Autonomous Mobility Justice

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Building Critical Awareness of a Sociotechnical Transition

Pascale-L. Blyth

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A doctoral dissertation completed for the degree of Doctor of
Science (Technology) to be defended, with the permission of the
Aalto University School of Engineering, at a public examination by
remote link, held on 26th June 2020 at 12:00.

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Printed matter
4041-0619

Abstract

The self-driving vehicle (SDV) represents a new era of vehicle systems, where part or all of the driver's actions may be removed by means of a combination of new technologies. As data reshapes transport networks and geographies by creating new practices and markets, a sociotechnical transition to autonomous mobility has complex social, technical, economic and political dimensions, presenting urban planners, local and regional governments, research organizations and society with unique challenges in mobility justice.

This dissertation investigates autonomous mobility justice. Drawing from the body of research on sociotechnical transitions, it investigates the transition from the perspective of the diverse ecology of autonomous mobility intermediaries involved in or concerned by the transition in Finland, and its capital, Helsinki---representing the result of a Finnish innovation policy promoting the development of digitalization and "smart economy". Inspired by a phronetic research approach in planning, and a revealing Danish investigation of shared mobility as a sociotechnical transition, the empirical part of the dissertation consists of 30 semistructured interviews with 31 Finnish intermediaries.

Drawing from a theoretical frame that includes political theory of technology and a geographical interpretation of the Foucauldian conceptualization of modern power, a thematic analysis reveals the power relations between self-driving vehicle technology, the built environment and institutional and human actors in the transition.

The dissertation finds the need for an expanded technological design horizon, that encompasses the societal implications of the emerging technology. From the empirical enquiry, it finds that the sociotechnical transition may inscribe spatial rationalities of government and moralities on the built environment that are indicative of mobility injustice. Moreover, it finds that while the technology has several domination transcripts, other intermediaries have expressed hidden transcripts of resistance. The implications for planners and policy-makers are that autonomous vehicle technology may reshape the built environment, space and society in inperceptible ways beyond just the street level.

> " Today urban space has become a mobile, monetized technology, and some of the most radical changes to the globalizing world are being written, not in the language of law and diplomacy, but rather in the spatial information of infrastructure, architecture and urbanism. Massive global systems — meta-infrastructures administered by public and private cohorts, and driven by profound irrationalities — are generating de facto, undeclared forms of polity faster than any even quasi-official forms of governance can legislate them — a wilder mongrel than any storied Leviathan for which there is studied political response. "

——— *Keller Easterling, Zone: The Spatial Softwares of Extrastatecraft, 2012*

Preface

A doctoral dissertation is never really completed in isolation, so I would like to thank the following people who helped make it happen.

First of all, I would like to thank my supervisor Professor Raine Mäntysalo for his support, and acknowledge Miloš N. Mladenović who was my first supervisor. I would like to acknowledge the generous amount of support I received from the late Professor Moshe Givoni (University of Tel Aviv), who was a Visiting Professor in the Department of Built Environment in completing this project. Professor Givoni passed shortly before this dissertation was completed, and I remember him fondly for his generosity in using his time to help us researchers. I would like to thank my colleague Professor Claudio Roncoli, as well as Professors Bonnie A. Nardi at University of California Irvine, Hamid R. Ekbia and Norman M. Su at Indiana University Bloomington, Senior Research Fellow Kate Pangbourne at the Institute of Transport Studies at the University of Leeds and Professor Dimitris Milakis at the German Aerospace Center (DLR) Institute of Transport Research for their helpful suggestions and critique. I would like to thank Professor Marianne Ryghaug at the Norwegian University of Science and Technology (NTNU) and Professor Tim Richardson at the Norwegian University of Life Sciences (NMBU) for acting as pre-examiners of this doctoral dissertation, and Senior Research Fellow Caroline Mullen at the Institute of Transport Studies at the University of Leeds for serving as my opponent in the examination. I would also like to thank Professor Martin Vermeer of the Geoinformatics Group at the Department of Built Environment for technical support with the LATEX 2_ε repository at Aalto University. This dissertation was typeset in LATEX 2_ε.

I would like to thank Professor Janet Stephenson and her colleagues at the Center for Sustainability at the University of Otago and Professor Stephen Graham and Doctoral Researcher Jennie Day of the School of Architecture, Planning and Landscape at Newcastle University for welcoming me so warmly on research visits.

I thank the School of Engineering at Aalto University, in particular our Dean, Gary Marquis, for funding most of my doctoral research. Part of this doctoral project was funded by the European Institute of Innovation and Technology (EIT) Climate-Knowledge and Innovation Community (Climate-KIC) grant "SELF-DRIVEN areas". The Aalto Millennium Foundation funded a research visit to the University of Otago in New Zealand. I would also like to thank NTNU for funding attendance at two academic events—the Nordic Geographers Meeting (funded by the Department of Social Anthropology) and an EnergySHIFTS

Helsinki, June 9, 2020,

Pascale-L. Blyth

Contents

List of Publications

This thesis consists of an overview and of the following publications which are referred to in the text by their Roman numerals.

I Blyth, Pascale-L and Mladenović, Miloš N and Nardi, Bonnie A and Ekbia, Hamid R and Su, Norman M. Expanding the Design Horizon for Self-Driving Vehicles: Distributing Benefits and Burdens. *IEEE Technology and Society Magazine*, 44–49, September 2016.

II Nielsen, Jesper Riber and Hovmøller, Harald and Blyth, Pascale-L. and Sovacool, Benjamin K.. Of "White Crows" And "Cash Savers:" A Qualitative Study Of Travel Behavior And Perceptions Of Ridesharing In Denmark. *Transportation Research Part A: Policy and Practice*, Volume 78, 113–123, September 2015.

III Blyth, Pascale-L.. Autonomous Mobility Justice in the Situated Finnish Context: A Foucauldian Perspective on Technology, Power, and Morality. Accepted for publication in *Energy Research & Social Science*, April 2020.

IV Blyth, Pascale-L.. Of Cyberliberation And Forbidden Fornication: Hidden Transcripts Of Autonomous Mobility in Finland. *Transportation Research Part D: Transport and Environment*, Volume 71, 236–247, June 2019.

Author's Contribution

Publication I: "Expanding the Design Horizon for Self-Driving Vehicles: Distributing Benefits and Burdens"

The author and Miloš N. Mladenović, Bonnie A. Nardi, Hamid R. Ekbia and Norman M. Su were jointly responsible for writing the article in decreasing order of contribution. The lead author was responsible for developing ideas, researching content and writing the main parts of the paper. Miloš N. Mladenović, the second author, provided comments on the work and additional content. Bonnie A. Nardi, Hamid R. Ekbia and Norman M. Su provided additional content. Hamid R. Ekbia additionally provided editing for style.

Publication II: "Of "White Crows" And "Cash Savers:" A Qualitative Study Of Travel Behavior And Perceptions Of Ridesharing In Denmark"

The author and Jesper Riber Nielsen, Harald Hovmøller, and Benjamin K. Sovacool were jointly responsible for writing the article. The author of this dissertation focused on data collection from the focus groups and provided additional research material. Jesper Riber Nielsen and Harald Hovmøller focused on the semi-structured interviews and partly to the focus group interviews. Interview transcription and coding was a group effort. Benjamin K. Sovacool was responsible for final drafting.

Publication III: "Autonomous Mobility Justice in the Situated Finnish Context: A Foucauldian Perspective on Technology, Power, and Morality"

The author was solely responsible for writing the article.

Publication IV: "Of Cyberliberation And Forbidden Fornication: Hidden Transcripts Of Autonomous Mobility in Finland"

The author was solely responsible for developing the article idea, conducting the interviews and writing the article.

List of Acronyms

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Introduction

1.1 Mobility justice and the challenge of autonomous mobility

The opening quote taken from Keller Easterling's "The Spatial Softwares of Extrastatecraft" (2012) refers to the unprecedented power of governance wielded by urban "meta infrastructures": an amalgam of urbanism, technological and other systems spanning a global scale and driven by capital.

The anthropologist Bonnie A. Nardi (2017; 2018) considers smart city technologies such as autonomous mobility to have such polity. A product of industrial capitalism, digital technology emerged to be hailed a "saviour" in economic crises since the 50s, providing abundant corporate profit opportunities in liberal, capitalist systems. Created by companies who lobby governments, receive subsidies and favourable legislation, these technologies are selected for profitability, and sold as expensive solutions to urban problems, which they deliberately leave out. Thus, they are insinuated into urban infrastructure, embedding capital in society for profit, and not for solving social problems. As infrastructural technologies, they have huge scale, and are very hierarchical. As a result, they have powerful lock-in effects, with important implications for social justice which are difficult to mitigate due to lock-in.

How may a digital technology such as autonomous mobility have polity in the built environment? According to Sheller (2018), mobility justice is the result of a complex intertwining of the spatial, political, and societal dimensions of human life in the built environment. Sheller (2018) draws from Fainstein (2014); Lefebvre (1991); Harvey (2006, 2009); Urry (1985) and Soja (1989) to understand space as a political place, involving contestation, reflecting social relations and

power in a given society. Mullen and Marsden (2016) argue mobility justice is about how people's lives matter in the built environment

This political contestation is between the interests represented by infrastructure and its human users, a Marxist concept (Marx, 1867). Because "the fundamental mission of the neoliberal state (is) ... to optimize conditions for capital accumulation" (Harvey, 2006, p. 25), cities push for infrastructure projects as a means to economic growth first, whilst putting the social consequences second, sometimes resulting in social injustice (Fainstein, 2014; Harvey, 2006). They are "mobilized and mobilizing" of capital and labour to serve the interests of international investors. Moreover, modern mobility's purpose is to facilitate the movement of means of production (capital, labour, energy, etc.) to enable further capital accumulation (Urry, 1985).

