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Urban Mobility Transitions: Governing through Experimentation in Bristol and New York City

by

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DECLARATION OF AUTHORSHIP

I, Fanny Emilia Smeds, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

ABSTRACT

Transitions away from car-dominance is one of the key debates in urban research, policy and practice today. Car-free public space, cycling and convenient public transport services are widely seen as desirable, yet the reconfiguration of our streets and transport networks has been incremental. This doctoral research examines how mobility in cities is governed through experiments, commonly understood as pilot projects, and whether experiments hold potential for transformative change in urban mobility systems, including transitions away from automobility. The research draws on a synthesis of sustainability transitions, transport studies and urban studies literature, and traces the outcomes of 108 experiments undertaken over two decades in two cities: Bristol (UK) and New York City (USA) between 1996/7 and 2016.

The findings demonstrate that experiments can contribute to transforming the physical shape of urban mobility systems and the institutions involved in governing them, and can even contribute to transitions, if assessed as change in commuting patterns away from car use. The research compares the capacity of respective municipal governments, Bristol City Council and NYC city government for 'transformative experimentation', and presents an institutionalist analysis of why the transformation of Bristol's mobility system was more limited than NYC's. To unpack the problematisation of piecemeal, 'project-based' experimentation driven by competitive funding landscapes, the research compares Bristol City Council and NYC city government as two municipalities with a different degree of reliance on external funding. The stronger capacity of NYC city government can be explained by its higher degree of fiscal autonomy and mobility policy discretion, whereas Bristol City Council's capacity was limited by the centralisation of the UK state. Yet the thesis also shows that both municipalities pursued successful endogenous strategies in response to multi-scalar structure, and points to organisational and governance practices that can create 'political space' for urban actors to further transitions.

IMPACT STATEMENT

This thesis provides urban policy-makers with insights on how they can effectively structure innovation activities within their organisations, and pursue partnerships with civil society and private sector actors. It provides insights for civil society campaigners interested in advancing transitions away from automobility, by hinting at the ingredients enabling transformative change. It points to how national and supranational funding programmes for urban mobility experimentation can be better structured to support municipal capacity for achieving transformative impacts. Policy recommendations are provided in chapter 10.

Policy impact

- Input to the UK Department for Transport's call for evidence on its Future of Mobility strategy, 2018.

- Invited input into US Department of Transportation's Request for Information on Transportation Equity Data, June 2021.

- Interviewed as expert on urban climate change policy innovation by EIT Climate-KIC, October 2019.

- 'Transitions towards Connected Places' seminar, May 2019, University of Bristol, Bristol (UK). Invited presentation, *Urban mobility transition in Bristol? Tracing the long-term impact of pilot projects from 1996-2017*.

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Peer-reviewed publications

Smeds, E. and Acuto, M. (2018). Networking Cities after Paris: Weighing the Ambition of Urban Climate Change Experimentation. *Global Policy*, 9(4), pp.549–559.

Smeds, E. (2019a). Unpacking the Politics of C40: 'Critical Friendship' for a Second Decade. *Global Policy*, 10(4), pp.720–722.

Conference papers and presentations

Smeds, E. (2021). *Urban mobility experimentation in Bristol and New York City 1996-2016: transformative impacts vs. whole-system reconfiguration.* Paper presented at 12th International Sustainability Transitions conference, Karlsruhe (Germany), October 2021.

Smeds, E. (2019c). *Varieties of entrepreneurial governance: urban mobility experimentation in Bristol, Singapore and New York.* Paper presented at 8th Nordic Geographers Meeting, Trondheim (Norway), June 2019.

Smeds, E. (2019). *Upscaling and governance logics: experimentation in the Bristol bus system.* Paper presented at 8th Nordic Geographers Meeting, Trondheim (Norway), June 2019.

Smeds, E. (2019b). *Urban mobility experimentation in Bristol and Singapore: comparing state capacity for reconfiguring urban infrastructure.* Paper presented at Comparative Urbanism Conference, Georgia State University, Atlanta (USA), March 2019.

Invited presentation, *Urban mobility transition in Bristol? Tracing the long-term impact of pilot projects from 1996-2017.* Department of Geography and Environmental Management Research Seminar, February 2019, University of the West of England, Bristol (UK).

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Smeds, E. (2017). *Experimentation for sustainable development in the EU: locating hope in a zombie landscape?.* Paper presented at 13th Nordic Environmental Social Science Conference, Tampere (Finland), June 2017.

Popular media

Smeds, E. (2018). Smart transport can change people's lives – but austerity is suppressing new transit tech. *The Conversation*, 4 September 2019.

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LIST OF ABBREVIATIONS

BCC. Bristol City Council.

BHLS. Bus with High Level of Service.

BRT. Bus Rapid Transit.

DfT. Department for Transport – of UK central government.

EU. European Union.

FWHA. Federal Highway Administration – of US federal government.

FTA. Federal Transit Administration – of US federal government.

GHG. Greenhouse gas.

LTP. Local Transport Plan – strategic policy document produced by UK local authorities.

MLP. Multi-level Perspective, theoretical heuristic.

MTA. Metropolitan Transportation Authority.

NYCT. New York City Transit – affiliate agency of MTA.

NYC. New York City.

NYMTC. New York Metropolitan Transportation Council.

(NYC) DOT. New York City Department of Transportation.

NYS DOT. New York State Department of Transportation.

PPS. Project for Public Spaces.

T.A. Transportation Alternatives.

SBS. Select Bus Service.

UK. United Kingdom.

US. United States of America.

1 INTRODUCTION

1.1.1 Cities and transitions to sustainability

Since 2000, the notion of sustainability transitions has emerged as a prominent new theme within transport studies (Holden et al. 2019) and cross-fertilised urban studies research on infrastructure and climate change (Bulkeley et al. 2014). This research takes an interdisciplinary approach to understanding the interrelation of experimentation and transitions: synthesising insights from sustainability transitions research, urban studies and transport studies, while being rooted in a geographical perspective. Sustainability transitions research examines socio-technical systems that represent different societal sectors of provisioning (e.g. mobility, energy, etc.), and the dynamics through which they shift away from the environmentally unsustainable status quo (Grin et al. 2010). The focus is on the 'puzzle of stability and change' (Köhler et al. 2019): *why is it, that despite the existence of so many 'change activities' and sustainability innovations, we see relative overall stability in socio-technical systems?* In other words: why do the multiplicity of efforts at changing systems fail to generate transitions?

This is a compelling question because transitions towards sustainable mobility have been slow. The 1992 Rio Earth Conference launched the Local Agenda 21 action plan that spurred a rapid increase in municipal sustainability activities (Bulkeley 2005; ICLEI 2012). The EU's response to the Rio Earth Conference, the *Green Paper on the Impact of Transport on the Environment* (EC 1992) first introduced the concept of 'sustainable mobility' as a vision for transport systems (Holden et al. 2019). Transport policy in the UK (Docherty and Shaw 2011) and some US states and cities (Zhou 2012) shifted to embrace this new paradigm, at least to the degree that a focus on road network capacity was complemented with policies promoting non-car modes. Despite this, in both the EU and US, GHG emissions from the transport sector were considerably higher in 2017 than in 1990, and have declined less and more slowly relative to energy and industrial sectors (EC 2019; EPA 2021). While private car use has declined in some European and US cities (Smeds

and Cavoli 2021; Teoh et al. 2020), in most places this has been modest, relative to the rate at which private car use increased during the post-war decades.

As the climate crisis has progressed, 'cities' have been positioned as a central beacon of hope that might 'save the planet' (Wachsmuth et al. 2016; Angelo and Wachsmuth 2020). It has become a platitude to note that urban innovation processes aimed at sustainable development are underway, equated with diverse conceptualisations of experimentation. Experiments are commonly understood as 'pilots' aimed at testing a policy intervention to learn more about its performance, or 'demonstrations' of the expected benefits of an intervention. Within transport studies, pilots and demonstrations are argued to allow for learning about the 'adoption pathway' of 'innovative' transport policies (Marsden 2011; Stead 2015), or as a way to bridge the 'implementation gap' for sustainable mobility policies by overcoming poor initial public acceptability (Banister 2008; Isaksson and Richardson 2009; OPTIC 2011). Others conceptualise experimentation broadly as a new, or at least increasingly prevalent, mode of governing urban sustainability, that holds potential for transformative change (Bulkeley et al. 2015; Evans et al. 2016b; Frantzeskaki et al. 2017b).

A popular idea is that cities can advance sustainability by learning from each other's 'best practices' within city networks (Acuto 2013), or act as local 'policy laboratories' from which knowledge can be harvested and deployed at the national level (EEA 2019). Indeed, the activities of city network members are argued to have surpassed development of sustainability plans, extending to urban climate change experimentation 'on the ground' (Kern and Bulkeley 2009; Bulkeley and Castán Broto 2013). Empirical evidence regarding the potential of experimentation for urban transitions is scarce, however. I have critically reviewed the potential of urban climate change experimentation associated with networks like the C40 Cities Climate Leadership Group, and argued that there is too much focus on learning and 'replication' of low-carbon policies *between* cities (Smeds and Acuto 2018). This thesis is concerned with urban mobility experimentation *in situ,* i.e. to what extent experiments *within* urban systems can generate *place-specific* transformative change and transitions. We know that sustainability-related policies are 'mobile' and circulate between

cities (McCann 2017b), yet we know less about whether experiments can contribute to transitions away from car dominance in specific cities, as illustrated by the vignette below.

1.1.2   The life and death of experiments

In June 2009, two female neighbours, living in a dense area of the UK city of Bristol, decided to organise an experiment: frustrated by the lack of space for their children to play outdoors, they decided to apply to their municipal government (Bristol City Council) for a permit to close their street to traffic for a few hours. A few years later, they had developed this into a model called 'Playing Out', which resulted in the institutionalisation of a new Council procedure allowing the model to scale up to regular events city-wide. By 2018, over 57 UK municipalities had adopted a similar procedure, allowing hundreds of communities to organise so-called 'play streets' (Ferguson 2019).

Lydon and Garcia (2015, p.2) discuss Bristol's play streets as an example of 'tactical urbanism': "an approach to neighbourhood building and activation using short-term, low-cost, and scalable interventions and policies", and a concept that has become tremendously popular within urbanist discourse. In parallel, Lydon and Garcia trace the historical emergence of play streets to New York City (NYC) in the 1910s and 1920s. This was led by a non-profit organisation called the Police Athletic League, as an initiative to protect children from the dangers of growing automobile traffic, and started with experiments with temporary street closures that gradually scaled up city-wide. NYC's concept attracted international attention and was discussed in UK Parliament, and in 1929, Salford became the first city in England to undertake an experiment 'along New York lines' (Cowman 2017). National legislation followed and by 1963, there were 146 street closure permits called 'Play Street Orders' covering 750 urban streets across the UK (*ibid*). However, after this high point, growing car ownership and on-street parking gradually edged play streets into obsolescence (*ibid.*).

By the 2000s, Bristol City Council did not have a Play Street Order. As mentioned above, one was created in 2012, following collaboration with 'Playing Out'. The women who led the first Playing Out experiment on their street were unaware of the historical precedence

(Ferguson 2019). In NYC, play streets never disappeared completely during the 20th century. With an experiment, local civil society organisation Transportation Alternatives successfully managed to push for the institutionalisation of a Play Streets Program run by NYC city government in 2012. By 2019, this Program had all but fizzled out.

Figure 1.1. Inspirational case study of Times Square pedestrianisation in NYC, within Mayor George Ferguson's *Vision for Bristol* (BCC 2013b, p.33). Image source: Bristol City Council.

Bristol and NYC contexts have continued to be (put) in conversation, e.g. in relation to cycling (Moore 2014; Brice 2017) and low-carbon growth (Clarke et al. 2013). From 2007, the New York City Department of Transportation (NYC DOT) launched a series of high-profile experiments that temporarily pedestrianised parts of Times Square and Broadway in Manhattan. Bristol Mayor George Ferguson's 2013 vision for mobility cited this as a key source of inspiration (Figure 1.1; see also foreword in Gehl and Svarre 2013). The fact that Bristol City Council referenced NYC city government in this way is unsurprising, considering that the Broadway experiments have emerged as a global exemplar of

municipally-led mobility experimentation (Kębłowski et al. 2019), cited by Lydon and Garcia (2015) as the 'ground zero' of their concept of 'tactical urbanism'. The experiments were undertaken under Janette Sadik-Khan as the head of NYC DOT, and Michael Bloomberg as the Mayor of NYC. Bloomberg has since risen to prominence as an urban sustainability 'guru', e.g. chairing the C40 network (Smeds 2019a), and cites the Times Square experiment in his book on how cities can 'save the planet' (Bloomberg and Pope 2017). NYC city government practices developed during the Bloomberg administration, including NYC DOT-style street space experimentation, are today being 'exported' globally through Bloomberg Associates, the consulting arm of Bloomberg's philanthropic foundation. Sadik-Khan's political memoir-manifesto *Streetfight* (Sadik-Khan and Solomonow 2016, p.294) argues that 'if streets can be remade in New York, they can be remade anywhere', suggesting that the NYC DOT low-cost approach to 'tactical' experimentation can be replicated in any city. The popularity of *Streetfight* and the imaginary of Times Square being pedestrianised 'overnight' is illustrated by the fact that Sadik-Khan and Solonomow (2016) are even cited by academic scholars (Bertolini 2020; Wild et al. 2017; Marsden et al. 2020; Hajer and Versteeg 2019), as a paradigmatic case of mobility experimentation. Yet few have examined to what extent this Bristol City Council would be able to adopt such an approach to 'tactical' experimentation. This research shows that it would not, necessarily: overall, its capacity for transformative experimentation has been weaker than NYC city government's.

Experimentation with 'public plazas' resulted in city-wide expansion within NYC, just as experimentation with play streets resulted in city-wide expansion in Bristol. Yet few have examined to what extent these trajectories of experimentation actually contributed to transitions away from automobility, in the respective context. This research shows that there is little evidence of this, or we simply do not know. By 2016, private car use had decreased in Bristol and NYC, but automobility had far from stopped dominating each city's streets. Bristol's transition away from automobility was more tentative and limited. Bristol is known as a 'green' city within the UK. Yet many of the key campaigners, entrepreneurs and intellectuals who have been part of Bristol's environmental movement reflect upon, in Brownlee's (2011) history of the movement, that the continued

unsustainability and dominance of automobility in Bristol is the issue for which the least progress has been made, since the 1960s.

1.1.3   Governing urban mobility transitions through experimentation

In addition to showing that 'mobile policies' do not necessarily translate into transformation of urban mobility systems in specific places, the vignette above encapsulates several starting points and findings of this thesis.

Thinking about urban mobility transitions, away from automobility

Urban mobility experimentation and transitions are not necessarily about sustainability; they are fundamentally about the allocation of public (street) space, in the context of automobility, as the system through which the car shapes such space and subordinates other forms of mobility (Urry 2004; Sheller and Urry 2000). This thesis is about transitions away from automobility, rather than towards sustainable mobility per se. Conceptualising change in urban mobility systems, including through experiments, involves studying material and spatial change generated by experiments (Schwanen 2015; Naess and Vogel 2012), rather than socio-technical innovation as the focus of sustainability transitions research rooted in neoinstitutional economics and sociology of technology (Geels 2010; Nelson and Winter 1982; Bijker et al. 2012). The literature on *urban* sustainability transitions explicitly calls for new theoretical lenses beyond dominant socio-technical transition theories (Frantzesaki et al. 2017a): this thesis draws on both transport studies and urban studies to provide a new lens on urban mobility transitions.

Experimentation can incrementally transform mobility systems, but not necessarily contribute to transitions

In contrast to previous research finding that experiments affect limited change in urban systems (Hoogma et al. 2002; Kivimaa et al. 2017; Bertolini 2020), this thesis demonstrates that trajectories of interlinked experiments can generate transformative change in urban mobility systems over the longer term. However, institutionalisation or scaling up of experimental configurations in the short-term does not necessarily result in transformative

impacts, in the sense of permanent material or institutional change. Impacts vary across different types of experimentation, and this thesis examines contextual factors that caused this variation. Even where experimentation trajectories do generate transformative impacts, these do not necessarily contribute to transitions, or at least we do not have the appropriate data and analytical tools to uncover whether they did.

Experimentation as a governing mechanism for introducing novelties

This research defines experimentation as a governing mechanism for introducing contextually-specific novelties into urban mobility systems. Not all experiments studied in this research have been led by municipal government: other public, private and civil society actors undertake experiments in seeking to govern. The vignette shows that experimentation has existed as a governing mechanism for a long time: this research traces the contemporary adoption of experimentation as a preferred governing mechanism to 'sustainability entrepreneurialism', where sustainability and entrepreneurialism agendas merge within municipal visions.

The capacity of municipal government in a multi-scalar context

The expansion of experimental configurations, like play streets, within urban mobility systems crucially involves institutionalisation of such configurations by and within municipal government, because of the reality of municipal control over street space in most cities across the Global North. Institutionalisation involves enabling and constraining influences from other governance scales, e.g. national government. This thesis focuses on the capacity of municipal government for transformative experimentation in the context of multi-scalar governance. However, local state-civil society relations are also central to municipal capacity for transformative experimentation, including co-governing and territorialised local politics beyond 'top-down' constraints.

