where couples meet and embrace, and families bump into friends and there is no sign of the rough sleeping which has been a feature in recent years. The families and couple imply the heteronormativity of this city as in the foreground a heterosexual couple bump into a woman pushing a pram with child whilst an older, man in a suit talks spiritedly on his mobile phone. The population of this scene appear to be entirely white and there are no persons with visible disabilities featured.

[Figure 2 here]

These videos all imagine a future and ask the viewer to engage with this particular vision for the city transport. They offer seductive vision of clean cities and integrated MaaS solutions that will enable the commuter to move seamlessly through the city landscapes and 'gift' time to the user. Notably this 'gift' of travel time and MaaS-enabled transit is imagined here as being received by a social group who are already afforded network capital, from their use of digital smartphone technology to the integration with other modes of transport. Again, we find little indication of a diversifying userbase.

Gender, class and ethnicity are also reflected in the different roles given to people within the videos. With the exception of one woman, all 'expert' interviews are conducted with men. Even interviews with members of the public are somewhat skewed: In *Autonomous vehicles go live for the first time in UK* (Transport Systems Catapult 2016c), two members of

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the public are invited to comment. Whilst the man responds with a self-deprecating

sentence describing his inclination towards backseat driving a CAV, the woman's response is

flattened and reduced to the six words that opened this paper:

'Wow, absolutely no hands? Wow, amazing!'

Aside from the brevity in word count, the words themselves are not overly substantial other

than to position her as an enthusiastic spectator to the success of the project, in relation to

the relatively 'expert' male commentators. Indeed, the technical details and objectives of

the project are mostly explained in the videos by men. There are some substantive

comments by women in other related videos including a reasonable in-depth contribution

by a younger female member of ORI, but for the most part white males are cast in the role

as 'experts'. The gender ratio and representation of ethnicity is similar to that which was

admitted by the TSC interviewees and so the imagery here somewhat reflects their site of

production more widely.

The secondary role of women in the project continues throughout the images sample with

there is a notable absence of women pictured in or around the LUTZ. Women appear in just

nine of the 64 images and only in one image is a woman pictured on her own.

Contrastingly, there are 16 images exclusively populated by men, all but three of these

images feature the pod flanked by men in business suits including politicians, industry

leaders and Prince William (the business suit being commonly found in smart city images).

The one photo featuring a woman on her own is taken from the *Realising Intelligent*

Mobility video so the character is a businesswoman. Her smart-casual dress code suggests

she is a middle-class professional, on her way to a business meeting. This purpose is clearer

still in Figure 3 (which was featured prominently at the top of project page on the TSC website) where an older man, in a business suit complete with briefcase.

[Figure 3 here]

Throughout interviews with TSC, there was a refrain that the pods were designed with 'everyone' in mind, including those with disabilities, however it was also stated by interviewees at TSC that the project was about testing the software and not accessibility hence the pod is not wheelchair-accessible. Reflecting this, there are no people with visible disabilities present throughout the images. There are photos by RDM Group released in January 2018 (after this sample was compiled) which document a visit to the pods by representatives of Guidedogs for the Blind charity including a visually-impaired man and guidedog. Generally, there is a lack of people with visible disabilities when considering the emphasis of disabled people as one of the principle groups of beneficiaries in much of the promotional literature around CAVs. Another glaring under-representation is of non-white persons with only four images that feature humans including visibly non-white people in either a primary or background role.