But infrastructure becomes a place of contestation between different groups in relations of power and justice and injustice to each other through the infrastructure (Sheller, 2018). The material infrastructures of the automobile defined spatial relations according to gender, colour, nationality, age, sexuality, differential abilities, etc. (Sheller, 2018). Cars engender the social submission of some groups to others in public space: in terms of who they injure (vulnerable road users), who they are affordable to (men mostly), how they depict men and women in advertising (typically gendered) (Jain, 2005), and what energy source they use (Ryghaug and Toftaker, 2014, 2016; Ryghaug and Skjølsvold, 2018). Public spaces, including public transport, can be unsafe places at night for women and other groups (Matrix, 1984). Transport history is rife with examples of mobility injustice against people of colour—from NY master planner Moses deliberately designing low overpasses into the city to prevent bus travel, mostly used by poorer people of colour, to nicer parts of New York city (Winner, 1986), as well as segregation inside public transport; to American trams being associated with whiteness, technological progress, and cleanliness (Sheller, 2018). Mobility injustice may be a thoroughly modern state of affairs: women were active users and occupiers of street space in preindustrial times (van den Heuvel, 2019), and a gendered one too: Wilson (1991) argues the rise of modern urban was embodied in a discourse of male-female dichotomy of order versus chaos.

Autonomous mobility represents a vision of transport technology that has arisen from the information technology market and is set to shape mobilities, built environments and mobility justice in ways bigger than the car. Driving this vision of mobility (Docherty et al., 2018) are information and communications technologies (ICT) developments and new ICT-enabled business models (Sheller and Urry, 2016). The Self-Driving Vehicle (SDV) is an arrangement of technologies whose aim is to remove some or all of a driver's actions and interventions; and serving to make mobility automated. While conventional vehicles were already technologically sophisticated, making use of sensing, processing, and communications technologies to collect, process, and communicate data about the vehicle (such as engine performance) and its environment (such as parking sensors or reversing cameras), autonomous mobility technology is effectively

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grounded in the generation, processing and management of a large quantity of data. To navigate any environment, and make and monitor driving decisions with little or no human action, SDVs must make use of a multitude of powerful, sophisticated sensors, increased processing power and data storage capacity accompanied by sophisticated algorithms (Leen and Heffernan, 2002; Olariu and Weigle, 2009; Ozguner et al., 2011; Baskar et al., 2011).

The spaces created by autonomous mobility technology comprise not only material, but also digital infrastructures that define spatial relations in ways that will have repercussions for mobility justice. Kellerman (2018) argues that automated mobility spaces may become a space of contestation of automated mobility technologies, users, and intelligent mobility spaces. They may offer new opportunities for spatial growth (Kellerman, 2018) and gender rebalancing (Balkmar and Mellström, 2018), or alternatively create or reinforce mobilities injustices towards certain groups of users. The digital technical systems in autonomous mobility may reproduce the gendered and racialized nature of the technological systems behind automobility, extending them to autonomous mobility (Hildebrand and Sheller, 2018; Weber and Kröger, 2018; Joelsson and Lindkvist Scholten, 2019), alone or in combination with the urban infrastructure they are embedded in. Electronic networks were engineered and brought into being by military and hacker communities of men, and today constituting networks of power dominated by men in business, finance, crime, war, pornography and hate speech—free of regulation, mobilizing political control and economic power (Wajcman, 2004, p. 4). Sheller (2018) points to the creation of business "kinetic elites"—evidenced with business entities such as Ford rebranding themselves as "mobility businesses" instead of "automotive makers". Autonomous mobility may frame value, and the framing of value may undermine autonomous mobility justice by privileging the choices and preferences of some and not others (Mullen and Marsden, 2016). Mobility injustice may be by design—with innovation studies under enrolling certain groups (such as women) in the technological innovation process. For example, "[a]gents in mainstream social studies of technology are most commonly male heroes, big projects and important organizations" (Wajcman, 2004, p. 43-45). Speed may be made desirable and an item of conspicuous consumption associated with the technological sublime (Hildebrand and Sheller, 2018)—giving rise to potential speed hierarchies (Easterling, 2015) and an elite of the "well-sped" (Illich, 1973).

While the dominating discourse is a positive one, imbuing technology with magical powers to solve social ills, there are the critical voices that seem to identify the threats to mobility justice, which, firstly, provide the motivation for the study, and secondly illustrate the importance of mobility justice. This dissertation considers autonomous mobility in the situated Finnish context, a bellwether for the study of the governance of digital urban systems. Autonomous, shared, and smart mobility feature prominently in a Finnish innovation policy that aims to leverage its ICT and telecommunications successes to foster a sociotechnical transition to that will bring capital accumulation to the country.

Effectively, an approach to a transition that seems rather unproblematic from the transport justice perspective may not be such when a societally broader concept of mobility justice is introduced.

1.2 Aim and scope of the dissertation

This dissertation aims to improve the state of theory and knowledge in relation to mobility justice described by Sheller (2018); and in particular the question of autonomous mobility justice. To address this knowledge gap, this dissertation considers four research questions (RQs 1-4), each with a specific research objective, and presented in Table 1.1.

Table 1.1. Research questions

	Research Question	Research Operationalization
1	**Theorizing autonomous mobility justice:** Does the technological design horizon encompass the benefits and burdens of autonomous mobility technology?	Publication I investigates by means of an interdisciplinary literature review the many social facets underpinning the technological design horizon—highlighting the social complexity brought by a powerful technology and providing the basis for the investigation of autonomous mobility justice.
2	**Conceptualizing the research design:** What kind of research design is needed for investigating perceptions related to autonomous mobility justice?	Publication II conceptualizes a research design that brings together concepts of users in shared mobility and sustainability transitions using the context of Danish shared mobility as proof-of-concept.
3	**Developing a theoretical conceptual frame:** What could a theoretical frame building on Foucauldian conceptualization offer to the research design?	Publication III examines how we may get a conceptual grip on infrastructural power and understand its implications for autonomous mobility justice by means of a Foucauldian theoretical perspective.
4	**Intermediaries' perspectives from the "intelligent mobility landscapes":** How are domination and resistance through technological infrastructure articulated in the intermediaries' narratives; and what does this tell us about mobility justice?	Publication IV considers power by understanding the domination by the technological infrastructure and losses by society, constituting new transition- and mobility justice landscapes. The empirical setup draws on narratives from the intermediaries in the Finnish context that anticipate the outcomes of autonomous mobility transition. The power and mobility justice implications of these are interpreted by using Scott's concepts of dominant and hidden transcripts.

Publication I argues the need for an "expanded technological design horizon", accounting for the changing role of the human inside and outside the vehicle as well as consequent impacts on sociotechnical structures and practices. Starting

with the current visions of SDV benefits and limitations, and their shortcomings, it warns of the danger of not looking beyond narrow conceptions of technology centered around usability and usefulness, and as a result neglecting the complexity of broader sociotechnical systems and the interdependencies between technical and social justice considerations. It argues that a starting point for such a paradigm shift, and expanded technological design horizon, is to study what people are doing with technical systems and why. It shows how a more holistic approach to the technology is needed, focused on the human. It establishes the background and agenda for the research in broad terms—the setting on which the research design is built with the theory, methodology and the empiric.

Publication II serves to conceptualize the research design of this doctoral dissertation, acting as a proof-of-(methodological)concept. In view of the findings from the literature review in Publication I on the need to expand the technological design horizon in autonomous mobility, it asks "what kind of research design is needed?" Publication II brings together concepts of sociotechnical systems, transitions, and intermediaries for another "new mobility" (Sheller and Urry, 2016), namely in the context of Danish user perceptions about shared mobility ("carpooling"), a form of mobility that is part of the public discourse in Denmark. Drawing from 47 semi-structured interviews and five focus groups (approximatively 50 respondents), it provides a good insight into the motivations and tensions surrounding ridesharing, and their complexity—suggesting that the qualitative framework in the research design may be adapted to provide a rich insight into autonomous mobility justice through the eyes of the actors in the transition.

To paraphrase Easterling (2015), Publication III presents a conceptual understanding of the "political character of infrastructure space" To that effect, Publication III uses a Foucauldian lens of biopower and governmentality adapted to geographies of power and political theory of technology. Publication III investigates how autonomous mobility may result in "spatial rationalities of government" (Huxley, 2007) and "diagrammed moralities" in the built environment, with implications for social justice. Using 30 semi-structured interviews with 31 respondents representing an ecology of Finnish intermediaries in the sociotechnical transition engendered by autonomous mobility technology, Publication III finds several potential spatial rationalities and moralities that may be diagrammed in the built environment by autonomous mobility, potentially affecting social justice.