Experimentation among 'cities in a world of cities'

The vignette shows that experimentation can be understood as a basic causal mechanism that can be compared across Bristol and NYC, as two cities in a shared global context of

purposive reconfiguration away from automobility. Drawing on 'comparative urbanism' as a methodological approach within urban studies (Robinson 2010; 2015), this thesis studies experimentation among 'cities in a world of cities': Bristol and NYC are not understood as uncomparable because of their population size, for example. The comparative approach examines a proposition derived from existing research on urban mobility experimentation in the UK and EU: that reliance on competitive and project-based external mobility funding is a decisive factor constraining municipal capacity for transformative experimentation (Hodson et al. 2013; Hodson et al. 2018), and tests this for the US context. Bristol City Council is studied as a representative case of the capacity of UK municipalities, with their limited fiscal autonomy and a high degree of reliance on external funding for experimentation. NYC city government is studied as a 'critical case' that is 'least likely' to verify the proposition, with its high degree of fiscal autonomy and purported strong municipal capacity for transformative experimentation. The research centres around the capacity of municipalities to mobilise resources for experimentation, from other levels of government and non-state actors: showing how fiscal autonomy in fact underpinned NYC DOT's tactical experimentation with street space.

1.1.4   Research questions

The research examines two primary research questions, over two decades: 1996-2016 for Bristol, 1997-2016 for NYC, depending on the start date of purposive reconfiguration away from automobility; and distinguishes between transformative mobility experimentation, and urban mobility transitions as two distinct but related phenomena.

Primary RQ1. How did multi-scalar governance cause municipal capacity for transformative experimentation to differ in Bristol and New York City, between 1996/7 and 2016?

Primary RQ1 considers how the diverging multi-scalar governance context that Bristol City Council and NYC city government operated in, explains why the former had weaker capacity for transformative experimentation than the latter.

RQ1.1. To what extent and in what ways have experiments resulted in embedding and transformative impacts?

The first sub-question establishes the transformative extent of mobility experimentation in each context, distinguishing between short-term embedding of experimental configurations, and longer-term transformative impacts from experimentation trajectories.

RQ1.2 How have the internal institutions and resources of municipal government influenced capacity for transformative experimentation?

The second sub-question examines the influence of municipal institutions and resources, including the interplay of how experimentation was funded, what type of experimentation was pursued, and whether experimentation was organised and approaches in a more piecemeal or systemic manner. This directly addresses the problematic regarding project-based experimentation reliant on short-term and competitive external funding, in the existing literature.

RQ1.3 How have the governance institutions characterising the relations between municipal government and other public, civil society and private sector actors, influenced capacity for transformative experimentation?

The third sub-question addresses the need for municipal government to partner with other actors to 'get things done' and achieve transformative impacts. It examines the relations between municipal government and non-state actors, including how the governance modes that municipal government chose to adopt for experimentation, and the mix of network, hierarchical and market relations within temporary experiment partnerships.

Primary RQ2. To what extent has there been a transition away from automobility in Bristol and New York City, between 1996/7 and 2016?

Primary RQ2 considers the relative extent of transitions away from automobility in Bristol's and NYC's urban mobility system, by examining change in high-level indicators (mode split, CO_2 emissions, traffic safety).

RQ2.1 To what extent has transformative experimentation contributed to urban mobility transitions?

The first sub-question examines to what extent experimentation has contributed to respective transitions, drawing on mobility statistics and secondary research available on the trajectories of experimentation that were found to have transformative impacts in Bristol and NYC.

RQ2.2 How can difference in the extent of urban mobility transitions be diagnosed through the lens of path-dependencies?

Experimentation is understood as a dynamic of change in mobility systems, but systems are also stabilised by counterweighing dynamics. The second sub-question examines to what extent differences in the extent of transitions in Bristol and NYC can be diagnosed through the lens of historical path-dependencies in public transport systems, city-regional governance, spatial structures and commuting flows, and civil society activism.

1.1.5   Thesis structure

The thesis is structured as follows. Chapter 2 reviews relevant literature on: how experiments and their outcomes can be conceptualised, the specific nature of mobility systems and transitions, and how municipal capacity for transformative experimentation can be conceptualised in the context of state restructuring and mobility governance. At the end of the chapter, the theoretical and conceptual frameworks for the research is presented. Chapter 3 presents the comparative research design, construction of two large-N databases of experiments for study, and the within-case methods employed. The case studies are presented in chapter 4, including case narratives established in existing literature, and traces the path-dependencies of mobility in Bristol and NYC from the

1950s to the 1990s (RQ2.2). Findings regarding municipal capacity between 1996/7 and 2016 (Primary RQ1) is presented for Bristol and NYC in turn, in chapters 5 and 6. Chapter 7 then presents a comparative analysis for Primary RQ1, for each sub-question in turn: comparing the outcomes of experimentation (RQ1.1), discussing municipal institutions and resources (RQ1.2), and contrasting governance institutions (RQ1.3). Chapter 8 then analyses the extent of urban mobility transitions in Bristol and NYC (Primary RQ2), including whether experimentation contributed to this (RQ2.2), and picks up on the historical context described in chapter 4, to diagnose the relative extent of mobility transitions through the lens of how pre-existing path-dependencies evolved between 1996/7 and 2016 (RQ2.2). Chapter 9 discusses the conceptual contributions of the thesis, the strengths and limitations of the research, and makes recommendations for future studies. Brief concluding reflections are presented in Chapter 10.

2 LITERATURE REVIEW AND THEORETICAL FRAMEWORK

Research regarding the potential role of experiments in engendering change in urban systems is at a nascent stage. There is no single theory or set of literature that would on its own be sufficient to conceptually and empirically ground investigation of the RQs. Thus, this research takes an interdisciplinary approach, drawing on three research fields: sustainability transitions, urban studies, and transport studies. Literature from all three fields is discussed in this chapter. Section 2.1 reviews how experiments, mobility systems and mobility transitions have been conceptualised in sustainability transitions and transport studies literature, as key analytic concepts referred to in the RQs, and with particular reference to experiment outcomes (RQ1.1) and transition dynamics (Primary RQ2). Section 2.2 informs the framing of Primary RQ1, discussing how municipal government capacity can be understood in the context of theoretical debates regarding governance and state restructuring, drawing primarily on urban studies. Section 2.3 considers frameworks and empirical evidence regarding municipal capacity for experimentation as a specific activity, with reference to evolving multi-scalar transport governance arrangements. An interdisciplinary synthesis of the literature reviews is provided in section 2.4. The final section (2.5) then presents the theoretical framework for the research, including conceptual frameworks for specific RQs.

2.1 Experimentation, systems, transitions

This section reviews how three key concepts that feature in the RQs: experimentation, urban mobility systems, and urban mobility transitions, have been defined in existing literature. This includes conceptualisations of how experiments may contribute to incremental system transformation (RQ1.1) and transitions (Primary RQ2).

2.1.1 Niche experiments and transition experiments

A systematic review of 170 studies focusing on experimentation within the sustainability transitions literature by Sengers et al. (2019, p.161) identifies seven different types of experiment conceptualisations, and propose an overarching definition of an experiment as "an inclusive, practice-based and challenge-led initiative designed to promote system innovation through social learning under conditions of uncertainty and ambiguity". I discuss three of the experiment concepts identified by Sengers et al. (2019): 'niche experiments', 'transition experiments' and 'urban experiments', because they have most commonly been applied to study urban mobility. Table 2.1 summarises how niche and transition experiments have been conceptualised.

Table 2.1. Conceptualisation of 'niche' and 'transition' experiments.

Literature	Definition of experiment	Processes through which experimentation can contribute to transitions	Key actors engaged in experimentation
Multi-level perspective Geels (2002, 2012)	Experimentation as a process of tinkering and learning about socio-technical configurations within niches, but not defined specifically.	Accumulation of a niche, which might eventually 'break through' the dominant regime and cause a regime shift	Regime-outsiders, radical entrepreneurs, early-adopter users
Strategic Niche Management (Schot and Geels 2008)	**Niche experiment**: "real-world experimental projects" that function as "important devices that precede market niche development" (p.539)	Niche accumulation, through which innovations can 'scale through the market', becoming market-competitive and causing regime shifts	
Transition Management (van den Bosch and Rotmans 2008)	**Transition experiment**: "an innovative project with a societal challenge as a starting point for learning aimed at contributing to a transition" (p.17)	Deepening: "Learning process through which actors can learn as much as possible about a transition experiment within a specific context" (p.29) Broadening: "repeating a transition experiment in different contexts and linking it to other functions and domains" (p.32)" Scaling up: "embedding an experiment in new dominant ways of thinking (culture), doing (practice), and organising (structure)" (p.33)	Actors that are sustainability 'frontrunners' in a particular context

The multi-level perspective (MLP) is the most prominent conceptual framework on sustainability transitions (Rip and Kemp 1998; Geels 2002). The MLP was formally introduced to the transport studies field by Geels (2012). In this article, a mobility system is defined as a socio-technical system: "a configuration of [social and technical] elements that include technology, policy, markets, consumer practices, infrastructure, cultural meaning and scientific knowledge" (*ibid.*, p.47). The MLP analyses dynamics at three system levels: niches as the locus of 'radical innovations', regimes as representing the status quo of the system, and a landscape level of 'exogenous' trends. Socio-technical regimes are the "deep-structural rules that coordinate and guide actors' perceptions and actions" (Geels 2012, p.473). Automobility can be understood as the dominant regime in many urban contexts, while trams, buses and cycling, etc constitute 'sub-altern' regimes (*ibid.*). Regimes are understood as stable and resistant to change, because 'incumbent' actors are invested in the status quo of reproducing automobility. Geels (2012) suggests that in addition to the car industry, national and local policy-makers are incumbent regime actors sustaining automobility because their foremost priority is economic growth and addressing congestion rather than low-carbon mobility.

Experimentation is understood to occur at the niche level, distanced from the regime, by non-state actors understood as 'regime outsiders'. Niches are 'protected spaces' in which novelties emerge (Smith and Raven 2012). Geels (2012, p.472) states that niches are often "are often carried by experimental or demonstration projects", which allow niche actors to work on "radical innovations that deviate from existing regimes… to learn about innovations in real-life circumstances". Niche actors are engaged in efforts to 'link together different social and technical elements' (Geels 2012, p.474), reflecting the conceptualisation of innovations as socio-technical configurations of many different elements (Geels 2002). Experimentation is thus referred to as a tinkering and learning process occurring in niches, but no specific definition is given.[1] Transitions are conceptualised as 'regime shifts' that can occur when a niche-innovation 'breaks through' the dominant regime, producing large-scale societal change as a new technology

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[1] In the diagrammatic MLP representation in Geels (2012, p.474), 'experimentation' is not mentioned. In Geels (2002), experimentation is mentioned ten times as an activity occurring within niches, but never defined.

establishes dominance: as per historical case studies, e.g. the transition from horse-drawn carriages to automobiles in the United States (Geels 2005).

Strategic Niche Management (SNM) draws on the MLP, but refers explicitly to 'niche experiments' that allow technological niches to 'accumulate' into market niches, and eventually for innovations to 'scale through the market' and become market-competitive, and thus cause regime shifts (Schot and Geels 2008). Based on this framework, SNM scholars developed a practical approach to managing real-life innovation, applied in a study of 8 experiments with sustainable mobility technologies (e.g. electric vehicles, car-sharing) across France, the UK, Switzerland, Germany and Norway (Weber et al. 1999). The scholars concluded that based on their findings, experimentation were unlikely to result in transitions (Hoogma et al. 2002, pp.195-6):

> "We were certainly over-optimistic about the potential of SNM as a tool for transition... The experiments did not make actors change their strategies and invest in the further major development of a technology… The experiments were relatively isolated events [and] there are limits to the power of experiments. Only occasionally will an experiment be such a big success that it will influence strategic decisions".

The MLP has clear appeal for thinking about incremental versus systemic change vis-à-vis automobility (Geels et al. 2012), and about technological mobility innovation (Whitmarsh 2012; Nykvist and Whitmarsh 2008). Many of the scholarly contributions I draw in this thesis are critiques and revisions of the MLP. However, the MLP is not suitable for analysing urban mobility experimentation because of: its lack of spatial and scalar articulation (Coenen et al. 2012); focus on analysing systems at a national rather than subnational scale (Markard et al. 2012); focus on technological innovation, thus ignoring retrofitting physical infrastructure as a central dimension of urban mobility (Schwanen 2015; Næss and Vogel 2012); indeed the SNM conceptualisation that change in mobility systems take place through 'scaling through the market' is limiting. The focus on 'radical' innovations is problematic because the 'radicalness' of different configurations (e.g. car-sharing) varies from place to place (Schwanen 2015).

Transition Management is an approach sharing the same theoretical antecedents as the MLP but with a focus on how transitions can be governed in practice (Rotmans et al. 2001). Transition Management advocates for a process in which actors convene in 'transition arenas' to engage in collective visioning (Loorbach 2010) and launch 'transition experiments' to produce social learning about innovative configurations (van den Bosch and Rotmans 2008). Applied Transition Management exercises in urban contexts involve small teams of 'frontrunners' actors understood to be sustainability leaders in a particular context, drawn from multiple sectors (Nevens et al. 2013). This often includes some municipal government employees, but with the process remaining purposively outside the bounds of formal policy processes, as the theory of change is that distancing experiments from government bureaucracies is crucial for enabling innovation (van Buuren et al. 2018). Transition Management defines three processes through which experiments can contribute to transitions: deepening, broadening and scaling up (Table 2.1).

Van den Bosch and Rotmans' (2008, p.34) definition of scaling up (Table 2.1) does not refer to geographical or *spatial* scale, i.e. expansion of a small pilot intervention to a larger spatial area, but instead to "scaling up perspectives, ways of thinking, routines, legislation, institutions", i.e. institutions previously confined to niche actors being adopted by regime actors. The example provided for scaling up in relation to mobility systems is that a real-life experiment in the Netherlands, seeking to reward commuters for avoiding peak hour travel, would "change the dominant practice of commuters", with the outcome that travel by sustainable (non-car) modes "becomes part of the dominant culture and structure of companies and government" (*ibid.*, p.37). In my view, this is a very ambitious outcome to expect from a single experiment. Furthermore, I find the conceptual definition of scaling up as change in 'thinking, 'doing' and 'organising' to be quite vague, and from the perspective of urban mobility systems, it is problematic that the Table 2.1 typology does not have any spatial articulation. For example, the extent to which novel configurations (e.g. protected cycle lanes) are scaled up across urban space clearly matters (e.g. for the propensity of people to cycle).

2.1.2 Empirical evidence on experiment outcomes

A systematic review by Kivimaa et al. (2017) analyses case study reports of 29 experiments within 18 articles on built environment, energy, transport and water sectors; as well as spatial planning. This is arguably the best-available synthesis of empirical evidence on the outcomes of experimentation within the sustainability transitions literature. Kivimaa et al. found that experiments had resulted in change in policy and institutional frameworks (planning practices, redefined actor roles), new technologies and infrastructures, creation of new consumer and business practices, and new markets. How Kivimaa et al. connect these findings with the typology of deepening, broadening and scaling up (Table 2.1) is somewhat unclear, however. Without explicit reference to specific types of impacts listed above, the authors state that deepening was the most common type of outcome, followed by only weak signs of broadening, and with scaling up as the least clear and most rare type. Kivimaa et al.'s (2017, p.22) conclusion is that it is unclear whether the experiments reviewed "succeed[ed] in disrupting the existing regime… [their] impact appears in many cases to be modest or incremental". This is based on the notion that broadening and scaling up, where innovative configurations either diffuse further or challenge the status quo are the 'critical' types of outcomes if experiments are to contribute to sustainability transitions. Kivimaa et al.'s (2017) overall finding that experiments have limited impact on incumbent regimes aligns with the conclusion of Hoogma et al. (2002).

Williams (2016) examines broadening and scaling up through case studies of three experimental European eco-districts (e.g. car-free Vauban in Freiburg). However, Williams takes a different approach to the sustainability transitions literature, in analysing outcomes in relation to geographical scale. Broadening is understood as replication of the experiment in the same city or other cities (nationally/internationally), whereas scaling up is understood as changing sustainable urban development regimes that are dominant within the same city, or at national or international scales. As noted in chapter 1, my research is only concerned with the outcomes of experiments on mobility transitions *within* a particular place, excluding scalar diffusion. What I find most valuable about Williams' contribution is how it unpacks the socio-technical configuration of each experimental eco-district, by identifying distinct constituent elements – e.g. low energy codes, solar

technologies and collaborative planning practices – and analyses the diffusion of each element separately. Crucially, this approach clarifies that it is not the experiment *itself* that is replicated or scaled up, but *specific elements* tested within the experimental configuration.

Bertolini (2020, pp.735; emphasis added) asks whether 'city street experiments can transform urban mobility', defining these experiments as "intentional, temporary change[s] of street use, regulation and/or form, aimed at *exploring systemic change* in urban mobility, away from 'streets for traffic', and towards 'streets for people'". Bertolini (2020) reviews 25 sources reporting on urban street experiments undertaken in different cities, including NYC,[2] and finds that "the literature documents significant positive impacts on physical activity, a shift of mobility away from the car and towards walking, cycling and public transport, increased safety, enhanced social interactions and social capital, and at least the absence of negative impacts on local business" (Bertolini 2020, p.749).[3] Furthermore, Bertolini draws on Transition Management literature (Roorda et al. 2014, p.31) to define criteria that experiments need to fulfil to potentially trigger transitions. Bertolini finds that the literature suggests that street experiments can be 'radical' in testing alternative practices, 'feasible' in being possible to realise in the short-term with readily-available resources and hold power for mobilising the broader public, but that their weakness is "feeble or non-existing links with broader and longer-term urban policies… [and] social and organisational learning processes" (Bertolini 2020, p.749).