The imagined users of these pods are usually alone. Two of the key images from this campaign feature passengers of the pod (rather than testers, researchers or other project staff) accessing the vehicle alone. The earlier video proposes that the pod is a single seater, resonating with an emphasis on the passenger as an independent consumer who makes a series of rational choices about their mobility (Bergman, Schwanen, and Sovacool 2017). Although interviewees claimed this was a vehicle for 'everyone' and attempts were made at

events with charities and local community groups, the sample repeatedly imagines this

'everyone' to be a lone professional or managerial worker. An individual who incorporates

the pod as part of their MaaS consumption in the largely white and male world of 'resource

man' (Strengers 2014). And noticeably this is a white world – despite the different

ethnicities present on the development teams behind the scenes – that demonstrates the

racial divisions of network capital (Urry 2007; Cresswell 2010) are still present in this vision

of mobility. Whether this is unstated yet deliberate decision or an unconscious push

towards the likely consumers of the product is unclear yet the ambiguity of targeting

'everyone' means this is a transport solution not for families, for vulnerable people and their

carers but for the professional or 'universal' (Bergman, Schwanen, and Sovacool 2017)

individual with high network capital, and as an instrument to support their busy lifestyle and

work.

Scaling up: visualising the technologies of CAV mobilities

At this point in the paper we begin to move away from thinking about who is being featured

in these images and videos, or indeed who 'everyone' is in this public campaign for the LUTZ

project. Instead we now concentrate on what is absent in these visualisations and how this

underpins an alternate destination for this CAV technologies.

Whilst we have focussed already on the people featured in the images and videos,

significantly there is a noticeable absence of humans in over half of the sample of both still

and video images: the pod is often pictured alone against an anonymous office building-

filled Milton Keynes backdrop. Even in Virtual Viewing's *Driverless pods* video (Figure 2), the

user of the pod is hidden behind the darkened windscreen and windows of the vehicle.

Indeed, in many of these visualisations, humans are hidden or reduced to body parts such as the hand or fingers used to engage the machines on their journeys. The withdrawal of individuals in many of these images related to the LUTZ reflects what Vanolo describes as one of the main tropes of smart city discourses whereby key images in smart cities are citizen-less. In an earlier article, Vanolo (2014) links the absence of humans in smart city images to the political unconscious that smart cities create, as governmental and corporate actors impose their vision of the city, compelling the citizen to conform rather than participate in the smart city projects. Similarly, the LUTZ project often focuses on the technology in development rather than the human story behind this. Humans are framed as potentially disruptions along its progress, resonating with the way in which accidents in Uber and Tesla testing vehicles have blamed on the human behind the wheel rather than the technology itself or the processes of testing the technology.

Milton Keynes also has an ambivalent role within the images and videos, being both explicitly absent yet visible within the sample as a set of anonymous urban landscapes. MK Council often heralds the city as a high-tech testbed, particularly in relation to smart cities and CAVs, but few of the videos mention Milton Keynes by name and this is usually only when council cabinet members are interviewed. Much of the promotional media also downplays the identity of the locality, and the lack of distinctiveness (and North American style of wide, gridded streets and pavements) of the urban centre allow the generically visualised environment to be universalised and imagined as other places. Indeed, several sites in Milton Keynes, including Station Square, doubled as the fictional North American city 'Metropolis' in the film *Superman IV*. The very lack of a distinctive global identity of the

streets allows for a scaling up of the technology in the visions of CAVs, as it can be imagined elsewhere in more profitable locations.

The pod itself also changes in appearance as it progress through different stages of research and development whilst still retaining its core visual identity. The pod is used across several different projects – LUTZ, SWARM, CORAM and UK Autodrive, all with different combinations of organisations working together – although the pod manufacturers, RDM Group, are always present. The pod specification regularly changes, both the vehicle and the livery it wears with several liveries have been used across the different trials and promotions: ORI's purple and white, a plain white version with logos of the UK Autodrive partners, an RDM/Aurrigo orange version, a green, black and white UK Autodrive edition and more widely used Union Jack emblazoned Innovate UK version. The pod is also being tested in South Australia and Ottawa, Canada under the Aurrigo Pod Zero brand.