Publication IV draws from theories of geographies of power to explore transcripts of domination and hidden resistance in the autonomous mobility transition. Publication IV considers intermediaries in the autonomous mobility transition to examine Finnish perceptions of autonomous mobility using a Foucauldian lens of biopower, governmentality, and political theory of technology. Using conceptualizations of Foucauldian power adapted for the study of geography of power and anthropology (Scott, 1985, 1990), it explores, by means

of the afore-mentioned interviews with an ecology of Finnish intermediaries, the values embodied in SDV technology, and the resistance and tensions to it. Publication IV finds three dominant transcripts of technological agency on the built environment (liberation of the driver, safety of the driver, customer accessibility), and four hidden transcripts of social context (restrictions in sharing space, vulnerability of the passenger, loss of safety of shared space, and loss of privacy), providing, in the words of Axsen and Sovacool (2019), "a particularly broad and dynamic perspective on SDVs".

1.3 Structure of the dissertation

To conclude this introduction to this doctoral dissertation, it behooves to provide the reader with a guide to the structure of the dissertation in the chapters ahead. To facilitate the path of the reader, the chapters are described below.

Chapter 2 expands the concepts introduced herein this introduction into a theoretical framework that will serve as the basis for the research design. It considers the nature of SDV technology, the sociotechnical system, autonomous mobility regime, Foucauldian power and concepts such as dominance and resistance.

Chapter 3 explains the research design used in this dissertation. Building from the theory in Chapter 2, it starts by introducing the importance of an approach that considers culture, followed by elaborating on the investigation of sociotechnical transitions and the choice of empirical context. Secondly, it considers research design—briefly introducing a research design elaborated for a Danish techno-cultural context, namely shared mobility, and used as a basis for the research design for the Finnish case study. Thirdly, it presents the Finnish data sample and collection method. Fourthly, the chapter presents the limits to methods and to the data collection, and finally the ethical considerations encountered with the collection, storage, and coding of the data.

Chapter 4 presents research insights gained from the dissertation, and introduces ideas for possible future research. Starting with research insights, these are divided into four sections, each of which frames a different research question, shown in Table 1.1. The first section provides research insights from taking a wider perspective than just transport justice. The second section reflects on the research conducted in Denmark to elaborate a research design for Finland. It considers aspects specific to the study of sociotechnical systems in transition, including regimes, infrastructure, users as consumers to users as intermediaries, etc. The third section reflects on the research insights that have been gained from using the Foucauldian frame. The fourth section reflects on the research insights into autonomous mobility justice. The fifth section reflects on the value of the approach of this dissertation—in terms of lessons learned, research design, and its implications for the design of future research on the one hand, and its mobility justice relevance to planners and policy-makers on the other.

2

Theoretical and Conceptual Framework

This chapter outlines the theoretical and conceptual framework of this dissertation. It begins by expanding the concepts behind autonomous mobility justice introduced in the previous chapter by explain the interrelation of technology and justice in the context of modernity and the built environment. From there, the chapter introduces the structural power of autonomous mobility technology. The chapter then introduces Foucauldian conceptualizations of modern power, bringing them to the empirical with the introduction of theories of spatial rationalities, public domination and hidden resistance. Firmly rooted in geographies of power, these theories are uniquely suited to exposing the deeper structures of power written about by Foucault, taking power discourses into the planning dimension.

2.1 The structuring power of technology

Chapter 1 introduced briefly the question of autonomous mobility justice, bringing to the fore questions of space, automobility, and digital technology. This chapter builds on those foundations to take a deeper theoretical approach to the problem.

Technology embeds social relations on a large-scale in a "grand narrative of modernity" (Rochlin, 2004) by means of large technical systems (LTS). LTS comprise numerous physical and institutional components, including infrastructure, data, organizations, knowledge, laws and many more that interact with each other in ways that are "socially constructed and socially shaping" (Hughes, 2012). They are spatially expansive, interconnected, and capital intensive (Sovacool and Hess, 2017). Moreover, they are organized according to Taylorist and Fordist principles, comprising myriad professions, to minimize financial

and other risks, and maximize profit. These include engineers, planners, academics, politicians, media and advertising professionals, and many others. In Ellulian terms (Ellul, 1964), these professions are the "technicians" (Foucault, 2000, p. 352) of the system. They turn the city into a laboratory for individual disciplines, where problems are "in the city" rather than "of the city" (Harvey, 2006). LTS represent a new form of governing and regulating social relations in urban environments. Historian of technology Thomas Hughes (2012) considered them powerful enough to have laid a material foundation for the entire modern American civilization.

Drawing on structuration theory (Giddens, 1984), LTS constitute infrastructure that constrain humans in their daily practices (their agency) to perform and reproduce a particular social structure. Moreover, their size, complexity, and embeddedness in human life, give them structuring power. Social justice and its opposite, "social evil", something that is "morally bad" or damaging to society, are the resulting social structures. Human users and the actors behind infrastructure have differing levels of resources, limiting their agency and therefore power. Those with large capital resources to build material infrastructure, and large technological systems, can shape social structure across society, including transport geographies and human agency to enable movement. New mobility technologies empower subjects differentially (Blomley, 2010), favouring some, whilst heightening the immobility of others. As a result, depending on the motives of the powerful actors that build these systems, governmentality, a concept that will be explored in the next sections, can be about compliance to socially evil systems—socially evil systems that may require resistance to oppose (Galvin, 2020).

Different forms of mobility require different built environments with different levels of structuration, potentially resulting not in the maintenance of patterns of life by built environment and technology, but their reconfiguration. Drawing from amongst others, John Urry (2004), Henderson (2009) contrasts the authoritarianism of automobility, which requires the state-backed large-scale regimentation of urban space to maximize the quantity and speed of moving people and goods, huge state subsidies and a powerful oil, highway, automotive manufacturing and real estate oligopoly, with active mobility, which does not. The urban planner Jane Jacobs (1962) argues in a humanist perspective, that the life of the city is constituted by the humans using sidewalks to constitute social practices and networks, whilst the death of the city is exemplified by corridors of circulation devoid of such social meaning in the urban context. Historically, the political contestation of space is modern. Modernity resulted in the industrialized city being planned and constructed through the male gaze of utilitarian experts, controlling of the movement of women, minorities and children, or even removing them from urban space altogether (Wilson, 1991), and purifying public space of the deviant or different (Blomley, 2010). Tools of governance represented male power of orderliness, and made cities dangerous places for women and minorities (Wilson, 1991). Moreover, if the right to the

city is about being granted access to the streets, and women (Wilson, 1991) and minorities (Sheller, 2018) have never fully been granted access to the streets, they suffer social injustice. If the act of walking in the city, by virtue of its simplicity and accessibility, has traditionally offered freedom to women (Wilson, 1991; Solnit, 2014), autonomous mobility may, by virtue of the large scale and power of its technology, be more authoritarian, embodying social relations to produce a place that advantages and disadvantages various groups, both inside and outside the vehicle.

2.2 The Large Technical System of autonomous mobility technology

Henri Lefebvre (2005) argued that space is socially constructed to reproduce the social relations of production. He recognized the power of technology to socially construct space, and was concerned about the power of ICT to socially construct space in general, and its colonizing of everyday life in particular. Digital urban technologies, such as autonomous mobility, structure social relations in urban space, monetizing it as part of a new capitalism in myriad ways and creating injustices. Digital technologies, by their embeddedness in built environment infrastructure, their scale and hierarchy, have "lock-in" effects.

Deleuze and Guattari (1997) contend that machines and technologies match their societies, expressing the social forms that make and use them. The political economy of autonomous mobility technology has roots in the Marxist conceptualization of the political economy of machinery in the Industrial Revolution (Marx, 1867) and is shaped by the political economy of ICT. Automation, from the Greek "automatos" (self-doing), is at its simplest defined as "a bunch of self-operated mechanisms" (Kellerman, 2018). While in pre-industrial Europe from Ancient Greece to Byzantine Constantinople, automata served as a display of wealth, the Industrial Revolution saw them become a tool for the accumulation of wealth (Malm, 2016). Driven by new energy inputs, machines redefined our relationship with the means of production (labour and nature), offering increased, and more predictable productivity and profit for an emerging capitalist class.

Deleuze and Guattari (1997) contend that capitalism has mutated away from production, to what Harvey (2003b) terms "accumulation by dispossession": a new form of capitalism based on rent extraction using property rights and spaces of enclosure (Andreucci et al., 2017). The app-mediated user access, algorithms, and databases of autonomous mobility help create new spaces of enclosure. Anthropologist Bonnie A. Nardi (2017; 2018) argues that in that process, data is reified, turned into a magic object seen as key to solving every social ill in a process of technological fetishism (Harvey, 2003a; Hornborg, 2001, 2014), dematerialized, devoid of economics, conflict, and interests. Reprising Kaika and Swyngedouw (2000), the dematerialization of data commodifies mobility, then fetishizes it (severs it from its social process of production) through ICT such as;

in the case of autonomous mobility; apps, algorithms and databases. These are effectively political technologies that create new spaces of panoptic enclosure (David Murakami-Wood, 2007) to facilitate the economic exploitation of users, in a new form of capitalism based on rent-extraction using technology and based on spaces of enclosure and property rights (Andreucci et al., 2017; Harvey, 2003b). Data is aggregated from multiple sources to constitute populations of users, socially sorting them using AI, to generate statistical, rather than causal truths, turning users into docile "data entities" in the biopolitical sense to be optimized for politics and profit, in a manner that reflects the dominant interests of the institutions involved (Albrechtslund and Klauser, 2014; Garrido, 2015; Zuboff, 2019). French philosopher Gilles Deleuze and psychoanalyst Felix Guattari 1997 term these individuals "dividuals", and masses, samples, data, markets "banks". Deleuze and Guattari (1997) might term the myriad data-brokers in autonomous mobility the new rentier class.