I argue that the Transition Management definition of experiments as intending *from the outset* to contribute to transitions as system change (Table 2.1) is too narrow. This definition is common to several articles reviewed here (Bertolini 2020; Sengers et al. 2019; Williams 2016), yet it does not make sense when considering the empirical nature of urban mobility experiments, e.g. experiments with play streets discussed in chapter 1 and by Bertolini (2020). Such experiments will often be motivated by practical concerns of providing car-free social space for their children (chapter 1), rather than with a 'pathway' to fundamentally disrupt automobility in mind. The definition of an experiment as

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[2] But only citing Sadik-Khan and Solomonow (2016) and Lydon and Garcia (2015) as sources of evidence.

[3] Bertolini's review was published after my research design and data collection were completed, and thus did not influence either aspect; however it is introduced here as it is a rare paper focusing on urban mobility experimentation specifically.

explicitly oriented towards a system change pathway makes sense where such experiments are undertaken within a purposive real-life Transition Management processes in different cities (Roorda et al. 2014; Nevens et al. 2013). But I argue that most mobility experiments undertaken in cities will not be oriented towards large-scale system change.

2.1.3   Post-experimental embedding

I find that Turnheim et al. (2018) offer the most appropriate typology of experiment outcomes for my research. Turnheim et al. (2018) synthesise conceptual insights from an edited volume on 'climate change experiments', making two valuable contributions. First, the authors distinguish between formal and informal experiments, with most formal experiments having: "(a) a beginning and an end tied to a budget, activities and expected outputs, (b) a particular institutional and geographical context within which experimental activities are carried out and; (c) clear goals and means for their evaluation", whereas informal experiments are more open-ended and have less clear boundaries (*ibid.*, p.219). The definition of a formal experiment accurately describes the empirical nature of pilot and demonstration projects, while the definition of an informal experiment highlights that not all interventions necessarily conform to such precise ways of organising. Second, Turnheim et al. (2018) propose 'embedding' as an overarching term to refer to how experiments and their outputs 'fit' with post-experimental contexts, proposing a typology summarised in Table 2.2.

The definition of scaling up in Table 2.2 appears to blend elements of institutional scaling up, as emphasised within Transition Management literature (Table 2.1), with attention to the spatial nature of system change, and the fact that because experiments are temporary, extended duration is an important outcome.

The definition of circulation is based on Castán Broto and Bulkeley's (2018) urban political ecology perspective, which is quite wide-ranging and opaque, as shown in Table 2.2. Yet, Castán Broto and Bulkeley's (2018) concept helps draw attention to the 'movement' of discrete elements, similarly to Williams (2016).

Table 2.2. Processes of post-experimental embedding.

Process of embedding	Definition (Turnheim et al. 2018)
Scaling up	"An experiment is (and its outputs are) expanded in scope (geographical, administrative, financial, etc.) or duration"; outputs (technologies, practices, actor-configurations and rules) adopted into 'standard practice' (p.232)
Replication	"Repetition and reproduction of an experiment in a new context (e.g. another policy domain) or location (e.g. new city or country)" (p.232)
Circulation	"movements of 'things' as calling for the realigning of existing relations (e.g. via new parameters and criteria)"; "'things' that can accompany or enable circulation of ideas or policies (e.g. templates, finance mechanisms and standards)"; "c) amplification and dissemination processes that can extend the pool of receptive public[s] (through e.g. the development of new imaginaries and visions that can support the mobilisation of expectations)" (p.233)
Institutionalisation	"experiment, or its outputs or outcomes, becomes part of governance structures, rules, norms and routines, whether formal or informal" (p.233)

In identifying institutionalisation as a process through which experiments may generate transformative outcomes, Turnheim et al.'s (2018) typology adds further value. In my view, it makes more sense to conceptualise institutional outcomes in this way, rather than as institutional 'scaling up' (Table 2.1). Institutionalisation is a widely used term within the social sciences to refer to institutional change, e.g. how formal and informal institutions (rules, norms, routines) become embedded within organisations (Keman 2021; Lawrence et al. 2011). This includes how experimental configurations might become embedded in policy strategies. It also relates to temporary experimental configuration achieving greater permanence: a central dimension of institutionalisation is that an institution attains stability in becoming more enduring and producing a regular pattern of social action (Brady 2001).

2.1.4 Urban transitions and experimentation

Literature on 'urban experiments' and 'urban transitions' has emerged at the intersection of urban studies and sustainability transitions research (Frantzeskaki et al. 2017b; Evans et al. 2016b). One strand of this literature focuses on the (critical) study of experimentation in 'urban laboratories', as specific organisational settings created for multi-actor innovation related to sustainable urbanism (Karvonen and van Heur 2013; Evans and

Karvonen 2011; Karvonen et al. 2014). This strand is beyond the scope of this review. My research is interested in experimentation as a more ubiquitous activity of governing urban mobility (e.g. street space), rather than as confined to specific laboratory settings.[4] Another perspective explicitly advocates for alternative conceptual lenses (to the MLP) for understanding *urban* sustainability transitions in 'cities as relational places', emphasising multi-scalar politics, spatial unevenness within and across the Global North and South, the differential agency of different urban actors, and the confluence of top-down and bottom-up initiatives (Grin et al. 2017). My research answers this call for new theoretical lenses, and contributes to debates on the geography of transitions, including the role of place-specific urban policies and the differential capacity of urban actors in securing external support (Coenen et al. 2012; Hansen and Coenen 2015).

I find that the pioneering contributions of Hodson, Marvin and Bulkeley have also been the most conceptually coherent; much of this thesis engages with their work. Evans (2016) discusses how urban space has been a site of experimentation throughout history, where different actors have sought to test interventions in the name of social 'progress' (e.g. the sanitary city). The question is thus what is specific about experimentation in cities today. Bulkeley and Castán Broto (2013) articulate this in relation to global climate governance, arguing that climate change is increasingly being governed 'by experiment' in cities. Partly influenced by sustainability transitions research, Bulkeley and Castán Broto (2013, p.361; emphasis added) define 'urban climate change experiments' as "purposive interventions in urban *socio-technical systems* designed to respond to the imperatives of mitigating and adapting to climate change in the city". Experiments are understood as "interventions to try out new ideas and methods", serving to "understand how interventions work in practice, in new contexts where they are thought of as innovative" (*ibid.*, p.93). Their conceptualisation is also linked to a qualitative database of 627 experiments implemented in 100 cities globally, including 118 experiments related to urban mobility, compiled through desk-based research (see also Castán Broto and Bulkeley 2013).

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[4] Neither of my case study contexts feature a 'living laboratory' relevant to urban mobility.

The strength of Bulkeley and Castán Broto's approach is their rigorous conceptualisation of experimentation vis-à-vis urban governance, and their clear criteria for what interventions qualify as experiments. I agree with Bulkeley and Castán Broto's (2013) critique that the predominant understanding of experimentation as a 'learning' process within the sustainability transitions literature, risks ignoring the political economy of experimentation, including what actors are leading and funding experiments in cities (Bulkeley et al. 2015). However, conceptualising experimentation as a mode of governing climate change is not entirely appropriately for urban mobility. Research on mobility policy in UK localities, for example, shows that national climate change targets filter down to the local level primarily in the form of 'symbolic meta-policy', but with economic development as the primary influence on policy *implementation* (Bache et al. 2015). I have argued elsewhere that urban experimentation has 'decoupled' from the global climate governance agenda and has multiple drivers, including economic competitiveness and 'smart city' discourses (Smeds and Acuto 2018). Bulkeley and Castán Broto's work also does not provide a clear sense of what outcomes experiments might have for (mobility) system change, but is rather interested in 'who governs' in a Foucauldian sense, focusing on experimentation as an open-ended process where agendas are negotiated (Bulkeley et al. 2014).

Hodson et al. (2017, p.311) propose a new research agenda on urban transitions, asking: "do experimental processes of embedding sustainable urban infrastructures and schemes provide the potential to reconfigure systems at the city-scale and in what ways?". Hodson et al. (*ibid.*, p.304) argue that rather than understanding experiments as 'bounded' (e.g. within laboratories), "a wider view of urban experimental processes is needed, of assembling technologies, social interests, and new modes of governing into place-based configurations and learning about these processes of embedding an infrastructure or a scheme in a particular place". I find that such an assemblage perspective on experimentation does little to advance conceptual clarity. It is unclear how this definition distinguishes between experiments as discrete, tentative and temporary interventions, and other processes through which urban actors negotiate infrastructural change. Hodson et al. (2017) make two valuable contributions. First, conceptualising urban transitions as

contextual "*reconfiguration* of *existing* urban infrastructure systems" (*ibid.*, p.7; emphasis added), in contrast to the MLP notion of monumental shifts from one dominant technology to the next. Second, Hodson et al. (2017) draw attention to the need to analyse experimentation in light of *pre-existing* urban governance arrangements, rather than with reference to 'clean' laboratories; and to how capacities to reconfigure urban infrastructure needs to be understood within the context of multi-scalar governance.

2.1.5   The specific nature of mobility systems

The literature reviewed thus far conceptualises experimentation and system change in relation to many different empirical domains, e.g. equating mobility systems with energy systems. Yet there might be considerable differences in the dynamics of such systems. My approach is to consider urban *mobility* systems specifically, drawing on insights from transport studies. The review in this section relates to Primary RQ2, RQ2.1 and RQ2.2.

Table 2.3 summarises how different scholars have conceptualised mobility systems, including the scale at which systems are analysed; how the boundary of the system is delineated; and the constituent elements, which are closely related to the path-dependencies that act as a stabilising force on systems.

Table 2.4 summarises how urban mobility transitions have been defined by different scholars, including triggers and/or thresholds for transitions and the markers by which transitions can be empirically observed.

With reference to Table 2.3, in the MLP, mobility systems are primarily defined in terms of their constituent regimes and associated institutions and actors, in line with the constructivist ontology of the MLP (Geels 2010), whereas the locus of infrastructure within the MLP has been defined inconsistently (Markard and Truffer 2008). Sorrell (2018) has convincingly argued that the MLP understanding of systems being entirely 'made up' of institutions is unsatisfactory from a critical realist ontology, which emphasises the objective and material nature of reality (echoed by Næss and Vogel 2012).

Table 2.3. Conceptualisations of mobility systems in existing literature.

Literature	Mobility system…			
	Scale of analysis	Boundary	Constituent elements	Path-dependencies
Geels (2002, 2012, 2018): 'socio-technical system'	National	Functional, empirical domain of societal provision (Geels 2010)	Institutions, actors; Single dominant regime (2002); Multiple regimes (2012; 2018)	Institutional, techno-economic
Urry (2004): 'automobility'	Global	None, ubiquitous	Car as object and form of mobility, techno-economic complex, culture, pollution and resource extraction	Techno-economic
Bertolini (2017): 'metropolitan mobility system'	Urban	Spatial: metropolitan	Transport and land-use feedback cycle	Spatial/material and institutional
Naess and Vogel (2012): 'sustainable urban development'	Urban	Spatial: functional urban region	Building stock, land use and transport infrastructure 'Multi-segmented' regime	Material and behavioural

Table 2.4. Conceptualisations of mobility transitions in existing literature.

Author	Mobility transition…		
	Definition	Triggers and thresholds	Empirical markers
Geels (2002, 2012, 2018)	Towards 'sustainable mobility' Regime shift (2002, 2012), whole-system reconfiguration (2018)	Patterns of niche-regime-landscape interactions	Distance travelled and trips for different mobility modes, vehicle registrations, CO_2 emissions
Urry (2004)	Move to 'post-car' system Disruption of car system, system moving into a new path	Six types of socio-technical change; building up to a tipping point	Unpredictable, cannot be empirically observed
Bertolini (2007, 2017)	'Transformative change', that is complex and non-linear	Change in multiple/critical mass of system components, in a coherent direction: both transport and land use	Change in mode split
Naess and Vogel (2012)	'Urban transition', in urban spatial structures	N/A	Change in mode split, building stock
Curtis and Low (2012)	'Transformative change' as a change of policy path (paradigm, goals)	Critical junctures, drawing on historical institutionalism	Policy discourse, decision-maker's perceptions

The MLP conceptualises the path-dependencies that 'lock in' automobility in terms of technological and economic institutions. This draws on the classic economic theory of path-dependency (Arthur 1994) where by virtue of 'chance events', certain technologies become 'dominant designs' and establish a path of 'increasing returns' within that is more and more costly to deviate from. Histories of automobility emphasise how the 'petrol car' became 'irreversibly' locked-in during the early 20th century (Geels 2005), by establishing a techno-economic complex of markets, government policies, industries and lifestyles supporting the dominance of automobility (Unruh 2000). With reference to Table 2.4, early work understood transitions as a regime shift from one dominant technology to the next (Geels 2002). A recent revision of the MLP by Geels (2018) suggests that mobility transitions can be understood as 'whole-system reconfiguration' where multiple regimes and multiple innovations interact to produce more gradual change.

Urry (2004, p.27) has conceptualised 'automobility' as a *global* system in itself, including "cars, car-drivers, roads, petroleum supplies and many novel objects, technologies and signs" at a world-wide scale. The essence of the concept is that the car dominates most aspects of society through a techno-economic and cultural complex, with automobility being the predominant form of 'quasi-private' mobility that subordinates other mobilities and structures how people organise everyday life (*ibid.*). Urry understands automobility as a 'self-expanding' and virtually 'irreversible' system, and like Geels, understands the path-dependencies of automobility as techno-economic (citing Arthur 1994). Urry (2004, p.33) argues that the move to a 'post-car' system, or a transition,[5] will need to involve a fundamental disruption of automobility:

> "The real challenge is how to move to a different pattern involving a more or less complete break with the current car system. The current-car system could not be disrupted by linear changes [like decreasing fuel consumption and improving public transport] but only a set of interdependent changes occurring in a certain order that might move, or tip, the system into a new path".

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[5] N.B. Urry does not use the term 'transitions' explicitly.

Bertolini's (2017) work on 'metropolitan mobility systems' and Næss and Vogel's (2012) critique of the MLP define the boundaries of urban mobility systems by 'functional' urban regions, pointing to how daily mobility flows are spread across spatial areas that transcend administrative boundaries. Bertolini (2017, p.26) conceptualises urban mobility systems as a 'transport land use feedback cycle', between transport networks (shaped by technological innovations, infrastructure investments and transport policy) and land use (locations and activities). Næss and Vogel's (2012) definition broadly agrees with this. Furthermore, Næss and Vogel argue that the MLP notion of automobility as a dominant regime does not reflect the realities of Western European cities where mobility systems are multi-modal; they thus propose that mobility regimes in these cities can be understood as 'multi-segmented'.

In emphasising the spatial and material nature of urban mobility systems, e.g. as related to land use, both Bertolini (2017) and Næss and Vogel (2012) argue that the MLP has too much of a techno-economic focus to offer an appropriate conceptual frame. Using Amsterdam's mobility transition from the 1960s as an example, Bertolini (2007) highlights the importance of path-dependencies in the morphology of land use and mobility networks, as well as the institutional path-dependencies of related policies. Næss and Vogel (2012) emphasise 'sunk investments' in infrastructure and buildings as key path-dependencies, as well as habitual mobility behaviours among the population that can be slow to change. These authors offer less clarity when it comes to conceptualising transitions. Bertolini (2017) discusses 'transformative change' as complex, non-linear and therefore uncertain, likely requiring a 'critical mass' of change in several components of the transport and land-use cycle. Both Bertolini and Næss and Vogel emphasise changes in 'mode split' as a key empirical marker for transitions, i.e. "the varying proportions of different transport modes which may be used by at any one time" (Mayhew 2009), usually indicated for a particular population category (e.g. working-age commuters).[6]

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[6] Mode split is also referred to as 'modal split'. In this thesis, I use 'mode split' to refer to the overall split of percentage proportions representing different modes, and 'mode share' to refer to each individual proportion.

Curtis and Low (2012) distinguish between two types of place-specific path-dependencies shaping urban mobility transitions: 'technical' path-dependencies, which they define as interrelated spatial structures and public transport systems, and institutional path-dependencies, which they define in terms of the self-perpetuating power of specific organisations, and inertia in policy discourses and the 'mental models' of decision-makers. Curtis and Low focus on examining the institutional rather than physical kind, which is reflected in their definition of 'transformative change' as a change in 'policy path', i.e. policy paradigms, overall policy goals and comprehensive institutional reform.