The pod therefore is an imaginary object; while it can change shape and colour, the *idea* of the pod remains the same and is plugged into different scenes and environments as required by the project brief. The physical pod present in these images is a signifier of the *real* pod of the future, stimulating contemporary actors and funders into action (Wilkie and Michael 2009); a pod in a state of becoming that is never fully finished as observed by Zandbergen (2017) in relation to smart cities more widely. As with the lack of verbal or textual reference to Milton Keynes despite the recognisability of the location to those who live and visit the town, the physical, visible pod is therefore a generic product that can be deterritorialized from MK and reterritorialized (Hollands 2008; Halpern and Gunel 2017) to

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other places, times and contexts. What the pods signify then, is unstable and subject to

fluctuation as it morphs from one context and technological application to the next.

The imagined absence of humans in the driverless world is further underlined by the

framing of the passengers in the pod. No interviews take place with anyone sitting in the

pod and no person interviewed talks about the experience of sitting in the pod as it moves.

Videos of the occupants, naturally, emphasise their lack of control of the vehicle as they

hold their hands visibly off the steering wheel. Yet there are often extreme close-ups of

fingers pressing buttons on computers or PC tablet screens, hands and wrists as they tighten

bolts or adjust electronics emphasise the technical skills in developing the CAVs. This is also

observed in Figure 1 where the ease of ordering a pod is illustrated by the hand bringing the

smartphone into view as the narrator asks us to imagine the futuristic transportation 'at our

fingertips' (Virtual Viewing 2014) as 'resource man' (Strengers 2014) strikes again. The

videos here provide the viewer with an empowering message of control – even when the

control of CAVs are entirely removed from their hands – that makes attractive the

articulation of this technology as a fate rather than an option.

As discussed in the introduction, the CAV market forecast is expected to transform private,

public and commercial transport systems over the next 10-20 years in the UK and have a

potentially huge economic impact. There is an assumption present in these videos that

values and instigates a shift from transportation as a public service provided by government

to a commercial opportunity seized on by small, medium and large companies, made

possible in a context of successive neoliberal British governments. Throughout the videos,

there is an underlying implication of the inevitability of the technology, and therefore the need to ensure local and national economies are braced for the opportunities to come.

The video *LUTZ Pathfinder – Shaping the future of autonomous transport* (Transport Systems Catapult 2015) for instance, builds this sense of determinism. Opening with time-lapse photography sequences of cars travelling along motorways and urban roads, leaving glowing trails from the headlamps and taillights (another visual trope used frequently in smart city visualisations). Super-imposed captions detail how many cars are on the world and the fatalities they cause. The sped-up urban landscape and volume of traffic photographed overwhelms the viewer and is accompanied by a Philip Glass-style driving minimalist piano that emphasises the momentum of the visuals. The viewer is powerless and can barely keep up with the speed of the visuals and the relentlessness of the music. A voice bluntly states 'something's got to change…' pronouncing the urgency of the situation, before continuing 'the truth is in years to come it will be much safer being in a vehicle that's controlled by a system or a computer rather than one that's controlled by a human.' This statement is unequivocal about the centrality of CAVs to the future, further reinforced by the next speaker from the ORI: '…you're going to see it [mobile autonomy] everywhere' and later the Leader of MK Council expresses similar sentiments. The narrative reflects 'corporate storytelling' of smart cities (Soderstrom, Paasche, and Klauser 2014); of an 'imagined future' (Wilkie and Michael 2009) with a singular vision of how the CAVs will enhance urban mobility. The driving momentum of the music, of the editing and of the narration that deploys aesthetic, sonic and verbal statements of a momentous inevitability of CAV futures.

The inevitability of this future is further sustained in the absence of people within the proximity of the pod. As noted above, the pod is mostly photographed on its own without human presence, and in the videos, such as *LUTZ Pathfinder – Shaping…* above the pod is filmed driving itself about, often with the passengers obscured from view behind the windscreen. Public participation is limited in the LUTZ world, other than providing obstacles and challenges for the pods to work around. Whilst there has been some public attitude survey work (as discussed earlier) and further consultation workshops, there are just two identified members of the public interviewed in the videos. As with visions of smart cities more widely, (Vanolo 2016), for the most part, the public are relegated to the background in shots of the CAV – resonating with Stilgoe's (2018) criticism of the privatisation of machine learning and lack of accountability in the public trialling of CAVs. MK residents are absent or generally bystanders as the videos and images imply the users to be people commuting into MK from outside the town. The visual absence of people and generic presentation of the vehicle and the place illustrates the centralisation of network capital to the investing companies which will operate the autonomous technologies and apply these in non-public, industrial contexts. A practice of visioning the future is enacted (Wilkie and Michael 2009), and underlying technology of CAVs – not people – are at the centre of this vision.