Moreover, these new panoptic spaces characterizing this new capitalism may serve to hide the social relations embodied in the technology. Namely, Kaika and Swyngedouw (2000) observe an ensuing hidden nature to urban technological networks serving to hide the social relations and recast modernity and the modern city. New mobilities may be reinventing old ones, and modernity may be being recast by reifying the data and the technology making use of it to enable the system—possibly both to hide failures of the preceding mobility systems (such as perceived failure of public transport, or congestion) (Kaika and Swyngedouw, 2000), and imbue the new technology with magical power to solve social ills around mobility in a form of technological fetishism (Hornborg, 2001; Harvey, 2003a).

Autonomous mobility technology effectively shifts relations of power between users, technology and space (Kellerman, 2018). Automation both minimizes or removes the need for human action to make and monitor driving decisions in many environments (Leen and Heffernan, 2002; Olariu and Weigle, 2009; Ozguner et al., 2011; Baskar et al., 2011), and shifts power from users to the engineers (Kellerman, 2018). While users determine the destination, activate (and deactivate) the mobility process and decide operation timing, engineers gain dominance over time and space resources, human resource cost savings, and increased production volumes (Kellerman, 2018), in a form of Taylorization in the service of capital gain (Harvey, 2003a). ICT will regulate the spatial mobilities of people, goods, and information over space and time, creating automated and autonomous mobility spaces and intelligent mobility landscapes of interconnected cars and infrastructures (Kellerman, 2018); and effectively embedding new social relations in the built environment. Users are disempowered by automation to extract profit, and limited in their travel choices. Autonomous mobility gives engineers the power to inscribe social relations in space, creating autonomous mobility spaces (Kellerman, 2018). In extracting value from users, autonomous mobility affects the social relation between capital (transport infrastructure) and labour (users).

Moreover, as artifacts, machines were and are still imbued with magical powers to solve all social ills—in a form of technological fetishism (Hornborg, 2001; Harvey, 2003a). But, David Harvey (2003a) argues, fetishist fantasies of total technological control can result in the unjust implementation of technology systems, benefiting larger, more powerful actors with lower labour surpluses, and burdening smaller actors with large labour surpluses. LTS based on ICT may have therefore prove especially powerful in their consequences on users. Moreover, David Harvey argues, such "hierarchy of expertise and strong centralization of decision making" (Harvey, 2003a, p. 23-24) do not make for democratic and autonomous individuals.

2.3 Foucauldian power

Michel Foucault's conceptualization of power has sociohistorical roots in industrialization and the rise of capital. Driven by new energy inputs, developments in Western scientific thought, and a rise in capital, the Industrial Revolution brought a shift in relations of power, associated with new technologies of government and the emerging political concept of democracy (Foucault et al., 2008; Wilson, 1991). Industrialization resulted in sovereign power (the power of death by the sovereign) giving way to a more distributed form of power involving the management and government of populations (the power of life). Incidentally, this shift of power was facilitated in western cities, as traditional feudal relations of power did not hold there and new forms of social organization emerged, as early as the middle ages (Wilson, 1991).

In the Foucauldian sense, " 'government' refers to the way in which the conduct of individuals or of groups might be directed—the government of children, of souls, of communities, of the sick... To govern, in this sense, is to control the possible field of action of others." (Foucault, 2000, p. 326). For that purpose, government, and the government of society makes use of certain "apparatuses" of power ("dispositifs"). Foucault conceptualized "governmentality" as "the conduct of conduct", namely "the ensemble formed by institutions, procedures, analysis, reflections, calculations and tactics that allow the exercise of this very specific albeit complex form of power which has as its target population" (Foucault et al., 2007, p. 88).

Foucauldian governmentality has several constituent parts: the production of a population of "docile bodies" (anatomo-politics), (or in this case of mobility, "docile mobile bodies"), the management of the population of docile bodies (biopower) using apparatuses of power; and the creation disciplinary regimes replacing delinquency with "discipline of the self". Foucault describes it as "body as machine; its disciplining, the optimization of its capabilities, the extortion of its forces, the parallel increase of its usefulness and docility, its integration into systems of efficient and economic controls, all this was ensured by the procedures of power that characterized the disciplines: the anatomo-politics of the human

body . . . the species body, the body imbued with the mechanics of life and serving as the basis of the biological processes: propagation, births and mortality, the level of health, life expectancy and longevity, with all the conditions that can cause these to vary. Their supervision was effected through and entire series of intervention and regulatory controls: a biopolitics of the population." (Foucault et al., 2007, p. 490, originally in History of Sexuality, Volume I).

The study of governmentality is therefore a study of the mechanisms used to order and manage population, and the resultant "regimes of truth" defined by expertise and experts embedded in the bureaucracy of power, making it relevant in critical planning and policy research.

While Foucault writes before the era of autonomous mobility, he writes that the infrastructure in a city has the role of governing "circulation" through a number of urban apparatuses—typically a relational ensemble of discourses, institutions, regulations, technological and spatial objects, and forms of knowledge. Foucault gives as an example the 19th century town plan, whose layout he considered a disciplinary mechanism to make individuals visible, and whose institutional mechanisms included savings schemes for renting or purchasing accommodation, health insurance, old-age pensions, and rules on hygiene which functioned as regulatory mechanisms. Planning and designing those apparatuses requires professional knowledge, making space fundamental in any exercise of power (Foucault, 2000). Therefore urban planning, Foucault argues, is power itself.

2.4   Spatial rationalities of government and diagrammed moralities

Governmentality includes not only the things shaping the behaviour of others and the self, or the technologies of power for knowing and directing the qualities of a population, but also the rationalities of government—regimes of truth—behind the steering of conduct. As Rose (1999, p. 19) puts it, analyses of governmentality are studies of " . . . the emergence of particular 'regimes of truth' concerning the conduct of conduct, ways of speaking the truth, persons authorized to speak truths, ways of enacting truths and the costs of so doing. Of the invention and assemblage of particular apparatuses and devices for exercising power and intervening upon certain problems". The nature of a regime of truth has implications for social justice in subjectification (Hull, 2013).

Huxley (2007) argues a regime of truth is not neutral, but embodies rationalities of government and moralities. These are then embodied in the built environment, to facilitate the governmental production of subjects, creating a "spatial rationality of government"—a space that disciplines and controls (Huxley, 2007). The built environment may therefore promote or limit certain practices, by means of the materiality of its design, but also by means of a multitude of other dispositifs of power.

Moreover, the design of space itself is not neutral. The dispositifs of governmentality have, according to Rabinow (1989), "discursive materiality", telling

a story of the motivations of government. The built environment, including infrastructure, spaces, and technologies; embody moralities, rationalities and logics. Modern space and place have intelligent design, the aim of which is the subjectification of a population, to govern it with purpose. It is effectively political, as it can be designed to diagram certain moralities. Osborne and Rose (1999) give the example of the 19th century city, having grids for discipline and ordering, constituting productive spatial rationalities supporting moralities of cleanliness, aesthetics, and social progress. Huxley (2007) gives the example of a "dispositional" spatial rationality characterized by a Cartesian efficacy of geometric ordering, combined with incarceration of citizens exhibiting devious behaviour.

2.5   Domination and hidden transcripts of resistance of the subject

To understand the complex entanglements of power faced by user-intermediaries in the context of autonomous mobility, this dissertation makes use of a framework drawn from Foucauldian power concepts, widely used in the study of geographies of power (Cresswell, 2005) and anthropology.

When asked about the power of architectural projects to foster liberation or resistance, Foucault answered: "I do not think that it is possible to say that one thing is of the order of 'liberation' and another is of the order of 'oppression'. . . . (N)o matter how terrifying a given system may be, there always remain the possibilities of resistance, disobedience, and oppositional groupings" (Foucault, 2000).

The car is argued to be a good case study of "violent submission" of certain groups, in particular women, to others Jain (2005). The SDV may reconfigure and augment this "violent submission" in new ways to new groups. To that effect, this dissertation considers autonomous mobility in the context of domination, submission, and resistance.

Scott (1990) reprises and adapts Foucault's conceptualization of power to an anthropological context. He considers power from the perspective of public domination and hidden resistance. According to Scott, dominance and resistance cannot be separated, but instead are inextricably linked in complex entanglements of power. Systems of domination, he argues, perform a public transcript of their interaction as dominators with the groups that are dominated/oppressed. The dominated, while appearing happy to comply with the domination, question it in private. This split between the public and the hidden is crucial, reflecting power and the lack of it. He has documented practices such as "foot-dragging, evasion, false compliance, pilfering, feigned ignorance, slander and sabotage" in rural (more dispersed and less politically organized) and factory settings, and tax- and conscription evasion among the middle class and elites (Scott, 1985, p. 29).

This dissertation applies Scott's theories of power to the dominance of techno-

logical systems. Autonomous mobility infrastructure has a public transcript in how it interacts with users, because technology is not neutral. How users react to that, feel about it, critique this technological power, is the hidden transcript of resistance. While users of autonomous mobility may appear acquiescent by using the technology, or implementing it, they may question it. This dissertation considers this by interviewing actors.