Discussion and synthesis

An appropriate conceptualisation of urban mobility systems and transitions can be developed through synthesis of the perspectives discussed. It is clear that the MLP's and Urry's conceptualisation of mobility systems and their path-dependencies are too techno-economic (Schwanen and Lucas 2011), ignoring how such systems are characterised by mobility flows determined by infrastructures and spatial structure. There are also strengths to Urry's and Geels' approaches. I find Urry's notion of transitions as *path-deviant* change powerful. Geels' (2018) recent argument that socio-technical transitions can be analysed through the lens of 'whole-system reconfiguration' including multiple regimes and niche-innovations is valuable, even if it remains focused on niche-regime-landscape interactions. To analyse passenger mobility in Great Britain from 1990 to 2016, Geels (2018) analyses automobility, railway, bus, and cycling regimes to provide a comprehensive picture of overall system change at the national scale. I interpret Geels' emphasis on whole-system reconfiguration as an analytic and methodological argument, for moving away from case studies of single experiments, towards comprehensive analyses of entire systems.[7]

A conceptualisation of urban mobility systems as shaped by place-specific institutional and material path-dependencies can be combined with Urry's concept of automobility as a *global* system. The notion that automobility systematically subordinates other mobilities and privatizes public space in all cities (Sheller and Urry 2000) and involves standardised

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[7] Indeed, this was the argument made by Geels in a keynote presentation during the 2018 International Sustainability Transitions conference.

infrastructures (e.g. road design, signs, markings) rings true, even as the degree of dominance varies from place to place (Schwanen and Lucas 2011). Drawing on Schwanen (2016), we can understand automobility as *resilient* even in places where it does not dominate, not in the sense of 'irreversible' lock-in, but in its 'capacity to endure' competition and disruptions posed by other mobility practices and technologies.

Analytic balance is needed concerning institutional and material path-dependencies. Næss and Vogel (2012) underplay the institutional dimension, while Curtis and Low (2012) overemphasise the institutional dimension. I would argue that Curtis and Low's definition of transitions as 'third-order' change in policy paths exemplifies how existing research on sustainable mobility tends to examine why policy paradigms change, and describes the different policies that were proposed or implemented as a result, but is then not able to account for why the material outcomes of policy implementation were limited. In other words, the focus tends to be on how there was a shift towards a 'sustainable mobility paradigm', but not explaining to what extent mobility systems changed 'on the ground'.

Empirical evidence regarding path-dependencies

As examining path-dependencies constitutes a small part of my overall research (RQ2.2), it is beyond scope to ground this in a full theorisation (e.g. historical institutionalism; Pierson 2000). Instead, I review empirical evidence regarding four mobility-specific path-dependencies: public transport systems, spatial structure and commuting flows, city-regional governance, and civil society activism.

As discussed above, Curtis and Low (2012) emphasise the first three. In mid-sized to large cities and city-regions, public transport services that can compete with private car use when it comes to travel times, reliability and comfort are needed for a development path that leads away from automobility (Cervero 2020). Research on public transport across the Global North has found that integrated planning of land use and transport through city-regional governance structures is a key ingredient of successful mode shift to public transport (Docherty et al. 2009; Rye 2008; Buehler et al. 2018; TRB 2001). Differences in the extent and quality of public transport systems, particularly rail-based services, are the

outcome of path-dependencies stretching back and continuing to evolve over the last 40-100 years or more. Traditions of city-regional governance vary significantly between countries, and governance reform does not occur often.

Naess and Vogel (2012) emphasise how the spatial structure of city-regions shapes mobility behaviour, and argue that there is widespread scholarly agreement that compact development patterns are associated with sustainable patterns of mobility (as does Banister 2008). This is at risk of simplification (Neuman 2016), as there is considerable debate about how built environment characteristics like density affects travel behaviour, yet it is undisputed that across city-regions, the accessibility of employment locations by public transport matters for reducing car commuting (Ewing and Cervero 2010). Employment locations exhibit some degree of path-dependence in terms of agglomeration economies and different types of building stock, even if this is by no means irreversible (Martin and Sunley 2006). Sprawled types of residential and office development that are inaccessible by public transport is indeed often understood as the quintessential 'lock-in' of urban form. By referring to path-dependent 'spatial structure and commuting flows', I mean whether the spatial structure of a city-region and its daily web of commuting flows is served by accessible public transport services.

Finally, analyses of transitions away from automobility in Amsterdam (Bertolini 2007), Bristol (Brownlee 2011; Ginger 2013), and US cities including NYC (TransitCenter 2015; Furness 2010) make clear that civil society activism had an important role in changing municipal policy and supporting the growth of alternative mobility cultures (including cycling). However, it is important to acknowledge that civil society traditions differ across places (Åberg 2015; Jones et al. 2014).

2.2 Governance and capacity for urban experimentation

This section reviews literature with a focus on Primary RQ1, justifying why this thesis focuses on *municipal government* capacity for transformative experimentation, and how such capacity can be understood in the context of debates within urban studies. While RQ1.2

focuses on the internal capacity of municipal *government* as an organisation, the framing of Primary RQ1 and RQ1.3 highlights that understanding government capacity in the context of *governance* is crucial. That is why this section starts with reviewing theoretical debates on the role of government in the context of governance.

2.2.1   Theoretical debates on governance

In its most basic sense, the concept of governance refers to the increased involvement of non-state actors in governing (Stoker 1998): the private sector and civil society being involved public decision-making and service delivery. Some argued that this was driven by the complexity of new collective action problems, which no single actor is able to tackle independently (Kooiman 1993). Stoker (1998) emphasised a more political angle: that responsibilities for addressing societal challenges and providing public services have become blurred, redefined as not just the task of the public sector, but other sectors too.

Early research emphasised that actors were interacting in governance networks (Stoker 1998; Torfing 2005; Rydin 2010) operating autonomously without externally-imposed structuring of coordination by government, i.e. in the absence of hierarchy. The role of government in this new context was understood to be 'steering' and facilitating collective action, rather than 'rowing' itself (Jordan et al. 2005). More controversially, some scholars argued that an empirical shift from 'governance to government' had taken place, with governance networks more-or-less overtaking government in importance (Stoker 1998). This was framed as a shift from a 'state-centric' perspective, to a 'society-centric' perspective that emphasises the ability of society to govern itself (Pierre and Peters 2005). Some scholars advocated for a society-centric governance paradigm on a normative basis, e.g. to advance greater participation of civil society in public decision-making (Sørensen and Torfing 2018), or as necessary to solve 'wicked problems' like sustainable development (Evans 2012).

The empirical basis of the society-centric perspective has been repeatedly called into question: today, there is a broad consensus that governance never really replaced government, instead, the role of the state remains important, albeit transformed (Capano

et al. 2014; E. Sørensen and Torfing 2018; Lynn 2011; Jordan et al. 2005). Most scholars acknowledge the proliferation of multi-sector interaction in the governance of urban sustainability (Rydin 2010), but understand governance as a mode of governing 'within the shadow' of hierarchy, rather than in its absence (Börzel and Risse 2010).

Current analyses focus on the relative prevalence of different 'modes' of governing in different geographical contexts and policy domains (Capano et al. 2014; Gross 2016; Blanco 2015). One classic typology distinguishes between hierarchical, market and network governance modes, presented in Table 2.5, with definitions adapted from Powell (2003), Lowndes and Skelcher (1998) and Evans (2012).[8]

Table 2.5. Hierarchical, network and market modes of governance.

Features	Governance mode		
	Hierarchical	**Market**	**Network**
Basis of relationship between members	Authority, legislative	Contractual, based on property rights	Shared interests, complementary strengths and trust
Actor preferences or choices	Dependent	Independent	Interdependent
Means of communication	Bureaucratic routines	Prices and costs	Relational
Ethos	Formal	Precision, calculation	Informal, open-ended, mutual benefits
Flexibility and conduciveness to innovation	Low	High	Medium
Governing instruments /Role of the state	Laws and regulations	Economic incentives	Enabling collaboration, encouraging voluntary behaviour

The distinction in Table 2.5 between each mode's relative flexibility and conduciveness to innovation is particularly relevant to experimentation. The hierarchical mode is associated with traditional government, evoking "a clear pyramid of control through which decisions

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[8] Evans (2012) cites another publication by Powell, the same publication by Lowndes and Skelcher (1998), as well as Rydin (2010), as the basis for his typology.

taken at the top are subsequently passed down to those below", and where interactions between individuals are based on their status as formal employees of different organisations (Evans 2012). Interaction is related to government authority, with the ethos between actors shaped by formal institutions, such as applicable laws and regulations. Efficiency of hierarchical coordination is achieved through the development of bureaucratic routines, however, this comes with a "reduction in flexibility and innovation because of a tendency to formalization and routinization" (Lowndes and Skelcher 1998, p.318).

Market governance relies on property rights as the foundation of interaction, with contractual relations between actors. Actors are independent of each other, highly flexible in their choice to participate in the market based on prevailing prices and costs, which also means that actor relations are primarily based on precise calculation and profit motives (Evans 2012). The role of government is posited as modifying the incentives for actors to participate in markets, e.g. lowering transaction costs.

Network governance is posited as a 'third way', where actors coordinate voluntarily based on shared interests that they have identified, and complementary strengths in achieving those interests. Here, the argument by institutionalist governance scholars (Lowndes and Skelcher 1998; Sørensen and Torfing 2018) is that network governance is about more than interdependent resource exchange, rather also extending to a desire for 'collaboration' based on shared goals. Actor relations are based on mutual trust, and collaboration is based on informal institutions, with more loosely defined and open-ended roles and responsibilities. The network mode is more flexible than the hierarchical mode because in the absence of legally-bound interaction, it "can be more responsive to emerging needs and opportunities" (Evans 2012). The role of government is to 'enable' network collaboration between actors, and encourage voluntary behaviour to achieve policy goals.

A key question is to what extent market and network modes are eclipsing the hierarchical mode associated with traditional government (Capano et al. 2014). The hierarchy-market-network typology is one of ideal types (Lowndes and Skelcher 1998), whereas the task of empirical research is to investigate spatio-temporal variation in governing modes. This

includes understanding why actors choose to model their interactions and partnerships on these different modes, for the governing modes "also provide the medium through which actors interpret and act to shape their reality" (Lowndes and Skelcher 1998, p.318). In other words, beyond understanding governance modes as the patterns that emerge as the outcome of social coordination (Kooiman 1993), state and non-state actors also exercise agency in adopting different modes of interaction.

2.2.2 Sustainability transitions: focus on non-state actors and networks

The consensus among governance scholars that government retains an important role within the broader context of governance, is scarcely reflected within sustainability transitions research, which espouses a network governance perspective, but lacks nuance on the (persistent) role of the state and how prevailing modes of governance reflect political trends.

Sustainability transitions research emphasises multi-actor processes, rejecting the idea that government can steer transitions from a 'top-down' perspective (Köhler et al. 2019). As shown in Table 2.1, government is typically seen to reproducing the unsustainable status quo of socio-technical systems, and hope is placed in non-state actors (private sector, technology users, civil society) seen to be more 'radical', to pursue innovation. The notion that actors come together in networks is a defining feature of sustainability transitions research (e.g. in SNM; Schot and Geels 2008). Geels et al. (2015, p.8) argue that transitions research has no preference for a single governance model, but nonetheless highlight that the strongest affinity is with 'interactive network governance', proposing that relevant government instruments include "demonstration projects and experiments, knowledge transfer policies, network management, vision building", i.e. the state as an enabler of voluntary network activities. Recent literature on experimentation within 'urban living labs' exemplifies how network governance is imagined, in referring to an 'open innovation' ecosystem focused on "co-creation of innovative solutions (i.e., products and services) in real world environments with users", with 'quadruple helix' collaboration between state, private sector, academia and civil society (Puerari et al. 2018, p.18951). The

notion is that urban experimentation takes place as a fluid and open-ended process of voluntary collaboration, based on shared normative goals of advancing sustainability.

The network governance orientation is reflected in two recent conceptual frameworks for analysing the capacity of actors for 'transformative change'. Wolfram's (2016, p.126) framework focuses on 'urban transformative capacity', defined as "the collective ability of the stakeholders involved in urban development to conceive of, prepare for, initiate and perform path-deviant change towards sustainability within and across multiple complex systems that constitute the cities they relate to". The range of 'stakeholders' that might be involved remains unspecified, but citing the collaborative planning tradition (Innes and Booher 2010), Wolfram emphasises diverse types of network collaboration between the state, civil society and private sector to enable collective learning processes. Hölscher et al.'s (Hölscher et al. 2018, p.125) framework focuses on 'transformative climate change governance', comprising four types of governance capacities, defined as "the collective abilities of actors to engage in processes that work to achieve desired system level outcomes". 'Transformative capacity' is defined to include capacities for experimentation that can create 'protected spaces' for novelties, anchor innovations in networks, and embed innovations in institutions; referring to SNM and Transition Management perspectives discussed in section 2.1.1. The empirical material referred to by Hölscher et al. (2018) is on climate governance in Rotterdam, with discussion of experimentation by city government.

Both Wolfram's (2016) and Hölscher et al.'s (2018) frameworks are based on a thoughtful synthesis of literature, providing a counterweight to state-centric perspectives. Yet I would agree with Bulkeley and Castán Broto (2013) that more critical perspectives acknowledging political economies and resource asymmetries within urban contexts is notably absent in research on experimentation. For example, Wolfram (2016) notes that developing transformative capacity requires access to 'human and financial resources', but this is not elaborated upon. It is unclear *whose* capacity is really at stake: as pointed out by Shove and Walker (2007, p.764), 'who manages', what other actors are involved, and "on what authority and on whose behalf do they act" seems to lack theoretical grounding within the Transition Management literature. Ideal-type models from innovation studies

have transmuted into literature that seeks to conceptualise how 'the urban' is governed (Marvin et al. 2018), yet it is difficult to see how 'open innovation' oriented around sustainability reflects the empirical realities of urban governance.

2.2.3 The need to understand municipal government capacity

The sustainability transition literature's emphasis on non-state actors makes sense for: 1) technological innovation, for which history shows that private sector entrepreneurs and users play an important role (Pinch and Bijker 2012); 2) critiques of narrowly-framed technology policy pursued by national governments uninterested in disrupting unsustainable industries (Smith 2004); or 3) real-life Transition Management processes that seek to empower civil society organisations. It does not make sense if we are talking about urban transitions related to infrastructure and services, as public goods that the state provides or guarantees provision of. I agree with Johnstone and Newell (2018, p.74) that the state has an implicitly assumed, but under-conceptualised, role within sustainability transitions.

Framing municipal governments as actors reproducing the unsustainable status quo is problematic for analysing urban mobility, because municipalities often play an active role in sustainable mobility innovation (Schwanen 2015). In most Global North cities, municipalities control the street network and hold the authority to regulate different mobilities with respect to cost, speed, behaviour, priority, etc. The role of municipal government is likely more central for urban mobility systems than energy systems, for example, where service provision is often managed by the private sector (Nochta and Skelcher 2020). Castán Broto and Bulkeley's (2013) survey found that 66% of 627 urban climate change experiments were led by local government: of this proportion, 62% were undertaken in partnership with other actors, and 38% by local government alone.[9] Considering only experiments related to mobility (N=96), the proportion with local government as the leading actor was 81%. These findings indicate that municipal governments are central actors governing urban mobility systems, with continued power

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[9] Author's calculation based on Table 9 in Castán Broto and Bulkeley (2013), 239 cases of local government as leading actor + no partnership, out of 413 experiments led by local government overall.

to govern alone, but also highlight that municipal capacity must be understood within the context of governance and with attention to partnerships with non-state actors.

There is a lively debate between state-centric and network-centric perspectives on 'who should lead' sustainability innovation (Lupova-Henry and Dotti 2019). My focus on municipal capacity is not based on a normative preference for a state-centric perspective, rather on the empirical reality of municipal control over urban mobility systems. To begin understanding the role of municipal government in the context of governance, I argue that it is productive to:

1. Conceptualise the capacity of municipal government for transformative experimentation, as separate from non-state actors but involving interactions with non-state actors, rather conceptualise the capacity for collective action, where the capacities of different actors are less clearly defined;
2. Examine the relations between municipal government and non-state actors, including the existence of network modes of governance, as an *empirical question*;
3. Conceptualise municipal capacity in the context of multi-scalar politics marked by state restructuring; while recognising the possibility of progressive municipal entrepreneurialism.

I turn to the third point in the next two sections.

2.2.4 Urban governance in the context of state restructuring

Critical urban research understands governance through the lens of neoliberal small-state ideologies that rose to prominence in the late 1970s. 'State restructuring' refers to a process whereby the state is continuously adapting to the changing nature of global capitalism, but with geographical variation in manifestations of neoliberalism and institutional responses (Brenner 2009; Shaw and MacKinnon 2011).

Jessop's (1997) concept of 'hollowing out' is one of the most prominent perspectives on state restructuring. To theorise the transition from an era of Fordist economic regulation and Keynesian welfare states, to a post-Fordist era of neoliberal competition states, Jessop (1997) identifies two types of 'hollowing out'. First, the *denationalisation* of the state:

national state capacities being reorganized 'territorially and functionally' at sub-national, supranational and trans-local scales; a "continuing movement of state power upwards, downwards and sideways as attempts are made by state managers on different territorial scales to enhance their respective operational autonomies and strategic capacities" (*ibid.*, pp.573-574). Second, the *destatisation* of the political system, reflected in partnerships between state and non-state actors, drawing attention to the fact that increasing involvement of non-state actors in governing is not simply a feature of societal complexity (cf. section above), but linked to the reorganisation of state provision. For example, privatisation of formerly state-controlled enterprises and contracting-out of public service delivery to private providers in line with the New Public Management doctrine (Gruening 2001; Kaboolian 1998). Brenner (2004) has developed the restructuring perspective further, referring to 'state rescaling'. For Western Europe specifically, Brenner (2004) argues that the regulatory capacity of the nation-state was rescaled 'upwards' to the EU as a supranational institution, and 'downwards' to the urban scale. New responsibilities and powers for economic regulation were delegated to local states, with competitiveness agendas driving an increase in public-private partnerships and *network forms of governance*.