Conclusions

One of the key objectives of the LUTZ project, as stated by Centre for Connected & Autonomous Vehicles (2018) and interviewees in this study, is establishing 'public acceptance' of the CAVs – especially as they are sharing the pavements with pedestrians and cyclists in Milton Keynes. As we argued earlier, visualisations of CAVs should be understood in relation to smart cities discourse that emphasises technical solutions to urban

==problems==. The underlying rhetoric of the videos and images is that CAVs will be a feature of future mobility and urban life, and the term 'public acceptance' rather than 'consultation' or 'attitudes', is cited by Centre for CAV above and by UK Autodrive as a key objective of the project. There is a risk here of society being 'locked' into a future by a consortium of CAV developers, government and investors (Porter et al. 2018). Yet the visualisations for the LUTZ project expose a gap between the wider public who are expected to 'accept' the pods and the user group who are likely to be the target market for such a technology. This paper has examined images of various kinds produced by the partners in the LUTZ project to explore in more detail just who is pictured as the CAV-user of the future.

The paper has demonstrated that from early in the project's visualisations there has been an underlying expectation as to who the user of the pods will be: In the original *Driverless pods* (Virtual Viewing 2014) video and throughout the subsequent videos, users of the pod have typically been white, professional, able-bodied and – often, although not exclusively – male, unburdened by complications of gender, ethnicity, class, (dis)ability or familial responsibilities, echoing other studies (Bergman, Schwanen, and Sovacool 2017; Hildebrand and Sheller 2018). Urry argues that 'network capital' is a key form of capital for people in contemporary societies. This paper has demonstrated that whilst discourse around the LUTZ pods has framed the universal availability of CAVs including to those with mobility challenges, the visual cultures imagining of how these pods are to be used reveals a less inclusive idea user in mind.

The paper has also argued that the absence of bodies and specified locality is as significant in the CAV imagery as their presence. This absence and abstractness underlines the

marginalisation of general publics from the discourse around driverless vehicles and smart cities more widely. As noted in discussion of Vanolo (2016) earlier, such visions produce a technology-centric city whereby the public acceptance of smart technologies is naturalised, devoid of political or civic debate or resistance. The absence of people in the images enables the CAVs to be liberated from being a solution that cures the ills of contemporary transport (pollution, safety, accessibility) to a product that can be sold globally. This aligns with smart cities discourse that corporations and technologies will provide the solutions to a set of problems that they themselves define.

CAV's monetisation potential in commercial, industrial, logistical or scientific ventures resonates with Holland's (2008) critique of the mobility of the smart city developers pitted against the spatially-fixed city. Indeed, the corporeal travel offered by the LUTZ pod is translated into a physical travel of the pod, and the Selenium software that drives it, as it is transported to new urban and industrial contexts. Should the Selenium software that 'drives' the pods be exported to other such uses, then its commercial success will have been enabled by MK Council who allowed, and the residents who shared, the public spaces in which the trials to take place. But like the photographic backdrops of Milton Keynes in the publicity images, the Council and residents' role in the development of the technology will be anonymous; the presentation of the city in the project communications as an unnamed, generic urban space suggests its potential exploitation in the future development of the technology in other cities. The mobility of capital in this instance takes advantage of, and necessitates (Hannam, Sheller, and Urry 2006; Urry 2007), the relative immobility of place and those who dwell within.