As such, Scott's conceptualization of power provides operationable tools for handling interview materials. Secondly, analysing dominance and hidden transcripts using Scott's conceptualization of power exposes better the deeper structures of power written about by Foucault. Namely, while Foucauldian discourses are hegemonic, Scott (1990) takes the discourses in to the planning and policy dimensions where people can discuss power (Publication IV).

2.6   The next chapter

The next chapter (Chapter 3) introduces the research design of this dissertation. It begins by introducing this dissertation as research inspired by and situated in the tradition of the study of "culture". Bridging the theoretical and the empirical, it first considers the role of users in the investigation of sociotechnical transitions. Secondly, it introduces the choice of empirical context as a techno-political and socio-historical one, with Finland presenting a unique technological and political context.

The chapter then considers the elaboration process involved in the research design for sociotechnical transitions. In that context, it presents briefly the design of a pilot study on Danish attitudes to ridesharing, which formed the basis for the elaboration of the Finnish research design. Using that design as inspiration, it presents the research design elaborated for the Finnish context—a study of the ecology of Finnish organizational intermediaries in the Finnish data sample.

Having presented the research design and data samples collected for this dissertation, the chapter then presents the limits to methods and data, as well as the ethical considerations in data collection, use and storage.

3
Research design

This chapter draws from the theoretical and conceptual framework presented in Chapter 2 to outline the research design used in this dissertation. The chapter starts with relating the sociotechnical transitions research tradition of investigating users with the choice of empirical context (Sections 3.1 and 3.2). It then proceeds to present the qualitative methodology design. For that purpose, it briefly introduces a Danish ridesharing study of Danish users-as-consumers using semi-structured interviews as a proof-of-concept to gather a rich testimony of human experience informed by the context of the sociotechnical system. Chapter 3 then introduces the research design for the Finnish case study, which examines user-intermediaries in the context of autonomous mobility in Finland—involving 30 semi-structured interviews (n=31). The chapter then outlines the limits in the data collection and methods, and ethical considerations on data collection, storage, and coding.

3.1 Investigating sociotechnical transitions: the importance of users

The transformation of sociotechnical systems is characterized by shifts in relations between actor groups, between infrastructures, and between technologies and contexts of application (Kivimaa et al., 2019). Drawing from a research tradition based on the sociotechnical systems perspective, whereby technology creates the need for sociotechnical transitions by reconfiguring social relations (Winner, 1993), this dissertation considers a comprehensive understanding of users (Oudshoorn and Pinch, 2003), in particular "user-intermediaries" (Kivimaa and Martiskainen, 2017; Kivimaa et al., 2019; Martiskainen, 2017; Schot et al.,

2016).

There are a lot of definitions of what an intermediary is, and by extension, a multiplicity of definitions of what the process of intermediation is or should be (Kivimaa et al., 2019). In a sociotechnical transition, intermediaries are actors that have many roles: bridging, facilitating, constructing, and brokering the transition with other intermediaries. They are protagonists in sociotechnical transitions in a context of promissory storylines about technology (van Lente, 2012), indicative of the social organization of a system, and reshape the boundaries of a system–as users and as organizations (Guy et al., 2012, p. 7–8).

This research considers intermediation as the process by which actors in or concerned by a sociotechnical transition "translate" (in the broad sense) a technology (Guy et al., 2012)—an approach that considers the built environment an assemblage of things such as infrastructure and people and their practices, influencing and influenced by each other. This approach has important advantages. It allows the consideration of a wide range of intermediaries that may differ substantially from each other—helping the process to be understood as a set of power relations, which, viewed through a Foucauldian lens, help reveal questions of mobility justice. Moreover, the approach enables the accounting for resistance to change, as well as adoption, thus revealing the entanglements of power brought by the technology. Moreover, the study of intermediaries in sustainable transitions is mostly a new field (going back to Van Lente et al. (2003)), with multiple definitions of what an intermediary and their role is (Kivimaa et al., 2019), this approach builds on and extends the body of knowledge on the conceptualization and role of intermediaries.

This dissertation considers two kinds of intermediaries, as defined by Johan Schot 2016: user-intermediaries (shaping the needs and desires of users as well as products, infrastructures, and regulatory frameworks in Finland; and user-consumers (appropriating products and services, producing meaning and purpose, and testing new systems in Denmark.

3.2   The choice of empirical context

Finland presents an interesting context for the study of transitions by way of being a leading knowledge-based society with an innovation policy which combines elements of the Finnish welfare state, Finnish politics and market economics (Niinikoski and Kuhlmann, 2015; OECD, 2017).

It originated with paying war reparations in the form of ships and technology, which forced Finland to develop a technological innovation policy. Industrial sectors were developed, such as ship building and paper production. However, following international shocks in the early 1990s, including the collapse of Soviet trade, the globalization of capital and timber markets, Finland deliberately shifted from being an industrial to an informational economy focused on emerging ICT technologies. Under the aegis of a three-tiered two pillar structure

articulated by the Ministry of Education and Culture and the Ministry of Employment and Economy under the leadership of the Research and Innovation Council mediating between academic research and technological innovation (OECD, 2017, p. 156, p. 157, p. 161), firms, financial institutions, universities (to leverage a highly educated workforce), ministries and state agencies concerted to adopt, diffuse, and use technology (Halme et al., 2014; Hyytinen et al., 2006; Ornston and Rehn, 2006) in a social-constructivist process (Niinikoski and Kuhlmann, 2015). Several industries have successfully emerged (e.g. Nokia in wireless technologies, possibly the best-known example), and after the financial crisis and a shift in policy from innovation to research, are continuously emerging, and shaping innovation policy (OECD, 2017; Aro and Heiskala, 2015; Niinikoski and Kuhlmann, 2015).

Several national innovation strategies in health, bioeconomy, and sustainable urban development are coordinated across several ministries and agencies to further the Finnish government strategic objectives of "1) improving employment and competitiveness; 2) reforming of knowledge and education; 3) promoting in health and welfare; 4) facilitating the bio-economy and clean solutions; 5) reforming ways of working through digitalization, experimentation and deregulation" (OECD, 2017, p. 154).

The national innovation strategy on sustainable urban development, known as the "six cities" strategy (OECD, 2017, p. 161), combines digital transformation and urban development. Digitalization is to help design better cities and open new markets, openly not in a purely technology-driven fashion but a rather more human-centred one (Ministry of Economic Affairs and Employment, 2019).

A simultaneous development of new mobility services together with digital platforms for cities and for the sharing economy (OECD, 2017; Halén et al., 2016). A Finnish smart mobility industry, using emerging concepts such as Mobility-as-a-Service (MaaS) (The MaaS Alliance, 2016) and autonomous mobility (Temmes et al., 2014), would leverage the Finnish communications networks industry (especially 5G), high ICT use, monetize driver travel data and the large customer databases of banks and insurance companies. According to Kari Wihlman, Head of the Finnish Transport Agency, "There are huge possibilities in utilizing data and transforming them into services. . . . In global terms, we are talking about billions of euros. In the utilization of new kinds of mobility services, Finland could be a path opener." (Sippola, 2018)

Policy measures to support the smart economy include favourable corporate taxation, liberalized regulation, favourable technology trialling laws and easy data use. Competition and consumer protection laws are written with digital platforms in mind, while public procurement favours them. Organizational co-operation, opening public data and standardization are encouraged. Success stories about Finnish platforms and digital services are told, and new experts trained for the digital platform economy and service design (Halén et al., 2016). As an example, to maximize efficiency in moving goods and people, the Finnish Act on Transport Services (Ministry of Transport and Communications, 2018) re-

quires all transport service providers to open and share standard data by means of a machine-readable form via open interfaces. Shared data includes routes, stops, timetables, prices, availability and accessibility; whilst ticket and payment systems and interfaces must be shared and interoperable (a requirement for public procurement): effectively interconnecting multiple single transport systems with each other (Pursiainen, 2019).

This research is timely in informing about the impact of innovation policy. Niinikoski and Kuhlmann (2015) argue that Finnish innovation policy is socially constructed, and therefore privileges particular technological interests. Kivimaa and Mickwitz (2006) show that the greening of Finnish innovation policy is not unproblematic. raise questions as to the question of sustainability transitions and Finnish innovation policy. Moreover, Harvey (2003a) and Hornborg (2001) argue that technological innovation policies represent a highly institutionalized form of technological fetishism, where technology imbued with the dual magical power to create wealth and solve all manner of economic and social problems (Harvey, 2003a).

3.3 Research design for sociotechnical transitions: An ecology of Finnish organizational intermediaries of autonomous mobility

In the first instance, the dissertation investigates an ecology of organizational intermediaries (including some representing users) in Finland.

Using an approach common in transitions research involving typologies of intermediaries (see, for example, Kivimaa and Martiskainen (2017), as well as Kivimaa (2014); Kivimaa et al. (2019); Martiskainen (2017); Schot et al. (2016); Van Lente et al. (2003); van Lente (2012)), 30 thematic research interviews involving 31 respondents were carried out (12 female, 19 male, one interview involved two respondents). Respondents were intermediaries drawn from a network of 23 institutions from the public, private and civil society sectors involved with and touched by the emergence of SDV technology in Finland. Importantly, those considered to be intermediaries in the emerging transition were not just drawn from the professions—but were deliberately drawn from a broader ecology. In Table 3.1, the Regional Transport Authority, the Regional Development Agency and the Material and Energy Efficiency Agency are owned by the municipalities in the greater Helsinki region. The two national government agencies represented traffic safety and transport networks and infrastructure. Respondents in the research organizational field represented intermediaries from transport, privacy law, constitutional law and campus management. Interviews were conducted over the course of late 2016 to early 2017. The majority (26) of the interviews were conducted face-to-face, two interviews were conducted over the phone, one interview over Skype, and one by email. Thirty of the respondents were located in Finland in the Helsinki capital region and one outside Finland. Judgement sampling was used, consisting of a list of key and

specialized respondents, supplemented by snowball sampling to complement the intermediary ecology. Table 3.1 shows their organizational positions.