Existing research on urban transitions has used the 'multi-level governance' perspective (Marks and Hooghe 2004), to compare 'local transition initiatives' in four European city-regions: Brighton, Stockholm, Dresden and Genk (Ehnert et al. 2018). The city-regions were chosen to represent four different political systems: a centralised unitary state (UK), decentralised unitary state (Sweden), 'cooperative federal' state (Germany) and 'dual federalist' state (Belgium), with actors within each city-region thus enjoying different levels of autonomy and 'hard power' (formal authority and funding). In my view, this is the best existing study on urban sustainability transitions from a comparative perspective; I draw some inspiration from its research design (chapter 3). However, I find the empirical findings discussed by Ehnert et al. less illuminating because the analysis focuses on generating generalisable findings regarding the relative 'comparative advantages' of unitary versus federal political systems for local actors driving 'transition initiatives': how actors draw on the structure of different systems to play strategic 'multi-level games' to achieve their aims. This reflects the concern of political science in theorising the (dis)advantages

of de/centralisation in different political systems and in rational choice perspectives (Dardanelli 2019). I argue that an understanding of how multiple governance scales shape agency in relation to urban transitions is better understood through 1) a dynamic perspective on evolving state restructuring over time, rather than 'static' political systems; 2) attention to the political economies of specific policy domains, i.e. how political priorities and financial flows across multiple scales shape urban *mobility* experimentation, rather than through the lens of 'optimal' political systems.

Critical scholars have expressed much scepticism about network governance and partnerships in urban contexts (Blanco 2015), including that: they involve coercive state control where civil society actors are enrolled to advance neoliberal state agendas (Davies 2007; 2015; 2016), and that sustainability-focused network governance arrangements are contributing to the erosion of democracy (Swyngedouw 2005; 2009). Network governance arrangements can be assessed on the basis of 1) democratic accountability, and 2) effectiveness in achieving desired outcomes (Geddes 2006). I do not argue any particular position regarding the desirability of network governance, nor do I assess this governance mode on its democratic quality. My research is interested in the effectiveness of different governance modes in enabling municipal capacity for transformative experimentation in an instrumental sense (RQ1.3).

The key point here is that local governance needs to be analysed within broader spatial scales (Rydin 2010). Understanding municipal capacity requires attention to state restructuring as a 'backdrop' to *simultaneous* 'horizontal' and 'vertical' restructuring.

2.2.5   The possibility of progressive municipal entrepreneurialism

Studying municipal government capacity for transformative experimentation is ultimately about recognising the possibility of progressive state action.

In critical urban scholarship, municipal agency is understood with reference to capitalist structure, where municipalities willingly reproduce the inequalities of neoliberal accumulation. Harvey (1989) argued that neoliberal global politics ushered in a shift from 'urban managerialism' characterised by a Weberian bureaucratic logic to 'urban

entrepreneurialism', with the emergence of new types of 'speculative' and financialised governing practices.[10] The shift to municipal entrepreneurialism was associated with a change in local-national relations that involved a "more decentralized geography of urban governance and significantly more autonomy for local leaders, as national states cut funding and decentralized policymaking authority" (Lauermann 2018, p.208). Speculative municipal entrepreneurialism is understood as the symptom of inter-urban competition under contemporary state restructuring.

This conception of structure and agency is too limiting. Bulkeley (2005) points out the overtly economistic framing of post-Marxist perspectives on state restructuring, and the genuine efforts many municipalities are making vis-à-vis climate change mitigation, above and beyond nation-states (see also Acuto 2013). The rise of local action on sustainability since the early 1990s, discussed in chapter 1, means that state transformation cannot be understood solely through the lens of capitalist regulation.

A recent strand of literature has argued that municipal entrepreneurialism ought to be understood in a more expansive sense. Lauermann (2018) has argued that while the 'speculative' practices associated with the classic definition of entrepreneurialism continue, today entrepreneurial governance can also be understood to comprise non-growth objectives and practices such as policy experimentation related to environmental sustainability, citing Bulkeley and Castán Broto (2013) as a case-in-point. Likewise, Phelps and Miao (2019) argue for the need to distinguish between the real possibility of urban 'intrapreneurialism' or public service innovations generated within municipal bureaucracies with progressive impacts on local welfare, and financialised municipal practices seeking to capitalise on changes in land and property values. Referring to Mazzucato's (2015) concept of the 'entrepreneurial state', Swilling and Hajer (2017) (re)define 'entrepreneurial urban governance' as a new governance paradigm, where the state has an 'active and goal-setting role', but promotes experimentation through

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[10] Such as real estate speculation, public-private partnerships for large infrastructure and regeneration projects, and the 'speculative construction of place' through city branding.

innovation partnerships and networks with non-state actors to deliver 'radical learning' that is not possible by municipal bureaucracies alone.

Swilling and Hajer put forward a more ideal-type, normative sketch of entrepreneurialism for sustainability transitions. I agree with the former authors' (Lauermann 2018; Phelps and Miao 2019) emphasis on the co-existence of different motivations and practices. Entrepreneurial practices that are oriented around economic growth *and* non-growth objectives (like sustainability) are undertaken in parallel in most cities – it is not that sustainability-related experimentation has squeezed out the economic competitiveness imperative that drives urban governance more broadly. Municipal entrepreneurialism will fuse multiple growth- and sustainability-oriented agendas, and may include experimentation as one potentially 'progressive' entrepreneurial practice, e.g. as related to transitions away from automobility.[11]

2.3   Municipal capacity: organisational and partnership dimensions

Having explained the focus on municipal capacity with reference to theoretical debates at the level of Primary RQ1, this section reviews literature on capacity for *experimentation* as a *specific* activity, thus informing the conceptual approach to RQ1.2 and RQ1.3. The first sub-sections (2.3.1, 2.3.2, 2.3.3) focus on the capacity of municipal government as an *organisation*: how experimentation is organised internally, and how human and financial resources is mobilised to govern. The latter sub-sections (2.3.4, 2.3.5) turn to consider the *partnership* dimension of municipal capacity: how state restructuring has redistributed authority to govern urban mobility across state and non-state actors, and how actor relations within temporary experiment partnerships can be analysed.

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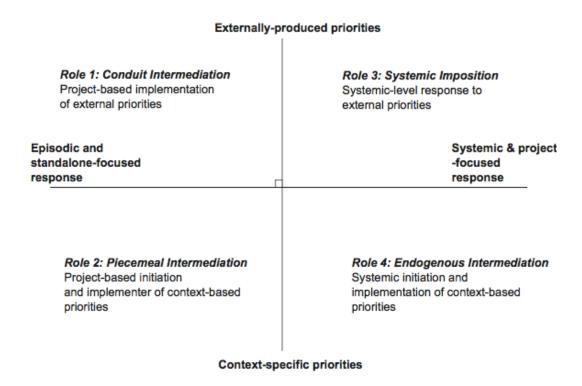
[11] I first developed this account of municipal entrepreneurialism in relation to urban experimentation in a paper presented at the 8th *Nordic Geographer's Meeting* (Smeds 2019c).

2.3.1 Organisational capacity for urban transitions

Hodson and Marvin (2010) examine the capacity of intermediary organisations in relation to urban energy systems. Based on research in five 'global' cities, Hodson and Marvin (2010, p.483) conclude that organisational capacity to steer transitions includes:

1. "Sustained broad-based financial support", reducing the "risk of the priorities… being dictated by the reactive chasing of funding";
2. Security of employee positions (by virtue of longer-term funding);
3. Shared organisational culture oriented towards learning and adaptation to changing context, the development of which is "unlikely to be solely effective through project-based thinking but rather should be systemic, strategic and long-term";
4. "Shared organisational view" as to how influence can be measured "beyond the often narrow metrics of external funders".

With the first and second point, Hodson and Marvin (2010) argue that long-term and certain funding is critical for organisational capacity, in allowing for experimentation to not be based on external funders' whims, which also applies to the way that experiments are evaluated, as per the fourth point. Hodson and Marvin (*ibid.*, p.482) contrast project-based intermediation as 'short-term thinking', with what they found to be more effective 'systemic, strategic and long-term' activities. These arguments were further developed into a typology of urban energy intermediation (Hodson et al. 2013) shown in Figure 2.1, building on a study of intermediary organisations in London (e.g. London Climate Change Agency) and Manchester. The vertical axis of the diagram captures the tension between energy priorities rooted in local contexts and 'external priorities' imposed by UK central government or EU institutions. The horizontal axis refers to how intermediation activities are organised, with project-based approaches again contrasted with systemic responses, including the development of larger programmes of projects or new organisations (Hodson et al. 2013, p.1412).

Externally-produced priorities

Role 1: Conduit Intermediation
Project-based implementation
of external priorities

Role 3: Systemic Imposition
Systemic-level response to
external priorities

**Episodic and
standalone-focused
response**

**Systemic & project
-focused
response**

Role 2: Piecemeal Intermediation
Project-based initiation
and implementer of context-based
priorities

Role 4: Endogenous Intermediation
Systemic initiation and
implementation of context-based
priorities

Context-specific priorities

Figure 2.1. Four modes of urban energy intermediation (Hodson et al. 2013, p.1410). Image reproduced with permission of the rights holder, SAGE Publishing.

While this typology (Figure 2.1) was based on hybrid agency activities, Hodson et al. (2013) define intermediary organisations as including municipal governments and intermediation activities as including "experimental projects and programmes to pilot and demonstrate new solutions" (Hodson et al. 2013, p.1414). I thus hypothesise that this typology can just as well be used to study urban mobility experimentation and how it is organised within municipal governments. Since Hodson et al. (2013) define organisational capacity as the ability to steer urban transitions 1) in line with a local vision, and 2) in a systematic way, my interpretation is that within Figure 2.1, quadrant 4 (endogenous intermediation) can be understood as reflective of the strongest municipal capacity for transformative experimentation, and quadrant 1 as the weakest municipal capacity.

Based on another Manchester case study, Hodson et al. (2018) extend this work by conceptualising externally-imposed constraints on urban experimentation with cycling infrastructure as five types of 'conditioning'. 'Fragmenting' delivery of infrastructure

through 'episodic' funding (e.g. piecemeal development of cycling network) and 'truncating' experimentation through inhibited learning processes (due to external funding requirements) are once again linked to the reliance of local governments on *project-based external funding*. Hodson et al. (2018) argue that the nature and objectives of experimentation in Greater Manchester are shaped by the structure of UK national funding programmes: for example, through imposition of a national political agenda centred on transport networks as facilitators of economic growth.

Drawing the three studies together (Hodson and Marvin 2010; Hodson et al. 2013; Hodson et al. 2018), we can note that Hodson and colleagues systematically draw attention to how experimentation is *organised* and *funded*. The crucial point made by the authors is that although external funding is often being awarded on a short-term basis, the four modes of intermediation point to the agency of urban actors in organising innovation activities in different ways. Figure 2.1 thus captures the interplay between exogenous drivers and endogenous strategies in relation to urban experimentation. The three studies suggest that multi-scalar governance might influence three aspects of experimentation:

- The *organisational forms* of experimentation: from short-term projects to longer-term programmes and new organisations;

- The *learning process* related to experimentation;

- The *scope* of experiments, i.e. what priorities for urban system change they reflect and what objectives they are informed by.

Other research has also problematised project-based experimentation as symptomatic of the constrained capacity of urban actors for transitions. The study by Ehnert et al. (2018), discussed in section 2.2.4, found that reliance on short-term, project-based funding created uncertainty and inhibited long-term impacts of 'local transition initiatives', across all the Western European cities studied. Schwanen (2015) studied low-carbon mobility innovation in Brighton and Oxford (UK) and found that long-term impacts were highly uncertain, due to the reliance of UK local governments on *competitive* funding national programmes to sustain mobility innovations. The capacity of the actors examined by

Ehnert et al. (2018) and Schwanen (2015) appears to fall within quadrants 1 or 2 in Figure 2.1, i.e. relatively weak but with some geographical variation.

In summary, existing research on the multi-scalar politics of urban transitions identifies a set of tensions regarding how innovation is organised: strategic versus piecemeal approaches, long-term versus short-term funding, and competitive funding versus greater funding certainty. *Projects* are understood as an organisational form linked to weaker organisational capacity. Since project-based experimentation can be observed as a central problematic in the existing literature, I unpack this further. I argue that there needs to be a distinction between two issues that are muddled in the existing literature:

1. That an experiment may be *organised* in the form of a fixed-term project;
2. Project-based *funding*, as funding that is short-term and/or competitive.

While the former concerns organisational practices, the latter concernst the multi-scalar politics of funding flows for urban experimentation. In the next section, I unpack the notion of 'experiments as projects' and the range of forms in which experimentation may be organised.

2.3.2   Forms of organising experimentation

As reviewed above, Hodson and colleagues have emphasised the importance of how experimentation is organised, yet still with little theoretical grounding regarding organisational forms. Within the sustainability transitions literature, there is a notable lack of attention to how experimentation is organised: as per the definitions introduced in Table 2.1, experiments are typically equated with projects, without reflection.[12] For example, in introducing the MLP to transport studies, Geels (2012, p.53) defines niches as 'carried' by "experimental or demonstration projects".[13] This thesis addresses the

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[12] E.g. Kivimaa et al. (2017) - 'pilots or demonstration projects'; Schot and Geels (2008) - 'demonstration projects'; Hoogma et al. (2002) - ubiquitous reference to 'projects'

[13] However, in the original articulation of the MLP (Geels 2002), experimentation is described as a niche-innovation process and 'projects' are not mentioned - perhaps unsurprisingly, given that this was based on case studies of historical transitions. Clearly, at some point within Strategic Niche Management literature, the contemporary manifestation of experiments became equated with pilot 'projects'.

shortcomings of both literatures, by drawing on organisational studies and public administration literature reviewed here.

Within organisation studies, projects are understood as a way of organising work. The Project Management Institute (PMI 2021) defines a project as "a temporary endeavour undertaken to create a unique product, service or result" with a "defined beginning and end in time, and therefore defined scope and resources". Projects are by definition limited temporally and in the resources allocated to perform a specific task (Munck af Rosenschöld and Wolf 2017). Projects grew to be an important organisational form within the private sector from the 1970s, and since then, projects and project management have become ubiquitous across society (Jensen et al. 2016), including as a form of organising in the public sector (Hodgson et al. 2019).

Table 2.6. Comparing conceptualisations of (formal) experiments and projects.

Features	(Formal) experiments	(Public sector) projects
Basic characteristics	Defined activities and outputs Fixed temporal term Fixed budget	Focused on a specific task Fixed temporal term Fixed budget
Potential opportunities	Innovation and learning Multi-actor learning process 'Protected space'	Innovation Collaboration Distance from bureaucracy
Identified challenges	Lack of longer-term and larger-scale impact; utilisation of experiment lessons	Knowledge transfer to permanent organisations Short-term policy-making

As shown in Table 2.6, there are striking similarities in how experiments are conceptualised within the sustainability transitions literature, and how projects in the public sector are conceptualised in the organisation studies literature. Like projects, 'formal' experiments are fixed interventions typically having "a beginning and an end tied to a budget, activities and expected outputs" (Turnheim et al. 2018, p.219). Like experiments understood as 'protected spaces' that are sheltered from dominant regimes (Geels 2002) or from stifling bureaucracy (van Buuren et al. 2018), projects are associated with opportunities for innovation, providing space for testing novel ideas and 'non-routine' organisational processes (Munck af Rosenschöld and Wolf 2017) with the potential to break bureaucratic inertia (Godenhjelm et al. 2015). Experimentation is

conceptualised as a multi-actor learning process, and projects within the public sector are understood to provide opportunities for collaboration to solve complex problems that require working across sectors or with external partners (Godenhjelm et al. 2015). Even the identified challenges are similar. Research has noted the lacking connections between experiments as 'isolated projects' (Hoogma et al. 2002) and formal municipal institutions (Kivimaa et al. 2017), whereas the successful transfer of knowledge transfer from projects (in the 'termination' phase of temporary organisations) to permanent organisations (to enable 'learning loops') is identified as a fundamental challenge (Lundin and Söderholm 1995). Project organising within public administrations has raised concerns about short-termism in policy-making (Godenhjelm et al. 2015), which echoes the concern of Hodson and colleagues (Hodson and Marvin 2010; Hodson et al. 2013) regarding the lack of systemic thinking.

As a new organisational form in the context of the firm, projects were theorised as 'temporary organisations', in contrast to mainstream organisational theory that assumed organisations were permanent (Lundin and Söderholm 1995). The concept of 'projectification' refers to a trend of "increasing reliance on temporary organisations" (Godenhjelm et al. 2015, p.328), e.g. within the public sector. Projects are only one form on what can be conceptualised as a spectrum of organisational forms, from the temporary to the permanent. *Programmes* and *portfolios* can be understood as 'semi-permanent' organisations (Maylor et al. 2006), under which related projects may be clustered. The new intermediary organisations that Hodson et al. (2013) associate with more 'systemic' approaches can be understood as new (fully) permanent organisations. Organisational theories thus help us make sense of Hodson et al.'s (2013) empirical observations regarding projects as related to more piecemeal approaches to experimentation, and and 'longer term' programmes and organisations as related to more 'systemic approaches': it is a question of how temporary versus permanent different forms of organising are.