The pods are a commercial, rather than public, venture and targeted towards an affluent, profitable MaaS consumer-base rather than a socially inclusive public. The promotions considered in this study perpetuate a techno-determinist narrative with a specific classed, gendered and racialized vision, reinforce social inequalities in the distribution of network capital. This is an imaginary in which the urban mobility problems of today are solved by the data-driven technologies of tomorrow, perpetuating the neoliberal values of the smart city through its visual culture. If CAVs are to radically change urban transport in the future, then visual communications surrounding these vehicles should support the goal of social inclusion that appears elsewhere in discourse about driverless technologies; serving the public, rather than simply seeking their 'acceptance' for the technologies to be trialled on their streets.

Acknowledgements

References

Apprich, C. 2017. 'Babylonian Dreams: From Info-Cities to Smart Cities to Experimental Collectivism'. *The Fibreculture Journal* 20: 10–30.

Aurrigo. 2018. 'Join the Autonomous Transport Revolution'. Coventry: RDM Group.

Bergman, Noam, Tim Schwanen, and Benjamin K. Sovacool. 2017. 'Imagined People, Behaviour and Future Mobility: Insights from Visions of Electric Vehicles and Car Clubs in the United Kingdom'. *Transport Policy* 59 (October): 165–73. https://doi.org/10.1016/j.tranpol.2017.07.016.

Braun, Virginia, and Victoria Clarke. 2006. 'Using Thematic Analysis in Psychology'. *Qualitative Research in Psychology* 3 (2): 77–101. https://doi.org/10.1191/1478088706qp063oa.

Brown, B. 2017. 'The Social Life of Autonomous Cars'. *Computer*, February 2017.

Centre for Autonomous & Connected Vehicles. 2018. 'UK Connected & Autonomous Vehicle Research & Development Projects 2018'. https://www.gov.uk/government/publications/connected-and-autonomous-vehicle-research-and-development-projects.

Cohen, Scott A, and Stefan Gössling. 2015. 'A Darker Side of Hypermobility'. *Environment and Planning A: Economy and Space* 47 (8): 166–1679. https://doi.org/10.1177/0308518X15597124.

Cohen, Scott A, and D. Hopkins. 2019. 'Autonomous Vehicles and the Future of Urban Tourism'. *Annals of Tourism Research* 74: 33–42.

Cresswell, Tim. 1993. 'Mobility as Resistance: A Geographical Reading of Kerouac's "On the Road"'. *Transactions of the Institute of British Geographers* 18 (2): 249–62. https://doi.org/10.2307/622366.

———. 2010. 'Towards a Politics of Mobility'. *Environment and Planning D: Society and Space* 28 (1): 17–31. https://doi.org/10.1068/d11407.

Department for Transport. 2015. 'The Pathway to Driverless Cars: Summary Report and Action Plan.' London. https://nls.ldls.org.uk/welcome.html?ark:/81055/vdc_100063396695.0x000001.

Department for Transport, Centre for Connected and Autonomous Vehicles, and Department for Business, Innovation & Skills. 2016. 'New Measures to Help Britain Lead the Way in Developing Driverless Technology'. GOV.UK. 11 July 2016. https://www.gov.uk/government/news/new-measures-to-help-britain-lead-the-way-in-developing-driverless-technology.

Eriksson, Lovisa, and Stephen McConnachie. 2018. 'Autonomous Vehicles: What Can Social Sciences Offer?' Milton Park, Abingdon, Oxon ; New York, NY: Transport Systems Catapult.

Fagnant, Daniel J., and Kara M. Kockelmand. 2014. 'The Travel and Environmental Implications of Shared Autonomous Vehicles, Using Agent-Based Model Scenarios'. *Transportation Research Part C* 40: 1–13.

Gardner, Nicole, and Luke Hespanhol. 2018. 'SMLXL: Scaling the Smart City, from Metropolis to Individual'. *City, Culture and Society* 12 (Journal Article): 54–61.

Goodspeed, R. 2015. 'Smart Cities: Moving beyond Urban Cybernetics to Tackle Wicked Problems''. *Cambridge Journal of Regions, Economy and Society* 8: 79–92.