The sample size was deemed to be sufficient when no new material or respondents were forthcoming. Some limitations in the sampling occurred—more respondents from special groups and other, non-capital, cities were wished for, but it proved impossible to find willing respondents from these institutions during the empirical research period.

In total, six questions were asked of the respondents, designed in a semi-structured manner to elicit a broad narrative, spanning from the general to the particular:

Q1: What are your views/opinions on the future of self-driving (vehicles/mobility) in an urban environment? (general question about SDVs)

Q2: What are, in your opinion, the most important factors from the point of view of your organization on SDV technology as a means of transport? What is the position of your organization on SDV technology as a means of transport?

Q3: Is your organization somehow preparing for self-driving vehicles? In your opinion, what are the key organizations that should take part in decision-making?

Q4: What do you think are the strengths and weaknesses of the concept of Self-Driving Urban Area, in PESTEL terms? (SUA specific)

Q5: What factors do you think enable and hinder the concept of Self-Driving Urban Area, in PESTEL terms? (SUA specific)

Q6: Any other opinions that you would like to add?

The research design was inspired by the research design of the Danish ridesharing study in Publication II. In the Nordic countries, ridesharing is regarded as a means to achieving a transition to sustainable mobility (and reducing greenhouse gas emissions) and is part of the public discourse. Users are considered key to sociotechnical transitions, as intermediaries of the new practice. On that basis, the study investigated users and non-users across a number of locations across the country to provide a representative picture of perspectives. They included Copenhagen (the capital and largest city), Aarhus (home to the second largest city and home to the largest university), Aalborg (the third largest city), Herning (in the industrial heartland of Jutland), and Skjern (a small rural community). The Finnish case, in contrast, investigated the diverse ecology of intermediaries involved in or affected by developing the new autonomous mobility regime.

Table 3.1. Respondents and their affiliations

Organizational field	Respondent affiliation	Number of respondents
Regional and local government	Local government authority	2
	Regional government authority	1
	Regional development agency	1
	Regional transport authority	3
	Material and energy efficiency agency	1
National government	Finnish government ministry	1
	Governmental agency 1	2
	Governmental agency 2	1
Finnish public authority independent from executive branch	Public authority for children's rights	1
	Public authority for privacy rights	1
Private sector	Autonomous mobility consultancy	1
	Finnish smart mobility start-up 1	1
	Finnish smart mobility start-up 2	1
	Public transport operator	1
	IT services company	1
	Sustainability innovation consultancy	1
Traffic association	Representative body for road traffic	1
Research	University 1	2
	University 2	2
	National government research organization	2
Civil society	Umbrella organization of citizen neighbourhood associations	1
	Representative body for disabled people	1
	Election candidate, political party	1
	Curator, robotics exhibition	1

3.4　Coding of the data

All interviews were transcribed and a thematic analysis was performed of the transcripts, allowing themes to emerge from the data.

Thematic analysis (Braun and Clarke, 2012) is "a method for systematically identifying, organizing, and offering insight into patterns of meaning (themes) across a data set." It is characterized by its examination of collective or shared meanings (so it is not about unique or single meanings) in a set of respondents, by means of coding data for themes across a data set. As such, it is a method whose strengths include avoiding complex theoretical underpinnings (such as discourse analysis), and as such is more accessible to a broader audience in use and in research results.

Braun and Clarke (2012) stipulate that coding may be inductive or deductive, and frequently both, and that clarity in the choice is a characteristic of good thematic analysis. An inductive approach means that the themes emerge from the data itself, a deductive approach means the data is coded against a pre-existing concept or theory.

This doctoral dissertation combines inductive and deductive thematic analysis: inductive as themes of technology, built environment and practices emerged from respondents' stories, deductive as we draw on theoretical constructs from social studies of science and technology, and geographies of power, such as domination and resistance and Foucauldian conceptualizations. During the coding process, seemingly diverse codes were aggregated, as it became apparent some were about technology, others spatiality, and others practices. Publication III reviewed existing coding in light of Foucauldian power conceptualizations.

According to Braun and Clarke (2012), a theme "captures something important about the data in relation to the research question, and represents some level of patterned response or meaning within the data set." The themes that emerged say something about the data beyond the individual questions and responses, and relationships between intermediaries and the technology in the context of geographies of power.

With regard to the coding, constructing themes was very hard. I noticed codes clustering around technology, built environment, and practices, which could be conceptualized in terms of geographies of power. However, following Braun and Clarke (2013) to the letter raised several issues. For instance, the division between the inductive and deductive does not seem so important in the obtention of findings, but rather a convenient convention. Secondly, the organizational nature of the respondents, namely their role as intermediaries in or concerned by the transition, made it difficult to code for one overarching theme, eliciting instead a multiplicity of perspectives.

Coding was performed using ATLAS.ti software (versions 7 and 8). To make sense of the data, an emergent coding scheme was used, as suggested by Lofland et al. (2006).

It is through initial content analysis of the transcripts that the theoretical

framework used in Publication III, emerged as appropriate. The interview transcripts were reread and coded for repetitive themes that could be characterized as dominant transcripts of technological agency and hidden transcripts of context.

3.5 Limits to methods

The use of stated preference methods such as interviews do have some notable benefits and drawbacks, which were first identified in Publication II, and were found to be to some extent present in Publication III and Publication IV. Interviews enable interactivity because they encourage respondents to talk openly, and also allow the conversation to attain suitable momentum that enables in-depth exploration of topics (George and Bennett, 2004).

As a minus, the qualitative aspect of interview responses made them difficult to code especially as answers varied for each respondent. Responses may sometimes have expressed a degree of social desirability, or predictability as a means to gain approval from the researcher—possibly brought about by the variety of respondents on the topic.

The analysis of the discourses of power was grounded on a phronetic research approach (Flyvbjerg, 2004), revealing knowledge that a systemic modelling approach does not. In this case, however, this occurs potentially through the implementation of a technology system, namely self-driving vehicles.

3.6 Limits to data collection

This section sums up the limits to data collection in this project.

The Finnish sample of user-intermediaries faces a number of limitations. More responses from older people, children, housing associations; as well as from ethnic minorities, queer mobility amongst others. A factor in this state of affairs was the location of the research in a department with a strong inherited transport engineering tradition of focusing on the systemic, a technologically-educated, white and male transport planning faculty, and an academic funding system that prioritizes the development of technology and its supporting sociotechnical system as part of government innovation strategy. Likewise, the high number of women in high positions in transport institutions in Finland helped increase the gender equality of the sample. Many female respondents suggested new, female respondents through snowballing.

Moreover, an important consideration was preserving the anonymity of participants. The Finnish transport planning community is a small, but friendly group. Even with anonymization, there was a real possibility of respondents recognizing each other through the anonymization. Respondents therefore were informed of this risk, and specifically asked if this was a problem. Not one

respondent objected or raised issues.

Moreover, the discourses identified from the interviewees' speech tended to be compartmentalized–i.e. planners talk about space–and some having broader coverage than others. Moreover, while the transcripts were selected to be revealing in terms of power relations, they are neither exhaustive nor finite. In the phronetic research tradition, they should be considered as a basis for further enquiry as part of a process of continuous knowledge making. Perhaps more richness and a more detailed outcome would have been achieved with a grounded approach.

In the collection of all data samples, limitations were encountered with the practicalities of recruiting participants, language barriers (some respondents dropped out because of feeling unconfident in English).

3.7 Ethical considerations in data collection, use and storage

The Finnish data set was collected in line with the guidelines of the Finnish National Advisory Board on Research Ethics (Finnish Advisory Board on Research Integrity, 2012), in compliance with the Finnish Personal Data Act (523/1999) (Finnish Ministry of Justice, 1999), and checked by the Aalto University Legal Office. An interview protocol was drafted, as well as a data collection and storage plan. It should be noted that the Finnish Personal Data Act (523/1999) (Finnish Ministry of Justice, 1999) has now been repealed by the new Data Protection Act (1050/2018) (Finnish Ministry of Justice, 2019) that entered into force on 1 January 2019.

Before the interviews, the respondents were sent information in the email invitation about the study (a short description, as well as two fact sheets) and the purpose of the data collection, the estimated time of the interviews and contact details for the study.

At the interviews, the participants were asked to give their consent though the signature of a release form, or verbally in the case of phone interviews, and were offered a copy of the Finnish Personal Data Act (523/1999) (Finnish Ministry of Justice, 1999) for reference, as well as a spare copy of the data release form for reference. The Finnish Personal Data Act (523/1999) (Finnish Ministry of Justice, 1999) stipulates that respondents may withdraw prior consent at any time. The data release form stipulated who had access to data, how long it would be stored for, where it would be stored, who to contact to withdraw consent or address any other queries, and legal address; therefore providing respondents with a spare was good practice. Particular care was taken to explain to respondents that they may be recognizable, despite anonymization, by other respondents who may know them professionally, as the sample of respondents is small and part of the same ecology—a well-known issue in qualitative enquiry that can have negative consequences for the researcher and the respondents.