Research on experimentation is thus 'reinventing the wheel' to some degree, in highlighting challenges that are well-established within organisational studies and public administration. As the project has become a widespread form for organising work and innovation activities across society, it is unsurprising if an urban mobility experiment is

organised as a project. Table 2.6 suggests that projects have both advantages and disadvantages as an organisational form: the potential opportunities identified can be used to understand why experiments might be organised as projects within municipal bureaucracies. Furthermore, the issue of how experimentation is organised goes beyond projects: there is a spectrum of organisational forms. Lastly, what is missing from this section is the influence of multi-scalar governance on how urban experimentation is organised, which is discussed next.

2.3.3 Contextualising mobility funding landcapes

We can turn to consider the issue of project-based funding as referring to funding that is short-term and/or competitive. To understand *why* funding is structured in this way, mobility funding landscapes must be contextualised in relation to state restructuring.

First, competitive funding is not limited to mobility policy, but relates to broader state restructuring as a first exogenous driver. Within Europe, Godenhjelm et al. (2015) identify two drivers of projectification in the public sector: EU funding programmes, and New Public Management emphasis on evidence-based policy-making. Projects are in some ways precise instruments of *control*: national and EU funding bodies need an organisational form for distributing funding "that allows appropriation, control, governance and monitoring" (Godenhjelm et al. 2019). Godenhjelm et al. (2015) trace the emergence of the project approach to EU funding to the reform of the EU Structural Funds for regional development in the 1980s as a 'tactical move'. The European Commission reprioritised its intergovernmental focus to a supranational-subnational relationship for the first time. However, the Structural Funds were based on the principle that national funding should not be substituted by EU funding; thus, new EU agendas instead had to be operationalised through 'additional' funding for short-term projects. For municipal governments, EU-funded 'pilot projects' thus became an 'added layer' shaping the governance of urban infrastructure (Tewdwr-Jones and McNeill 2000). After limited engagement with subnational (transport) policy during the early days of the EU (Cavoli 2015), the European Commission expanded its influence to urban mobility with its 1995 Green Paper (Halpern 2014). The Paper focused on best-practice sharing, R&D for European competitiveness

and "support for first time application… [of] new concepts" (EC 1995, p.25), illustrating how EU mobility policy has always partly been focused on supporting experimentation, as a specific activity.

In the UK, the emphasis on 'pilots' can be traced to local government reform during the New Labour government, inspired by a New Public Management focus on efficient public service delivery (Ettelt and Mays 2019). The reliance of UK local governments on a fragmented landscape of competitive funding programmes across policy areas (LGA 2020a) can be traced back at least to the Thatcher government, which held competition as a core ideological principle and radically reformed local-central government relations through centralisation and cuts to central government grants (Ward et al. 2015). To a large extent, New Labour continued with inter-urban competition by rewarding higher-performing local authorities and introducing new competitive urban funding programmes (Tewdwr-Jones and McNeill 2000). In the US context, the 1960s and early 1970s saw a great wave of new federal government funding programmes for urban policy innovation, which saw the emergence of 'grantmanship' i.e skill in writing competitive funding applications as an important municipal competence (Berg 2007). Following this, neoliberal state restructuring under the Nixon and Reagan administrations reduced funding to municipal governments, but consolidated competitive urban funding programmes into 'block grants' in a drive to reduce administrative costs (Ross and Levine 2012).

A second exogenous driver is austerity politics. In the 21st century, a trend towards competitive grant funding for municipalities has persisted in the context of national austerity programmes. As 'core' non-competitive funding to UK local authorities was cut from 2010, reliance on uncertain competitive funding increased (Gray and Barford 2018). Peck (2012) discusses 'austerity urbanism' in the US after the Great Recession of 2007-2009 as a 'scalar dumping' effect of federal and state governments passing down the burden of the financial crisis to the local scale, thus imposing austerity cuts top-down on municipal budgets. Peck (2012, p.650) argues that there has been a simultaneous trend towards competitive 'tournament' funding by federal government, where cities pursue "challenge, bid-based or demonstration-project financing, in the absence of programmatic support". While austerity is typically discussed with reference to economic, social and

healthcare policy, it is important to understand its impact on municipal capacity for experimentation with infrastructure (Smeds and Acuto 2018). 'Austerity politics' is a conceptual term that acknowledges how decision-making is based on political choices and narratives regarding the necessity of cuts to public expenditure.

Peck (2012) argues that many US municipalities have been 'complicit' with austerity agendas. Other empirical research has counterargued that since the Great Recession, what can be observed across the US is 'pragmatic municipalism', where municipalities seek to balance cuts with protection of public services (Kim and Warner 2016). US municipalities have much greater fiscal autonomy than UK municipalities (chapter 3), so Peck's argument regarding self-imposed austerity is more relevant to the US context, but the concept of 'pragmatic municipalism' applies also to variation in UK local authority responses to austerity.

My argument is that to understand how municipal government's availability of resources affects experimentation, we need to pay attention to how 'funding landscapes' evolve in the context of state restructuring. Funding for urban *mobility* cannot be understood in isolation from funding landscapes that affect multiple public service domains. Variation across urban contexts must further be related to overall *volumes* of funding, as related to austerity politics. The point here is also that there is a difference between the trend towards competitive and short-term grant funding, and how municipal governments exercise agency in organising experimentation internally: in other words, with reference to Figure 2.1, the fact that a municipal government receives competitive funding does not necessarily mean experimentation falls within quadrant 1 or 2.

2.3.4   Modes of urban mobility governance

Turning to consider the 'horizontal' aspect of urban governance, this section reviews empirical literature on how state restructuring has affected modes of governing urban mobility, as a specific empirical domain.

Research on transport governance remains empirically and conceptually thin (Marsden and Reardon 2017). Most classic typologies of urban governance focus on local economic

development (Pierre 1999; DiGaetano and Strom 2016) and are less enlightening for urban sustainability and infrastructure (McCann 2017a). One perspective on urban governance that fills this 'gap' is Bulkeley and Kern's (2006) typology. Bulkeley and Kern examine municipal capacity to govern climate change, against the backdrop of state restructuring and contracting-out of public service delivery, through empirical research on energy, transport, planning and waste services/infrastructure in German and UK cities. Bulkeley and Kern (2006, p.2242; emphasis added) conceptualise four modes of governance that capture the (changed) relations between municipalities and non-state actors:

- "*self-governing*, the capacity of local government to govern its own activities";

- "*governing by provision,* the shaping of practice through the delivery of particular forms of service and resource";

- "*governing by authority,* the use of traditional forms of authority such as regulation and direction which persist despite [local government] reforms", and;

- "*governing through enabling…* the role of local government in facilitating, co-ordinating and encouraging action through partnership".

The three first modes are described as involving municipal government largely acting alone, whereas *governing by enabling* involves non-state actors. Bulkeley and Kern (2006) found that while *governing by provision* had declined and it was unusual for local governments to *govern by authority*, *self-governing* and *governing through enabling* comprised a significant proportion of local climate governance. In relation to mobility, the authors suggest that public transport provision (in German cities) and authoritative governance (e.g. road pricing, pedestrianisation) has given way to self-governing activities such as greening municipal fleets, and enabling activities such as 'safer routes to school' initiatives, 'green travel plans' aimed at encouraging sustainable commuting among private sector staff, and 'quality partnerships' with private public transport providers (with these enabling activities seemingly all describing UK cities).

Public transport privatisation can indeed be identified as an important driver. The 1980s and 1990s saw a wave of public transport privatisation across the US and UK (Charlton and Gibb 1998). UK central government under Thatcher deregulated the bus industry at a national scale in 1985-6, creating a new privatised market for the provision of bus services by private sector operators (White and Farrington 1998). While privatisation generated some operational and cost efficiencies in many urban areas (Mackie et al. 1995), the possibility of achieving social and environmental policy goals by increasing bus ridership under a laissez-faire approach came under question by the early 2000s, thus resulting in the pendulum regarding state intervention swinging back somewhat (Docherty et al. 2004). Sørensen and Gudmundsson (2010) analyse the governance restructuring of Manchester's bus system between 1986 and 2007 through the lens of hierarchical, market and network governance. The authors argue that with the privatisation of bus services from 1985, there was a shift from hierarchical to market governance as the dominant mode, albeit some elements of hierarchical governance remained with the retention of a city-regional governance body for public transport. During the New Labour government, the bus industry remained deregulated (and thus market governance continued to dominate), but with the 2000 Transport Act UK central government introduced 'partnerships' between local authorities and private bus operators as a new governance instrument. It is this instrument that Bulkeley and Kern (2006) observe, with reference to *governing by enabling*. Sørensen and Gudmundsson (2010) argue that the partnership approach signalled the emergence of a network mode, since it was based on collaboration between local authorities and private operators in the absence of formal hierarchical power.

Rye et al. (2018, p.205) characterise voluntary bus quality partnerships as 'informal institutions', e.g. trust-based relationships between private bus companies and municipalities, noting such institutions are critical to successful delivery of public transport services, as an antidote to "the increasingly complex formal institutional structures that are found in the public transport sphere in Europe, often resulting in a lack of clear responsibility and agency to 'get things done'". Rye et al. (2018) identify a salient issue: the need to analyse governance in relation to its *effectiveness* in allowing for innovation in

infrastructure and services. Rye et al.'s (2018) pragmatic argument is that in the absence of legislative requirements, an informal 'glue' to hold actors together is needed. However, evidence from the UK suggests that voluntary bus partnerships have not been an effective governance arrangement, in terms of achieving mode shift from private car use to bus use (Davison and Knowles 2006) nor in terms of achieving integrated public transport ticketing (Bray 2015). Indeed, Geels (2018) argues public transport privatisation has been an important barrier to sustainable mobility transitions in Great Britain from 1990-2016, as reflective of neoliberal ideology.

In the US, the Reagan administration also pushed for the privatisation of urban public transport systems (Black 1991). However, in many large US cities including Seattle, Portland, Denver, Chicago, Boston and NYC, public transport continues to be provided by public transport agencies that are controlled by municipal or state governments. A study by US think tank TransitCenter (2018a) on these cities found that bus service innovation was advanced through interorganisational partnerships between municipal governments and these separate public transport agencies, with informal relationships between staff and agency leaders playing a crucial role. Evidence from the US thus suggests that network governance can bear fruit for public transport experimentation.

Outsourcing can be identified as a second driver affecting mobility governance. Aldred (2012) has argued that UK cycling policy reflects an 'outsourced cycling state', where responsibility for cycling policy implementation has been outsourced to quangos (Cycling England during the 2000s) and voluntary organisations (e.g. prominent civil society organisation Sustrans), whereas planning and research has often been outsourced to consultancies (citing Steer Davies Gleave in the case of Bristol's Cycling City project). Aldred links this contracting-out to the private sector with a broader weakening of municipal capacity for spatial and transport planning work, that Higgins and Allmendinger (1999) observed had affected the majority of UK local authorities by the late 1990s. A recent review finds that outsourcing and lack of staff expertise remains a barrier to investment in cycling within the UK (Aldred et al. 2019). As discussed in section 2.1.5, civil society activism has also played a major role in fostering transitions away from automobility in different cities; Aldred's (2012) argument is that municipal-civil society

relations can also take the form of outsourcing and thus perpetuating 'hollowing out' of state capacity. While outsourcing of public service delivery to both profit and non-profit sectors has been widespread among US municipalities since 2000 (Warner and Hefetz 2012) and civil society organisations have been played a prominent role in urban cycling policy development (Pucher et al. 2011), there is no evidence to suggest that Aldred's argument applies to US cities.

The emergence of new markets for 'smart mobility' (e.g. electrified vehicles, shared mobility services) can be identified as a third exogenous driver that is beginning to reorganize urban mobility governance (Docherty et al. 2018), opening up a new arena for experimentation that could diversify mobility options. Municipalities are seeking to partner with private providers to ensure creation of public value: increasingly, the need for public regulation of private services, beyond voluntary collaboration, is being emphasised (*ibid.*).

From this review, we can identify a hypothesis for RQ1.3: municipal capacity for transformative experimentation is likely dependent, to some degree, on the ability of municipal government to partner with non-state actors to 'get things done'. Pre-existing modes of urban mobility governance include both market (for public transport, mobility services; relations based on outsourcing) and network modes (voluntary partnerships).

Yet, I tentatively argue that Bulkeley and Kern's (2006) findings might overstate the extent to which *governing by provision* and *governing by authority* are rare, in considering urban mobility systems specifically. Most local governments in the UK and US retain considerably more power over mobility systems, compared to energy or waste services that Bulkeley and Kern also study, because of the powers they hold over street space, for example. Bulkeley and Kern's (2006, p.2249) mode of 'governing by enabling' encompasses partnerships that are very different, including activities like information provision (enabling citizens), bringing other stakeholders on board (partnerships), and "enabling other actors, in the voluntary and private sectors and at the community level, to act for public purpose". I feel that the term 'enabling' is misleading, if used to describe partnerships reflective of 'hollowing out'. Acknowledging the *politics* of state restructuring requires distinguishing

between municipal government partnering with civil society organisations for contracting-out service delivery vs. enabling civil society to undertake their own experiments; and between municipalities partnering with a private company to deliver public services because of nationally-imposed privatisation vs. partnering with a company to enable it to pursue R&D experimentation that is additional to public service delivery.

2.3.5   Urban experiments as temporary partnerships

The discussion of governance modes in the previous section relate to the overall patterns of state and non-state relations in relation to urban mobility infrastructures and services. A different conceptual tool is necessary to understand actor relations within the specific partnerships through which experimental interventions are implemented.

Temporary 'project partnerships' are discussed within the urban governance literature. This concept is appropriate for understanding how actors are working together within experiment partnerships, even experiments need not be equated with projects, as discussed above. Lowndes and Skelcher (1998, p.314) examine partnerships for UK urban regeneration projects, underlining that:

> "partnership as an organizational structure is analytically distinct from network as a mode of governance… The creation of a partnership board does not imply that relations between actors are conducted on the basis of mutual benefit, trust and reciprocity – the characteristics of the network mode of governance. Rather, partnerships are associated with a variety of forms of social co-ordination – including network, hierarchy and market".

This distinction between partnerships as a form of *organising* actors, and modes of governance as related to the *relations* between those actors, is helpful in analytically separating partnerships and network governance, as research tends to conflate the two (section 2.2). Lowndes and Skelcher (1998) examined what mix of governance modes (network, hierarchy and market) characterised the relations between the actors involved in four different stages of partnership 'life cycles'. For example, they found that the pre-partnership stage was predominately characterised by a network mode based on informal

relations, trust and shared goals, whereas the delivery stage was characterised by a market mode of tendering and contracts with lower levels of collaboration.

Lowndes and Skelcher (1998) also distinguish between two theoretical positions on interorganisational partnerships: the position that actors enter into partnerships because they are dependent on other actors to secure the resources they need to achieve their own goals, versus the position that non-interdependent actors desire to collaborate based on the expectation of 'synergistic gains'. The authors found that regeneration partnerships reflected both theories: driven by a desire for collaboration, however, partnership "also demonstrates the tensions involved in seeking collaboration in a severely constrained resource environment" (*ibid.*, p.317), referring there to the landscape of competitive funding by UK government and the EU.

Bradford and Bramwell (2014) emphasise the temporary nature of project partnerships. The authors examine economic development initiatives in Canadian cities and distinguish between three types of governance arrangements: project partnerships, sector-specific networks and institutionalised collaboratives. Bradford and Bramwell (2014, p.18) describe project partnerships as arrangements where different actors "come together around specific development projects [including infrastructure investments], programs, or services that are time-limited and well defined", but "their instrumental and episodic character differentiates them from the ongoing relations characterising institutionalised collaboratives and sector networks", with the key question thus being the degree to which project partnerships "provide a springboard for further cooperation among the various participants or remain passing 'one offs'". Bradford and Bramwell (2014) thus draw attention to an important issue: what happens to actor relations when a temporary partnership is terminated, e.g. when an experiment is over? Bradford and Bramwell's observation that urban infrastructure investment often involves bespoke project-based partnerships that potentially do not translate into longer-term governance arrangements, echoes the notion of experiments as having uncertain long-term impacts in terms of actor collaboration.

2.4 Interdisciplinary synthesis

As introduced in the first paragraph of this chapter, this thesis takes an interdisciplinary approach drawing on three different research fields (sustainability transitions, urban studies and transport studies). This is reflected in the distinct sets of literature reviewed, for which this section presents an integrated synthesis, which in turn informs the theoretical framework presented in the next section. The argument presented below is that in combining perspectives from transitions, urban and transport research, each perspective complements the strengths and limitations of the others.