Grayling, Chris. 2017. 'Getting Ready for the Automated Car Revolution'. GOV.UK. 6 November 2017. https://www.gov.uk/government/speeches/getting-ready-for-the-automated-car-revolution.

Haboucha, Chana, Robert Ishaq, and Yorum Shiftan. 2017. 'User Preferences Regarding Autonomous Vehicles'. *Transportation Research Part C* 78: 37–49.

Halpern, O, and G Gunel. 2017. 'Demoing unto Death: Smart Cities, Environment and Preemptive Hope'. *The Fibreculture Journal* 29: 51–73.

Hannam, Kevin, Mimi Sheller, and John Urry. 2006. 'Editorial: Mobilities, Immobilities and Moorings'. *Mobilities* 1 (1): 1–22.

Hanson, S. 2010. 'Gender and Mobility: New Approaches for Informing Sustainability'. *Gender, Place and Culture: Journal of Feminist Geography* 17 (1): 5–23.

Hildebrand, J.M., and Mimi Sheller. 2018. 'Media Ecologies of Autonomous Automobility: Gendered and Racial Dimensions of Future Concept Cars'. *Transfers* 8 (1): 64–85.

Hollands, Robert G. 2008. 'Will the Real Smart City Please Stand Up?' *City* 12 (3): 303–20. https://doi.org/10.1080/13604810802479126.

Hudson, John, Marta Orviska, and Jan Hunady. 2019. 'People's Attitudes to Autonomous Vehicles'. *Transportation Research Part A: Policy and Practice* 121 (March): 164–76. https://doi.org/10.1016/j.tra.2018.08.018.

Innovate UK. 2014. 'Driverless Cars: 4 Cities Get Green Light for Everyday Trials'. GOV.UK. 2014. https://www.gov.uk/government/news/driverless-cars-4-cities-get-green-light-for-everyday-trials.

Innovate UK, and Centre for Connected and Autonomous Vehicles. 2018. '£25 Million Boost for Self-Driving Technology: Apply for Funding'. GOV.UK. 26 June 2018. https://www.gov.uk/government/news/25-million-boost-for-self-driving-technology-apply-for-funding.

Jain, Juliet, and Glenn Lyons. 2008. 'The Gift of Travel Time'. *Journal of Transport Geography* 16 (2): 81–89. https://doi.org/10.1016/j.jtrangeo.2007.05.001.

Joss, Simon, Matthew Cook, and Youri Dayot. 2017. 'Smart Cities: Towards a New Citizenship Regime? A Discourse Analysis of the British Smart City Standard'. *Journal of Urban Technology* 24 (4): 29–49. https://doi.org/10.1080/10630732.2017.1336027.

Karvonen, Andrew, and Bas Van Heur. 2014. 'Urban Laboratories: Experiments in Reworking Cities'. *International Journal of Urban and Regional Research* 38 (2): 379–92.

Kinsley, Samuel. 2010. 'Representing `things to Come': Feeling the Visions of Future Technologies'. *Environment and Planning A: Economy and Space* 42: 2771–90.

Kitchin, Rob. 2014. *The Data Revolution: Big Data, Open Data, Data Infrastructures and Their Consequences*. Sage. https://books.google.co.uk/books?hl=en&lr=&id=GfOICwAAQBAJ&oi=fnd&pg=PP1&dq=kitchin+the+data+revolution&ots=pcyjQXYk_V&sig=_S0jk9DVu1hEHBHaCcTffKah3bw.

Laurier, Eric. 2004. 'Doing Office Work on the Motorway'. *Theory, Culture & Society* 21 (4–5): 261–77. https://doi.org/10.1177/0263276404046070.

Loeb, Josh. 2017. 'Pedestrians Rage at Autonomous Pods and Delivery Bots on Pavements'. The Institution of Engineering and Technology. 6 July 2017. https://eandt.theiet.org/content/articles/2017/07/pedestrians-rage-at-autonomous-pods-and-delivery-bots-on-pavements/.