During the interviews, permission was sought to record, and the respondent

was informed when the recording would start. The interviews were recorded on a small journalistic recording device, and transferred and stored on Aalto University servers for security and backup, and, in compliance with data storage regulations, only accessed using an Aalto University computer by the author and her original supervisor.

One of the most delicate, and challenging parts of the data collection was the anonymization process, as was considering how to put this material into the public domain.

Data was collected anonymously—recordings were anonymous (i.e. were assigned a number), and respondents spoke knowing they were recorded. They could stop the recording if they wanted to say something off the record. The recordings were made on a journalistic recording device, and transferred to university servers immediately and removed from the device.

Recordings and list of participants were stored in secure separate files on password protected university servers, offering data security and backup. As per the research protocol agreed with participants, only my first supervisor and I had access to them. After changing supervisors, my new, second supervisor did not have access to the recordings or transcripts.

Personal names were replaced with aliases where deemed necessary, proper names were categorized (though the Finnish statistical classification was not followed), and background information (such as job title and organization) were categorized.

Anonymization always reduces information in the data, and this had to be balanced with the value of showing the organizational position in the smart mobility ecology. Therefore, data was first pseudonymized—to reflect the nature of the organization and the professional background. The European General Data Protection Regulation 2016/679 (European Commission, 2016) states that data can be a direct identifier (name, position, etc.) or an indirect identifier (weak or strong), and care was taken to ensure pseudonymization removed identification. In the first instance, respondents were assigned a generic job title and generic institutional classification, to reflect their perspective in the intermediary ecology. This served to coarsen the data, to help further prevent identification. For instance, a respondent might be identified as "Founder, tech start-up 1" or "Founder, tech start-up 2". Even if the organization might be identified, the individual respondent cannot. At the transcription stage, all direct identifiers (such as references to employer names, etc.) were removed.

To ensure anonymization, an additional step was taken to destroy the encryption file to the pseudonymisation.

4

Research Findings

This chapter summarizes the research findings of this dissertation under the four original research questions presented in the introduction. In answering RQ1, an interdisciplinary literature review in Publication I shows the many social facets underpinning autonomous mobility justice. In answering RQ2, Publication II conceptualizes a research design based on the study of intermediaries in sociotechnical transitions in shared mobility in the Danish context as proof-of-theoretical-concept for a study of intermediaries in the sociotechnical transition to autonomous mobility in the Finnish context. In answering RQ3, Publication III finds that the Foucauldian conceptual frame revealed a number of potential spatial rationalities of government and moralities diagrammed in the transport system, showing that the study of power relations offers a deeper understanding of sociotechnical transitions. In answering RQ4, Publication IV finds that interviews revealed potential hidden changes in social and spatial relations, embodied by three dominant transcripts of technological agency and four hidden transcripts of social context. Finally this chapter reflects on the lessons learned from this research, and contemplates potential avenues of further research.

4.1 Expanding the technological design horizon for autonomous mobility justice (RQ1)

Publication I investigates by means of an interdisciplinary literature review the many social facets underpinning the technological design horizon—to determine whether the technological design horizon encompasses the benefits and burdens of autonomous mobility technology. Its starting premise is that technology is a

profoundly social phenomenon, highlighting the social complexity brought by a powerful technology and provides the basis for the investigation of autonomous mobility justice.

Publication I starts by highlighting how strongly SDVs are conceptualized in terms of technologies—to construct automation and autonomy—and imbued of algorithmic authority over human authority. In that light, autonomous mobility technology is a technologically deterministic system.

Publication I outlines a raft of technologically-mediated visions of autonomous mobility futures used as means to disrupt today's technologies, contrasted with a great many unknowns about the future. Visions promise reduced negative externalities (fewer traffic deaths and injuries, pollution, greenhouse gas emissions, congestion and parking shortages, amongst others). But these visions are accompanied by many uncertainties about the consequences of the technology for the human, society, and the built environment, creating the need for investigation.

Current visions of expected benefits and limitations stem from technology development practices situated in the dominant market-based culture, shaped by myriad interconnected institutions including the media, government, law enforcement, and the insurance industry. This includes the glamorization of speed by the entertainment industry, alcohol and automotive advertising by mass media (which makes substantial revenues for advertising in programming typically targeting a young male audience—with many accidents involving young males resulting from beer consumption combined with speeding), and the insurance and automotive industries, in combination with law enforcement and government.

Technologically-mediated visions deem "algorithmic authority" superior to "human authority" without the existence of any necessary rich set of scenarios and use cases which might assess the social consequences of this new technology. Publication I finds that the changing role of the driver, and the power imbalance between the driver and SDV technology commercial interests (technology companies) must be considered, but are missing from autonomous mobility development. Moreover, the technology is so powerful, that it may be authoritarian, and engender a police state. Namely beyond the implications for the driver, and for the built environment, current development visions neglect a range of potential implications of the technology for civic values such as privacy, harmony, and mutual respect.

As the potential burdens of autonomous mobility go beyond those of the automobile, Publication I finds that there is a need for a broader vision on SDV development—one that goes beyond just solving the problems of the automobile to take into consideration the societal dimensions and their interdependencies of this new technology. There is a need for scenarios and use cases. Moreover, the deterministic nature of the technology is used to replace the discussion and debate with stakeholders that is the basis of planning and policy practice. It is this technological determinism, concludes Publication I, that is the source of injustice—as technology designers and implementers have a responsibility to

design for the future for all people in an equitable way.

In light of the findings of Publication I, a research design is needed that investigates the technology beyond "algorithmic authority" and the systemic. This is explored in the next section.

4.2   Conceptualizing the research design (RQ2)

Research question 2 (RQ2) asked what kind of research design is needed for investigating perceptions related to autonomous mobility.

Publication II presents a Danish case study from which a number of methodological lessons can be learnt. The study was motivated from a Nordic policy report recommending the need for ridesharing as part of sustainability and carbon emissions reduction—providing a motivation for the investigation of user perceptions of shared mobility in a Danish context. The study found that in Denmark, despite ridesharing being part of the public discourse, the motivations for and against had little to do with established theories on ridesharing motivations and barriers—suggesting that collecting the hidden perspectives of intermediaries in shared mobility (in this case users) brought significant insight into sociotechnical transitions. A qualitative methodology of semi-structured interviews and focus groups was used in different locales across the country to collect data in different sociocultural geographies to interview users as intermediaries—urban, rural, etc.

As a case study, it investigates Danish user (and non-user) perceptions of shared mobility (ridesharing) using a qualitative research method based on semi-structured interviews and focus groups (a summary of the methodology is presented in Chapter 3). In the first instance, collecting user and non-user perceptions about the social practice of ridesharing resulted in both positive and negative perceptions being highlighted. This is an important finding for the research design, for it shows that perceptions are far from homogenous and care must be taken not to only collect one perspective. In the second instance, many of the perceptions highlighted had a connection with or were pertinent to, the topic of mobility justice, with safety, awkwardness and social exclusion being some examples (see Table 2 in Publication II). In the third instance, the method showed that societal grand challenges such as carbon emissions and climate change, while important, should not be used as the basis for justification of a particular transport practice. Effectively, none of the users and non-users interviewed mentioned climate change as a motivation for ridesharing or not ridesharing, suggesting that the social practice of transportation is not undertaken on the basis of climate considerations. This is important when planning transport systems so as to not plan them on grand visions.

Finland's innovation policy of pursuit of autonomous mobility is based on grand challenges to be solved by technology—as a government policy, it is part of the public discourse too, involving many players. Adopting a similar research

design for a Finnish study adapted for the Finnish context was found to potentially offer the following advantages. In the first instance, such a research design interviewing intermediaries in the transition to autonomous mobility is anticipatory of the transition. In the second instance, intermediaries in the transition are better positioned to understand the transition as they face it. This issue is important when the choice of intermediaries is considered—not all intermediaries are officially labelled intermediaries in Finland, some are deliberately left out of the government policy process. This makes this methodological approach potentially extremely valuable in collecting the perceptions of those groups who may not have a voice in planning, but who are nevertheless impacted by it. In the third instance, this methodological approach may highlight intermediaries' unanticipated motivations and perceptions of autonomous mobility. This includes perceptions that may not be highlighted by a systemic approach, or by technologically-dominant intermediaries, such as marginalized groups (disabled, etc.). This point will be the focus of Publication IV.

To sum up, the research design inspired from the Danish study enabled the dissertation to answer critical questions about how to do research.

4.3 The Foucauldian conceptualization of the theoretical frame (RQ3)

Publication III took a Foucauldian theoretical perspective on infrastructural power and its implications for autonomous mobility justice. Effectively, it echoed Easterling (2015) and Sheller (2018), investigating how autonomous mobility technology inscribes power into space and the built environment. The Foucauldian conceptualization of power concerns modern power—associated with capitalism, and sociotechnical transitions. Power works at two levels: the discipline of the individual and the management of the population, both of which require apparatuses, or mechanisms ("dispositifs") of power. In the context of the built environment, these can include the layout of city, but also institutions, such as mortgages, insurance, road infrastructure, traffic regulations, etc. In geographies of power, therefore, infrastructure, and the built environment, is seen as a space where rationalities of government, and moralities are diagrammed. This is indicative of a regime of truth about space.