The literature on sustainability transitions (section 2.1) was the starting point for this thesis, because this field offered the most well-developed conceptualisations of what experiments are, what outcomes they might have, and how such outcomes may contribute to transitions. These clear definitions and typologies enabled the formulation of RQ1.1. Sustainability transitions research offers a *systems* perspective on change in urban mobility, including experiment-system interactions, which is largely missing from the other fields. Furthermore, while urban studies has often ignored the central role of car dominance in shaping the city (Sheller and Urry 2000), transitions research has engaged with theoretical articulations of automobility and how difficult transitions away from it are (e.g. Geels 2005), arguably more so than transport studies itself.

Two limitations to the sustainability transitions field have also been discussed. First, its theories do not capture the specificities of *mobility* systems, nor support analysis of such systems at an urban scale (section 2.1.5). This has been addressed by reviewing how the nature of urban mobility systems are understood within transport studies, which provide insights on their spatial articulation, empirical evidence on path-dependencies, and the empirical markers/indicators by which we can ascertain whether mobility systems are transitioning or not. The review highlights how sustainability transitions literature can be complemented by transport studies knowledge, to provide a more well-rounded theoretical framework than either perspective, on its own, could inform. This improved the conceptualisations related to RQ1.1, and the allowed for the formulation of Primary RQ2, RQ2.1 and RQ2.2.

The second limitation of the sustainability transitions literature is how the capacities of urban actors for experimentation and transitions have been conceptualised (section 2.2.2, 2.2.3). The grounding in a normative network governance perspective where multi-actor collaboration is assumed to be motivated by collective learning about shared sustainability interests, leaves unanswered political questions about whose capacity is really at stake. Critical debates central to urban research are missing from this perspective: changing authority and relations between municipal government, civil society and the private sector in the context of governance and state restructuring (section 2.2.3, 2.2.4). This thesis is based on the premise that urban studies literature provides a stronger grounding for understanding capacities for transformative experimentation. For this reason, urban studies – complemented with empirical insights regarding transport governance – provides the primary grounding for Primary RQ1, RQ1.2 and RQ1.3, as reflected in the literature reviewed in sections 2.2 and 2.3. The thesis owes the greatest intellectual debt to the work of Mike Hodson, Harriet Bulkeley and Simon Marvin (section 2.1.4, 2.3.1). Their work exemplifies urban studies scholarship that connects questions of governance, infrastructure and sustainability, engaging with sustainability transitions research while remaining geographically grounded. The overall thrust of my research follows in this vein.

2.5 Theoretical framework

2.5.1 Analytic concepts: urban mobility systems and experiments

This section defines two core analytic concepts referred to in the RQs: urban mobility systems and urban mobility experiments. It draws on the literature reviewed in section 2.1.

For the purposes of this research, an **urban mobility system** is constituted by:

1. *Social and material elements.*
   Social elements are understood as institutions (formal and informal). Material elements include mobility infrastructures (built environment, streets), mobility technologies (digital and physical artefacts) and mobility flows (movement of people). Different mobility technologies (e.g. bodies, bicycles, cars, smartcards) are used by people to move, channelled through infrastructure and producing flows.

2. *Actors and the institutions guiding their actions, segmented for different mobilities.*
   Urban mobility systems comprise various types of actors: this research focuses on public sector, private sector and civil society organisations. The behaviour of these actors – and their interactions with each other – is structured by institutions, of the types described in the next section. Drawing inspiration from Næss and Vogel's (2012) concept of a 'multi-segmented' mobility regime, I understand the mobility system as segmented in different sets of institutions surrounding different 'mobilities'. This research examines four mobilities: automobility, busmobility, velomobility (cycling), and (mobility in) public space, with this choice discussed in section 3.4.1.

3. *An analytic unit delineated by municipal administrative boundaries.*
   For Primary RQ1, I delineate my definition of an urban mobility system by the administrative boundaries of municipal government, as an analytic construct that aligns with the study of municipal government capacity. In other words, I examine municipal government capacity for experimentation within the territory over which it has jurisdiction. When diagnosing path-dependencies shaping the extent of mobility transitions (RQ2.2), I engage with the city-regional dimension.

I define an **'urban mobility experiment'** as an intervention in an urban mobility system with the aim of testing a socio-material configuration that is novel in the context of that system. This is a hybrid of conceptualisations in existing literature, drawing on:

1. The sustainability transitions literature in understanding experiments as involving *configurations* of different *elements* (Geels 2002). However, in line with my definition of urban mobility systems, I emphasise that configurations comprise social and material (rather than technical) elements. I understand experiments as material interventions occurring within the urban mobility system.

2. Bulkeley and Castán Broto (2013) in emphasising relative innovativeness, i.e. experiment configurations are not necessarily radically innovative, but simply novel within a particular context (in this research, Bristol and NYC).

3. Bulkeley and Castán Broto's (2013) in defining experiments as interventions aimed at *testing* a novelty, i.e. there is a sense of *tentativeness* about the configuration and intervention taken at limited scale, rather than expanding a configuration widely.

From a processual perspective, I understand **experimentation as a basic causal mechanism.** While the specific socio-material configuration tested in an experiment can be understood as the 'content', experimentation can be understood as a process involving a sequence of actions (Luederitz et al. 2017), including the design of an experiment (an idea regarding the general scope of an experiment being translated into a specific configuration), implementation (configuration being tested in a real-life context) and evaluation (of the impacts of the experiment, which may or may not inform decision-making). My conceptualisation of experimentation as a mechanism draws on Bardach's (2004, p.209) definition of a basic mechanism as "a method of actualizing some latent potential and converting it into any number of possible ends". From this perspective, the outcomes of an experiment depend on its processual features (design, implementation, evaluation) as actualised by the latent powers and resources held by the actors involved. Experimentation can be understood as a 'basic mechanism' of introducing novelties into urban systems, that can be compared across contexts.

Experimentation may be adopted as a **mechanism of _governing_ through which novel configurations can be introduced into an urban mobility system.** This mechanism is distinguished by its tentativeness, because novelties can also be introduced through conventional, non-tentative policy implementation. There are multiple competing visions for sustainability and urban mobility in any urban context, and multiple motivations for actors to engage in experimentation (Hodson et al. 2017). I thus find that it makes sense to define experimentation as a mechanism that is about the introduction of novelties, in a general sense, rather than as a process through which actors seek to produce system change or govern climate change, as defined in the existing literature (section 2.1). The question becomes at what point in time and for what purposes, do actors _choose to adopt_ experimentation as a preferred mechanism for governing urban systems. I understand experimentation to be linked to the desire of the (local) state to purposively reconfigure urban infrastructure, driven by both normative and strategic motivations (Hodson and Marvin 2010). I develop a specific account of such politics termed 'sustainability entrepreneurialism', as introduced in the next section.

2.5.2   Framework for Primary RQ1

This section outlines the theoretical framework for Primary RQ1: _How has multi-scalar governance caused municipal capacity for transformative experimentation to differ in Bristol and New York City, between 1996/7 and 2016?,_ as well as specific conceptual frameworks for analysing RQ1.1, RQ1.2 and RQ1.3.

Institutions in the context of resource mobilisation

The aim of Primary RQ1 is to build towards theorising the institutional geography of municipal capacity for transformative experimentation. This draws on literature reviewed in section 2.2. The theoretical framework focuses on the agency of municipal government in the context of governance and relations with non-state actors, which in turn is understood as structured by multi-scalar governance contexts. My conceptualisation is rooted in the 'new institutionalist' approach as articulated within urban studies (Lowndes 2001). Institutions can be defined as "a set of formal and informal rules which structure

social action and are shared within a particular organization or community" (Lowndes 1996, p.193) and within 'new institutionalism' includes both formal institutions like organisations, rules and laws, and informal institutions such as norms and customs.[14] Within neo-Weberian state theory, the state is understood as a formal organisation and relatively autonomous actor vis-à-vis the rest of society, with state capacity defined as the extent to which "state authorities are able to implement their decisions across the territories they claim to govern, even at the expense of the interests of powerful non-state actors" (vom Hau 2014, p.136). In contrast to such 'old institutionalism' that focused solely on government bureaucracies, the 'new institutionalist' approach focuses on institutions as rules rather than organisations, and government institutions as embedded rather than independent (Lowndes 2001). This does not mean that organisations are not an important focus in new institutionalist analysis, indeed they remain important as "collective actors subject to wider institutional constraints and also as arenas within which institutional rules are developed and expressed" (*ibid.,* p.1958). The analytic relationship between institutions and organisations is conceptualised as follows (Lowndes 2001, p.1958; citing Fox and Miller 1995):

> "Institutions "provide the 'rules of the game', while organisations—like individuals—are players within that game. At the same time, organisations have their own internal institutional frameworks that shape the behaviour of people within them. Institutions are sets of rules that exist 'within' and 'between' organisations"".

Drawing on the approach described above, municipal capacity for transformative experimentation is understood as constituted by two types of institutions:

1. Municipal government as an organisation and its internal institutions, corresponding to 'municipal institutions' in RQ1.2;

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[14] There are three major strands of neo-institutional theory: historical, rational choice and sociological institutionalism (Hall and Taylor 1996). Lowndes (1996) argues that institutional analysis need not be grounded only in one of these perspectives, indeed a multi-theoretic approach can be productive; I follow this approach.

2. The actors and institutions involved in urban mobility governance: the institutions that exist between municipal government, other public actors, private sector and civil society actors, corresponding to 'governance institutions' in RQ1.3.

Conceptual frameworks for each type of institution are presented below.

New institutionalism provides a good fit with the arguments I developed in section 2.2. Old institutionalism was rightly criticised as state-centric by urban governance scholars who pointed to the need to consider decision-making beyond local public administrations (Lowndes 2001). However, Lowndes (*ibid.*) argues that this necessitates the *reformulation* rather than *rejection* of institutional analysis, which has parallels with scholars pointing to the persistently important role of the state within governance arrangements (Capano et al. 2014; Nochta and Skelcher 2020). New institutionalism provides a flexible framework that distinguishes between organisations and institutions, but is interested in them both (Lowndes and Skelcher 1998), and allows for understanding institutional change within local bureaucracies as well as relations with non-state actors (Lowndes 2001).

Municipal institutions (policies, organisational practices, etc.) are understood to be actualised in the context of available human and financial resources – as per the reference to municipal resources in RQ1.2. I agree with Sorrell (2018) that sustainability transitions research neglects the structural politico-economic forces shaping the agency of social actors, of which the distribution of resources is one aspect. Detailed attention to resource mobilisation is a defining feature of this thesis. The ability of municipal government, private sector and civil society actors to govern is shaped by their respective capacities to mobilise resources, in addition to the institutions guiding their actions.

Municipal agency and multi-scalar structure

The reference in Primary RQ1 to how 'multi-scalar governance' shapes municipal capacity refers to a relational process: the interplay between municipal agency and multi-scalar structure. My understanding of real entities with agency and social structure as enabling or constraining that agency falls in line with Jessop's (2005, p.49) strategic-relational approach to critical realism, which pays attention to spatio-temporal differentiation:

> "The scope for the reflexive reorganisation of structural configurations [change in structure] is subject to structurally-inscribed strategic selectivity (and thus has path-dependent as well as path-shaping aspects); and that the recursive selection of strategies and tactics depends on individual, collective, or organisational learning capacities and on the 'experiences' resulting from the pursuit of different strategies and tactics in different conjunctures."

Structure can be understood as specific strategies emerging in particular places and at particular times, as reflected in varying multi-scalar governance contexts (geographies of state restructuring, governance modes, institutional frameworks, etc.), whereas agency can be understood as "structurally-oriented strategic calculation" (Jessop 2005, p.48) where actors exercise agency by devising strategies developed in relation to those structures.

My framework includes interplay between structure and agency at two levels:

1. *Municipal policy at the nexus of growth and non-growth politics.* At this level, I conceptualise municipal agency through what I call 'sustainability entrepreneurialism': following Lauermann (2018), the merging of municipal policy agendas related to sustainability and entrepreneurialism. Structure is understood as national competition states, in relation to which experimentation may be adopted as a 'progressive' governing mechanism among a broader set of entrepreneurial practices. Sustainability entrepreneurialism is related to the content of overall *municipal visions* for mobility, which shape the *scope of experimentation* (Figure 2.3 below). The empirical articulation of sustainability entrepreneurialism is provided with reference to the case contexts of Bristol and NYC, in section 4.4.

2. *Municipal capacity for transformative experimentation.* At this level, I conceptualise municipal agency as *endogenous strategies* in relation to municipal institutions, municipal resources and governance institutions, developed in response to specific *exogenous drivers* that reflect structure as geographically-varying multi-scalar governance contexts. This reflects the relational political struggle over who governs urban mobility systems through experimentation.

This thesis is grounded in Jessop's (1997) perspective on state restructuring, rather than state rescaling theory (Brenner 2004). In referring to multiple governance 'scales' in this thesis, I mean the territorial scales (as per Jessop 1997) related to relevant units of public administration in the UK and US context: municipal government, state government (US), national government bodies (US and UK) and supranational institutions (EU); with attention to how non-state actors relate to these scales when partnered with municipalities. Such an approach has been critiqued as 'verticalist', in understanding scale in terms of static territorial 'containers', with scholars arguing that governance scales should be understood as relationally and socially constructed (Bulkeley 2005; Brenner 2009). I examine governance scales as dynamically evolving, but otherwise limit the nuance with which I treat scale, in order to limit the already-broad theoretical synthesis of my research. Although I acknowledge that governance scales in themselves are relationally and discursively constructed (Roy and Ong 2011), I choose not to engage with this.

Conceptual framework for RQ1.1

This section presents the conceptual framework for RQ1.1: *To what extent and in what ways have experiments resulted in embedding and transformative impacts?*. It draws on the literature reviewed in section 2.1.

I use the term 'embedding' to refer to the short-term outcomes of an experiment (following Turnheim et al. 2018), where a configuration or specific elements of that configuration are tested in an experiment, and become embedded within an urban mobility system. I understand experiments to affect urban mobility systems in two ways (Figure 2.2):

- Material change: change in mobility infrastructures, technologies and flows

- Institutional change: change in municipal and/or governance institutions (the two types of institutions included in the theoretical framework presented above, and defined further below).

Table 2.7 shows the typology used to analyse the embedding outcomes of experiments. 'Scaling up' as defined by Turnheim et al. (2018) is disaggregated into two separate

categories: *stabilisation* (permanence) and *scaling up* (spatial expansion). Stabilisation captures instances where an experimental configuration persists in the form or location in which it was originally tested, but does not generate further change. I borrow Castán Broto and Bulkeley's (2018) term of 'circulation' but redefine it. I draw on Williams (2016) in distinguishing between *circulation* as related to the 'journeys' of *specific elements* tested within an experiment configuration, and *scaling up* as instances where the entire configuration is expanded as a whole. Circulation is defined as an outcome where specific elements circulate among actors in the urban mobility system, even if the original configuration tested is not expanded. For example, a new type of electric vehicle charging station is tested and not scaled up, but the same type of smartcard payment technology is later used in another experiment. Circulation thus captures instances where experiments have less direct impacts, but where knowledge production may still cause one intervention to 'build' on a previous experiment. The *institutionalisation* category draws on Turnheim et al. (2018) and is defined as embedding in municipal or governance institutions.

Table 2.7. Typology of embedding outcomes from experiments.

Embedding outcome	Type of change	Definition
Stabilisation	Material	The socio-material configuration is stabilised. Expanded temporal duration of an experiment, or the configuration is made permanent.
Scaling up	Material	Scaling up of an experiment as a relatively intact whole. The socio-material configuration of an experiment is expanded to a larger spatial area/extent, with only minor changes to the original configuration.
Circulation	Institutional	Specific social or material elements circulate to new interventions (experimental or non-experimental), where they are redeployed.
Institutionalisation	Institutional	Configuration or element(s) become(s) part of new or existing municipal and governance institutions, e.g.: municipal policy, organisational structures and forms, governance structures and governance modes/logics.

Transformative experimentation (in the RQs) is defined as experimentation that generates *transformative impact(s)*, for which a typology is presented in Table 2.8. This typology was

developed inductively by analysing findings for the Bristol case (and later validated for the NYC case). The analysis revealed that in many instances, experiments triggered a trajectory of linked interventions that over the longer-term amounted to more significant impacts. Transformative impacts reflect change over the entirety/by the end of the study period (1996/7-2016).

Table 2.8. Typology of transformative impacts generated by experimentation.

Type of transformative impact	Definition
City-wide spatial expansion (material change in mobility infrastructures and technologies)	Trajectory resulted in a particular type of configuration being expanded to a significant spatial extent, by 2016 – either city-wide, or covering large areas of the city/street network.
Significant new policy or governance institutions (institutional change)	Trajectory generated new municipal institutions (with 'policy' used as a shorthand) or governance institutions that were present in 2016.
Change in mobility flows (material change)	Experimentation trajectory caused a significant change in mobility flows (e.g. cycling volumes) by 2016.

Figure 2.2 below provides a visual summary of how experiments are conceptualised to affect urban mobility systems.