Luque-Ayala, Andrés, and Simon Marvin. 2016. 'The Maintenance of Urban Circulation: An Operational Logic of Infrastructural Control'. *Environment and Planning D: Society and Space* 34 (2): 191–208. https://doi.org/10.1177/0263775815611422.

Lyons, Glenn, Juliet Jain, and David Holley. 2007. 'The Use of Travel Time by Rail Passengers in Great Britain'. *Transportation Research Part A* 41 (1): 107–20. https://doi.org/10.1016/j.tra.2006.05.012.

Milton Keynes Council. 2017. 'MK Highways - July/August 2017'. 2017. https://www.milton-keynes.gov.uk/newsletter/read/mkhighways/2673/11236.

Porter, Libby, John Stone, Crystal Legacy, Carey Curtis, James Harris, Elliot Fishman, Jennifer Kent, Greg Marsden, Louise Reardon, and Jack Stilgoe. 2018. 'The Autonomous Vehicle Revolution: Implications for Planning/The Driverless City?/Autonomous Vehicles – A Planner's Response/Autonomous Vehicles: Opportunities, Challenges

and the Need for Government Action/Three Signs Autonomous Vehicles Will Not Lead to Less Car Ownership and Less Car Use in Car Dependent Cities – A Case Study of Sydney, Australia/Planning for Autonomous Vehicles? Questions of Purpose, Place and Pace/Ensuring Good Governance: The Role of Planners in the Development of Autonomous Vehicles/Putting Technology in Its Place'. *Planning Theory & Practice* 19 (5): 753–78. https://doi.org/10.1080/14649357.2018.1537599.

Reese, K. 2016. 'Accelerate, Reverse, of Find the Off Ramp? Future Automobility in the Fragmented American Imagination'. *Mobilities* 11 (1): 152–70.

Rose, Gillian. 2016a. 'Rethinking the Geographies of Cultural "Objects" through Digital Technologies: Interface, Network and Friction'. *Progress in Human Geography* 40 (3): 334–51.

———. 2016b. *Visual Methodologies: An Introduction to Researching with Visual Materials (Fourth Edition)*. London: Sage.

———. 2017. 'Look Inside: Corporate Visions of the Smart City'. In *Geomedia Studies: Spaces and Mobilities in Mediatized Worlds*, edited by Karin Fast, Andre Jansson, Johan Lindell, Linda Ryan Bengtsson, and Mekonnen Tesfahuney, 97–113. New York: Routledge.

Rose, Gillian, and Alistair Willis. 2018. 'Seeing the Smart City on Twitter: Colour and the Affective Territories of Becoming Smart'. *Environment and Planning D: Society and Space*, April, 0263775818771080. https://doi.org/10.1177/0263775818771080.

———. 2019. 'Seeing the Smart City on Twitter: Colour and the Affective Territories of Becoming Smart'. *Environment and Planning D: Society and Space* 37 (3): 411–27. https://doi.org/10.1177/0263775818771080.

SAE International. 2018. 'J3016B: Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles - SAE International'. https://www.sae.org/standards/content/j3016_201806/.

Sheller, Mimi, and John Urry. 2000. 'The City and the Car'. *International Journal of Urban and Regional Research* 24 (4): 737–737. https://doi.org/10.1111/1468-2427.00276.

Soderstrom, O, T Paasche, and F Klauser. 2014. 'Smart Cities as Corporate Storytelling'. *City* 18 (3): 307–20.

Söderström, Ola, Till Paasche, and Francisco Klauser. 2014. 'Smart Cities as Corporate Storytelling'. *City* 18 (3): 307–20. https://doi.org/10.1080/13604813.2014.906716.

Stilgoe, Jack. 2017a. 'Tesla Crash Report Blames Human Error - This Is a Missed Opportunity'. *The Guardian*, 21 January 2017, sec. Science. http://www.theguardian.com/science/political-science/2017/jan/21/tesla-crash-report-blames-human-error-this-is-a-missed-opportunity.