Using the data from the interviews with autonomous mobility intermediaries, a thematic analysis revealed several potential spatial rationalities of government and moralities. In the first instance, autonomous mobility may bring about a spatial rationality of flexible infrastructure, street segregation to facilitate speed, and even the removal of local transport norms. The same technology that removes the driver and his social function was found to create a need for surveillance, particularly of women and children, and reinforce the car as a male object, a place of safe enclosure for women. As well as these spatial rationalities of government, the interviews revealed potential moralities diagrammed in

the transport system—that of the treatment of users with disabilities, and the policing of what might be considered socially divergent behaviours in the Finnish social context.
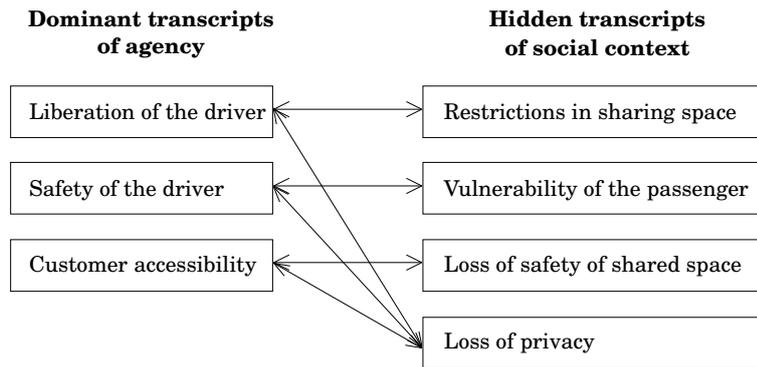
The Foucauldian conceptualization of a theoretical frame helped evidence the complex social justice dimensions involved in planning for autonomous mobility, and their connectedness. Injustices may be politically embedded in the built environment. Publics are constituted, normal, and abnormal, reflecting values held by societal institutions.

4.4 Intermediaries' perspectives (RQ4)

Publication IV drew from theories of geographies of power to investigate how transcripts of domination and hidden resistance through technological infrastructure are articulated in the narratives of the intermediaries, and what this says about autonomous mobility justice. To that end, Publication IV considered power by understanding the domination by the technological infrastructure on the one hand, and losses by society on the other, constituting a novel approach to transition- and mobility justice landscapes. This approach is about bringing out that which is hidden by those with less power in the face of a dominant power. It is less power of the human because of the huge power of technology to produce large technical systems that govern our lives. Therefore bringing out the hidden is necessary when attempting to address justice concerns in the modern era.

From the interview material, three dominant transcripts of agency and four hidden transcripts of social context emerged (see figure 4.1). The three dominant transcripts of agency are based on cyberlibertarian ideology: liberation of the driver, safety of the driver and customer accessibility. Dominant transcript of agency mean transcripts where technology is conceived narrowly as a tool for the car user agent, where it is described as bringing gains to the user, as such a solution. The four hidden transcripts of social context represent narratives dealing with potentially profound transformations in societal relations and urban living around the SDV car user agent, regarding such issues as societal privacy, use of streets and institutional trust. These transcripts are transcripts of resistance that express doubt and criticism towards the dominant cyberlibertarian transcripts presented above. Taken together, the hidden transcripts articulate that one of the keystones of technology in urban planning is that it affects people in the plural, at the multiple level, rather than the individual at the personal level. Namely technology perceived as a tool highlights the individual user perspective while neglecting technology as common socio-material and spatial infrastructure.

This study of dominant and hidden transcripts is relevant to the perspective of autonomous mobility justice in several ways. The hidden transcripts not only reveal the autonomous mobility injustices, but who may be affected by them. The restrictions on sharing space reveal that those restricted are the

**Dominant transcripts
of agency**

**Hidden transcripts
of social context**

Liberation of the driver	Restrictions in sharing space
Safety of the driver	Vulnerability of the passenger
Customer accessibility	Loss of safety of shared space
	Loss of privacy

Figure 4.1. Dominant transcripts of technological agency and hidden transcripts of social context

most vulnerable users, such as pedestrians and cyclists, in contrast to enclosed drivers. The most vulnerable passengers are revealed to be disabled users, in contrast, for instance, to able-bodied men. The most unsafe in both the vehicles and the street are revealed to be women and children, sometimes thus subject to surveillance, in contrast to men. Loss of privacy is a cost to all users.

4.5   Lessons learned and avenues for future research

This dissertation has hopefully shown that there is a need for real phronetic research on sociotechnical transitions in the built environment, beyond narrow technological envisioning. As such, the approach in this dissertation helps extend current user-focused approaches to the study of sociotechnical transitions.

One important, and unexpected, lesson learned was the importance, for a researcher investigating sociotechnical transitions in the built environment, of reflecting on the research design. The qualitative interview research approach to intermediaries' perceptions and anticipations brought important insights for phronetic research. In the first instance, the research suggested that including a broader range of intermediaries revealed greater insights into unseen and unspoken injustice, suggesting that innovation policy must be broad in its conceptualization to reveal hitherto unseen and unspoken injustice. Moreover, approval for a new technology may profit dominant interests whilst trumping other groups through the power relations created by the technology—an unwished-for development. In the second instance, using a method that involves direct testimony from respondents brings another insight—it helps get to the envisaged possible human impacts of the technology, when the technology itself is opaque, not implemented yet, or technology actors may not be forthcoming about the precise workings or implementation of the technology. Therefore such a method enables phronetic research useful to investigating the social justice implications of emerging sociotechnical transitions. As a result, this approach enabled the identification of a gap between the visions of how autonomous mobility may shape the future by increasing mobility justice, and mobility in practice,

and the choices real people make with regards to mobility.

The second lesson learned was about the value of using a theoretical lens that considers power relations in autonomous mobility justice. The lens revealed how autonomous mobility may diagram spatial rationalities of government and moralities on the built environment as part of the process of unequal power relations between technology users and technology developers. This insight has revealed how a more system-based, technology-deterministic approach to mobility may miss these important dimensions of mobility injustice. These dimensions address how the materiality of the mobility system is diagrammed with rationalities of government and moralities that exclude certain groups according to criteria that are not traditionally evidenced in transport justice. While the Foucauldian lens considered rationalities of government and moralities diagrammed in the built environment, the Foucauldian conceptualization of power is known for its theoretical flexibility and adaptability to a variety of contexts, meaning it can be used to study other aspects and dimensions of sociotechnical transitions beyond space, dominance and resistance.

The third lesson learned was about the value of the study of dominant and hidden transcripts to autonomous mobility justice. Futures, whether they happen or not, are crafted from dominant transcripts, which therefore represent power, while hidden transcripts reveal the injustices. Using a dominant and hidden transcript approach reveals the voices of resistance that can be used to assess the justice and injustice of a built environment technological transition, voices that would not be heard in a more deterministic, systemic approach, and yet very much are at the center of the mobility justice lens.

Building on these new empirically-oriented research pathways for the study of technological transitions, a number of avenues for further research emerge. In a modern society, where digitalization will enable technologies to emerge continuously in ever greater numbers, reshaping our society and our spaces, more research is needed into how they will wield power to shape our lives for both better and worse. This research opens more empirically-orientated research pathways for the study of the social justice of technological transitions. These new empirical pathways using a Foucauldian theoretical lens can be the examination of space, dominance and resistance, but also extend to other, new dimensions of power, specific to the particular transition. Moreover, the insights that this approach to sociotechnical transitions bring have relevance for future planning research, and a source of competitive advantage for Finland as a knowledge-based economy.

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Errata

Publication IV

Quote in Publication IV should read: "It limits my autonomy. If I go to a gay bar in Helsinki, people will know. People in the system who are taking my order, the drivers and assistants, who know my privacy. Privacy is basically thrown out the window. Even though there are strict guidelines about maintaining client confidentiality, it does not actually hold in the real world. I am very sensitive to the idea that somebody would know at all times where I am and where I am going, and how I have used the system. I am not saying that I would be doing criminal with my time, but it somehow gives you the idea of potentially doing something criminal with your time. I use the word criminal in the sense that you are abusing the system, when the system is made up so that your abuses will be seen normally." [Senior Official, Representative Body for Disabled People]

Publication II

Publication III

Publication IV

The self-driving vehicle (SDV) represents a new era of vehicle systems, where part or all of the driver's actions may be removed by means of a combination of new technologies. A transition to autonomous mobility is often promoted by a promise of the technological sublime—an exalted relationship between man, machine and built environment mediated through a context of technologically-controlled parameters that remove or solve many transportation problems.

But little is known about how the emerging technology will reshape autonomous mobility justice. Drawing from a theoretical frame that includes political theory of technology and a geographical interpretation of the Foucauldian conceptualization of modern power, this dissertation goes beyond the technological sublime to reveal the power relations between self-driving vehicle technology, the built environment and institutional and human actors in the transition. The dissertation finds in a thematic analysis of intermediaries in the sociotechnical transition, technological domination and hidden transcripts of resistance indicative of the dark technological sublime. It also finds that autonomous mobility will diagram moralities and spatial rationalities in both urban space and society, and potentially increasing mobility injustice and bringing implications for the justice of sociotechnical transitions and user adoption of technologies and pathways.

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