———. 2017b. 'Self-Driving Cars Will Only Work When We Accept Autonomy Is a Myth'. *The Guardian*, 7 April 2017, sec. Science. http://www.theguardian.com/science/political-science/2017/apr/07/autonomous-vehicles-will-only-work-when-they-stop-pretending-to-be-autonomous.

———. 2018. 'Machine Learning, Social Learning and the Governance of Self-Driving Cars'. *Social Studies of Science* 48 (1): 25–56.

Strengers, Yolande. 2014. 'Smart Energy in Everyday Life: Are You Designing for Resource Man?' *Interactions* 21 (4): 24–31.

Sturken, Marita, and Lisa Cartwright. 2001. *Practices of Looking: An Introduction to Visual Culture*. Oxford: Oxford University Press.

Transport Systems Catapult. 2015. *LUTZ Pathfinder - Shaping the Future of Autonomous Transport*. https://www.youtube.com/watch?v=erjo8yfyD9w.

———. 2016a. *Realising Intelligent Mobility*. https://www.youtube.com/watch?v=cixAelH0C5s&t=120s.

———. 2016b. 'Strong Local Support for Self-Driving Pods'. Catapult. 20 January 2016. https://ts.catapult.org.uk/news-events-gallery/news/strong-local-support-for-self-driving-pods/.

———. 2016c. *Autonomous Vehicles Go Live for First Time in UK*. Milton Keynes. https://www.youtube.com/watch?v=j-Lx9_IThKM&t=19s.

———. 2017. 'Market Forecast for Connected and Autonomous Vehicles'. Milton Keynes: Transport Systems Catapult.

UK Autodrive. 2017. 'Survey Finds UK Public'. 8 August 2017. http://www.ukautodrive.com/survey-finds-uk-public-still-open-minded-about-self-driving-vehicles/.

———. 2018. 'Guide Dogs for Blind Get Hands-on with UK Driverless Pod Vehicles'. UK Autodrive. 3 January 2018. http://www.ukautodrive.com/guide-dogs-for-blind-get-hands-on-with-pods/.

Urry, John. 2007. *Mobilities*. Cambridge: Polity.

Vanolo, Alberto. 2014. 'Smartmentality: The Smart City as Disciplinary Strategy'. *Urban Studies* 51 (5): 883–98. https://doi.org/10.1177/0042098013494427.

———. 2016. 'Is There Anybody out There? The Place and Role of Citizens in Tomorrow's Smart Cities'. *Futures* 82 (September): 26–36. https://doi.org/10.1016/j.futures.2016.05.010.

Virtual Viewing. 2014. *Driverless Pods*. https://www.youtube.com/watch?v=RoWxF9xvfqw.

———. 2015. *Driverless Pods Commissioned by Transport Systems Catapult*. Milton Keynes. https://www.youtube.com/watch?v=FxcPXdJnyiQ.

Wadud, Zia, and F.Y. Huda. 2019. 'Fully Automated Vehicles: The Use of Travel Time and Its Association with Intention to Use'. *Proceedings of the Institution of Civil Engineers*.

Weber, Jutta, and Fabian Kroger. 2018. 'Introduction Autonomous Driving and the Transformation of Car Cultures'. *Transfers* 8 (1): 15–23.

Wilkie, A, and M Michael. 2009. 'Expectation and Mobilisation: Enacting Future Users'. *Science, Technology & Human Values* 34 (4).

Willis, Katherine, and Alessandro Aurigi. 2018. *Digital and Smart Cities*. London and New York: Routledge.

Wilson, Matthew W. 2014. 'Continuous Connectivity, Handheld Computers, and Mobile Spatial Knowledge'. *Environment and Planning D: Society and Space* 32 (3): 535 – 555. https://doi.org/10.1068/d14112.

Zandbergen, Dorien. 2017. '"We Are Sensemakers": The (Anti-)Politics of Smart City Co-Creation'. *Public Culture* 29 (3 83): 539–62. https://doi.org/10.1215/08992363-3869596.