Actors and institutions

Institutions segmented: automobility, busmobility, velomobility & public space

Municipal institutions & resources + governance institutions are activated in an experiment, with an experiment in turn potentially generating institutional change (circulation or institutionalisation; signification new institutions in longer-term)

Interaction between mobility infrastructures, technologies and flows

Experiment reconfigures mobility infrastructure, technologies or flows, sometimes resulting in:
→ material forms of embedding (stabilisation, scaling up)
→ longer-term transformative impact (city-wide spatial expansion, mobility flows)

Municipal government

Relations and partnerships

Municipal institutions & resources

Institutional change

Automobility

Busmobility

Velomobility

Public space

Relations and partnerships

Governance institutions

Institutional change

Civil society

Private sector

Mobility technologies

Experiment

Mobility infrastructures

Mobility flows
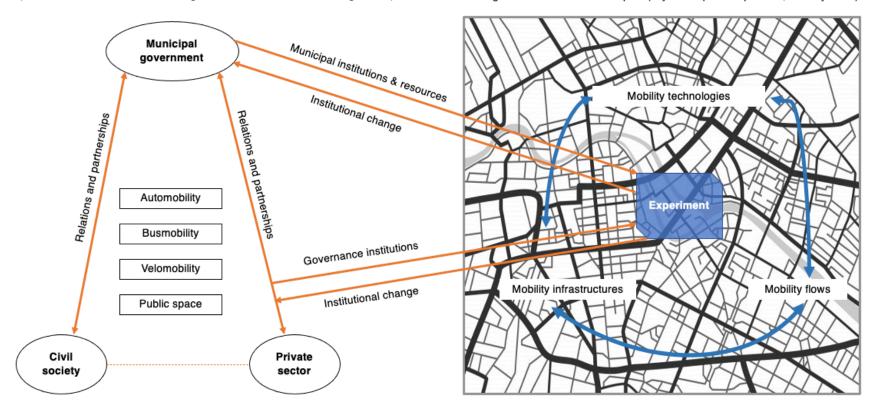
Figure 2.2. Conceptualisation of experiments affecting an urban mobility system.

Conceptual framework for RQ1.2

This section presents the conceptual framework for RQ1.2: *How have the internal institutions and resources of municipal government influenced capacity for transformative experimentation?*. It draws on the literature reviewed in section 2.3.1, 2.3.2 and 2.3.3.

To answer RQ1.2, I examine the interrelation of *municipal institutions* and *municipal resources*, e.g. how external funding shapes organisational forms. The thesis extends Hodson et al.'s (2013) framework with a theoretically grounded conceptualisation of temporary versus permanent organisations. I examine variation in municipal institutions by using the conceptual framework presented in Figure 2.3 below, which is adapted from the typology by Hodson et al. (2013; Figure 2.1).

- The vertical axis refers to whether the *scope of experimentation* (types and aims) is in line with external priorities for urban mobility systems (at national or supranational governance scales) or with municipal government visions.

- The horizontal axis refers to how experimentation is organised, with Figure 2.4 providing a more detailed spectrum of *organisational forms* from the temporary to the permanent (following literature cited in section 2.3.2). Systemic approaches (Type 3 and 4) are understood to be more effective and thus signifying greater municipal capacity for transformative experimentation, than piecemeal approaches (Type 1 and 2).

- In addition, I examine *evaluation processes*: what kind of formal process of knowledge generation on experiment outcomes informs decision-making, and to what extent this is in line with municipal or external funders' priorities.[15]

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[15] I consciously do not refer to 'learning' here (cf. Hodson and Marvin 2010; Hodson et al. 2018), since I do not engage with theories about what knowledge production processes constitutes (different types of) learning.
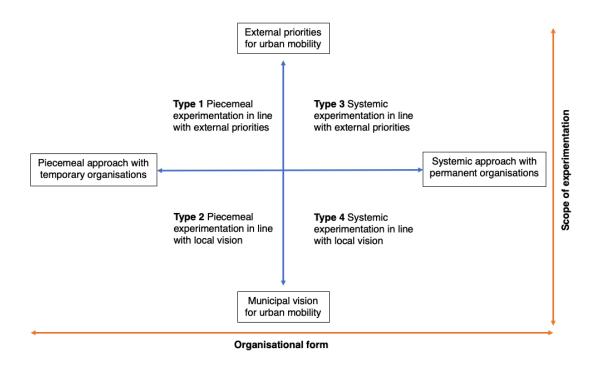
Figure 2.3. Four municipal government approaches to experimentation.
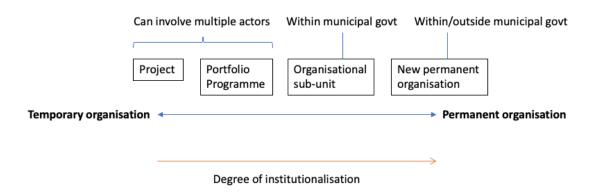
Figure 2.4. Spectrum of organisational forms, from temporary to permanent.

My study of *municipal resources* includes:

- Financial resources available to municipal government for urban mobility experimentation

  o Overall volume of resources (as a combination of internal revenues generated by municipal government and external grant funding)

- o Capital financing (through borrowing)

- o Degree of reliance on external funding (as a proportion of overall resources)

- o Types of funding: competitive versus non-competitive; short-term versus long-term grants

- o Funders' criteria for experiments: eligible activities for spending (affecting *scope* of experiments), requirements regarding *organisational form*, requirements regarding *evaluation process*

- Human resources within municipal government for urban mobility experimentation (following Hodson and Marvin 2010):

- o Size of staff working on mobility policy and/or experimentation

- o Continuity of staff, degree of staff turnover

The *exogenous drivers* influencing municipal institutions and resources are identified as:

- Municipal fiscal autonomy in the context of state restructuring

- Mobility funding landscapes (types of funding programmes)

- Austerity politics

Conceptual framework for RQ1.3

This section presents the conceptual framework for RQ1.3: *How have the governance institutions characterising the relations between municipal government and other public, civil society and private sector actors, influenced capacity for transformative experimentation?* It draws on the literature reviewed in section 2.3.4 and 2.3.5.

RQ1.3 examines whether governance institutions enable or constrain municipal capacity for transformative experimentation, in the context where municipal government *needs and wants* to partner with non-state actors to 'get things done'. It is likely that municipal

government is driven to pursue partnerships *both* because of a need to access resources from non-state actors *and* based on shared normative goals (Lowndes and Skelcher 1998). I have argued that existing literature may overestimate the extent to which real-life experiments feature informal network collaboration based on trust and shared sustainability goals. On the other hand, the literature suggests that network collaboration is more flexible and conducive to innovation than hierarchical governance characterised by formalisation and bureaucratisation (Table 2.5).

My research systematically maps the different types of governance institutions related to experimentation. Figure 2.5 shows my conceptual framework for RQ1.3: a nested two-level approach.
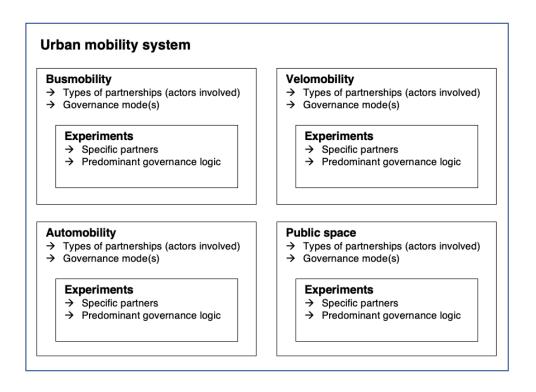
Figure 2.5. Nested two-level approach to analysing governance institutions.

I conceptualise urban mobility systems as made up of institutional 'segments' related to different mobilities: busmobility, velomobility, automobility and public space (section 2.5.1). I employ a typology adapted from Bulkeley and Kern (2006) to analyse *governance*

modes and actors involved in governing (Table 2.9), at the level of these mobilities. Experiments related to each type of mobility are undertaken in the context of these broader modes, as per the depiction of experiments as nested within mobilities. In my modifications to Bulkeley and Kern's typology (Table 2.9), I distinguish between partnership with non-state actors to provide public services, calling this 'governing by co-provision', and partnership within non-state actors that seeks to enable them to undertake experiments based on their own priorities, which I refer to as 'governing by enabling'.

Table 2.9. Governance modes analysed with respect to different mobilities.

Governance mode	Definition: municipality governing mobility through…
Self-governing (Bulkeley and Kern 2006)	Experiments with its own activities (functions and staff)
Governing by authority (Bulkeley and Kern 2006)	Experiments with regulation
Governing by provision (Bulkeley and Kern 2006)	Experiments with direct provision of public services and infrastructure
Governing by co-provision (new mode)	Experiments with provision of public services in partnership with other actors
Governing by enabling (modified definition)	Enabling experiments initiated by non-state actors

For temporary experiment partnerships (Lowndes and Skelcher 1998; Bradford and Bramwell 2014), I use the typology of hierarchical, market and network governance to analyse the relations between the actors involved, which I refer to as *governance logics* (Table 2.10). The typology is adapted from the one presented in section 2.2.1 (Table 2.5), with added markers through which the different logics can be identified from empirical data, based on the literature reviewed in section 2.3.4. Whereas I explore multiple modes at the level of mobilities, I focus on identifying one predominant governance logic in relation to experiment partnerships.

Table 2.10. Governance logics analysed for experiment partnerships.

Characteristics	Hierarchical logic	Market logic	Network logic
Basis of actor relations	Formal state authority, legislation and regulation	Financial transactions, exchange of services, client-provider	Desire to collaborate based on shared goals, trust, complementary strengths

Style of actor interactions	Formal bureaucratic, interorganisational, roles and responsibilities codified	Contractually negotiated, pragmatic, precisely defined roles and responsibilities	Informal relationships, open-ended and negotiated roles and responsibilities
Flexibility and conduciveness to innovation	Low	High	Medium
Empirical markers	Statutory partnerships, bureaucratic procedures, hierarchical forms of organising	Contracts, tendering and procurement (outsourced delivery of municipal services)	Personal relationships between individuals, voluntary partnerships, formal network organisations.

The *exogenous drivers* influencing governance institutions are identified as:

- Public transport privatisation

- Outsourcing of public service delivery

- New markets for smart mobility

2.5.3   Framework for Primary RQ2

While Primary RQ1 focused on transformative experimentation, Primary RQ2 examines urban mobility transitions as a distinct phenomenon. This section outlines the theoretical framework for Primary RQ2: *To what extent has there been a transition away from automobility in Bristol and New York City, between 1996/7 and 2016?*, including the analytical approaches to sub-questions RQ2.1 and RQ2.2. It draws on literature reviewed in section 2.1.5.

I define an urban mobility transition as *a system shift away from automobility*. I understand automobility as a global and resilient system (Urry 2004; Schwanen 2016), manifest in urban mobility systems to a varying degree of dominance. Drawing on Urry's (2004) notion of path-deviant change, I define transitions away from automobility as a scenario where an urban mobility system is changing along a 'path' away from private car use, *while simultaneously also* reconfiguring car use (e.g. towards sharing, low-emission vehicles) and

mitigating its externalities (CO_2 emissions and road safety). I include the mitigation of externalities because negative impacts should be mitigated in the short-to-medium term. Externalities imposed on traffic safety is a key way in which automobility subordinates other types of mobility. Research on transport decarbonisation pathways needed to achieve internationally agreed climate change mitigation targets has established that low-emission vehicles will realistically be a crucial part of the policy mix.[16] This thesis adopts a whole-system reconfiguration perspective on transitions (Geels 2018), in the sense that strives towards a comprehensive analysis of urban mobility systems by analysing four different types of mobility (section 2.1.5, section 2.5.1).

The approach to answering Primary RQ2 relies on trends in high-level quantitative indicators (mode split, CO_2 emissions, traffic safety), as 'proxies' for urban mobility transitions. Mode split (section 2.1.5) is used as the primary empirical marker for assessing the extent of transitions away from automobility. In line with Bertolini (2017) and Næss and Vogel (2012), I argue that for change in urban mobility systems to qualify as a transition, there must *at least* be a significant shift in mode split away from private car use.

The approach to answering RQ2.1: *To what extent has transformative experimentation contributed to urban mobility transitions?* Is analysing whether change in mobility flows (e.g. increase in cyclist flows) as one type of transformative impact generated by experimentation trajectories (Table 2.8) is associated with change in high-level indicators of transitions (as per Primary RQ2).

The approach to answering RQ2.2: *How can differences in the extent of urban mobility transitions be diagnosed through the lens of path-dependencies?* examines the extent of transitions through the lens of forces stabilising systems (RQ2.2), beyond experimentation as a dynamic of change. Four types of path-dependencies are used for diagnosis. The material path-dependencies are public transport systems, spatial structure and commuting flows; the institutional path-dependencies are city-regional governance structures, and civil society

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[16] Modelling by the European Climate Foundation (CLIMACT 2018) explored the feasibility of the EU reaching net-zero emissions by 2050, finding that all pathways required: transport demand to be stabilised to 2018 levels; mode shift away from private car use by 10%; and improvements in vehicle efficiency/emissions as the third crucial element.

activism. In line with Bertolini (2017) and Næss and Vogel (2012), I analyse these path-dependencies for what I refer to as 'city-regions' in this thesis, corresponding to the definition of a 'functional urban area' used by the EU and the OECD, which consists of a city and its surrounding commuting zone, i.e. "the economic and functional extent of cities based on people's daily movements" (Dijkstra et al. 2019, p.1).

2.5.4 Integrated account of the framework

To conclude this chapter, I provide an integrated account of the theoretical framework as a whole, across all RQs.

The starting point is that a multiplicity of actors are increasingly seeking to govern urban mobility systems through experimentation. There is an urban mobility system, which can be understood both through the material/spatial articulation of flows, technologies and infrastructures, as well as through the institutions guiding the behaviour of actors within the system, segmented around automobility, busmobility, velomobility and public space (Næss and Vogel 2012). Multiple actors seek to purposively reconfigure systems through introducing novelties – what is often understood as urban 'innovation' (Hodson and Marvin 2010). Actors adopt experimentation as a mechanism to do this, in seeking to govern, by testing novelties in a tentative manner. Experiments can be understood as interventions testing ssocio- socio-material configurations that are novel in the context of a specific system (Geels 2002; Bulkeley and Castán Broto 2013). Following Bardach (2004), experimentation is a basic mechanism involving a sequence of actions (design, implementation, evaluation) that are tailored to this tentative nature of intervening; as a causal mechanism, it actualises the latent capacities of the actors involved.

The question is to what extent this purposive governing through experimentation actually results in significant material and institutional reconfiguration of the system, that qualifies as 'transformative'. In other words, the thesis is not only concerned with *who* governs and *how,* but also *to what effect?* Primary RQ1 takes an explanatory, institutional geography approach to answering this: analysing how the institutions of multi-scalar governance differ across urban contexts, to account for why the instrumental capacity of municipal

governments to pursue transformative experimentation differs. Primary RQ1 draws on 'new institutionalism' (Lowndes 1996, 2001) as an overarching theoretical approach, to examine both organisations (units, sub-units, multi-actor partnertships) and institutions (organisational practices, policies, rules and norms) in the context of resource mobilisation. It examines government in the context of governance, and thus includes attention to 'municipal institutions' as the institutions internal to municipal government as an organisation, and 'governance institutions' as the institutions characterising the relations between municipal government and non-state actors. The thesis combines 'new institutionalism' with both normative and critical currents in urban studies, focusing on the capacity of municipal government in the context of possibly progressive 'sustainability entrepreneurialism', while examining such capacity in the context of (often neoliberal) state restructuring that has marked recent decades. From a strategic-relational perspective (Jessop 1997), the institutionalist geography of municipal capacity is examined not just through the interplay of multi-scalar governance structure and municipal agency in a static sense, but through the interplay *over time* between *exogenous drivers* reshaping the multi-scalar politics of urban mobility in specific contexts (e.g. changing national transport policies and funding frameworks) and the *endogenous strategies* that municipalities adopt in response (e.g. organising experimentation in a different way).

The first step of answering Primary RQ1 is establishing whether experimentation has been transformative in different contexts, or not. The first sub-question (RQ1.1) thus simply 'records' what the material and institutional outcomes of experimentation have been from a realist perspective, distinguishing between short-term embedding of experimental configurations (stabilisation, circulation, institutionalisation, scaling up) and transformative impacts generated by trajectories of linked experiments in the longer-term (change in mobility flows, significant new institutions, city-wide spatial expansion). The conceptualisation of embedding outcomes draws on sustainability transitions research (Turnheim et al. 2018, Williams 2016). The understanding of material change is grounded in transport studies, while the conceptualisation of institutional change caused by experiments is grounded in new institutionalism and the distinction between 'municipal' and 'governance' institutions.

To explain what enabled or constrained transformative impacts from experimentation, RQ1.2 draws on Hodson et al. (2013) and Hodson and Marvin (2010) to analysing the different approaches municipalities adopt for designing and organising experimentation, where municipal priorities are in tension with the priorities of external (national and supranational) actors. The thesis adapts and extends Hodson et al.'s (2013) conceptual framework with insights from organisational studies, to examine a spectrum of forms in which experimentation may be organised – beyond projects – from the temporary to the permanent. In doing so, it considers the multi-scalar politics of mobility funding and the problematic of project-based experimentation as central issues emphasised in existing literature (Hodson et al. 2018; Ehnert et al. 2018; Schwanen 2015).

The thesis also looks beyond this problematic of municipal reliance on external funding and project-based experimentation, to consider 'horizontal' governance at the urban scale. This is based on the argument that explaining why municipal capacity for transformative experimentation varies across contexts is not possible without also considering how municipalities seek, and often are required to, govern in partnership with other actors 'to get things done'. RQ1.3 employs a nested two-level approach to analysing the institutions involved in governing urban mobility experimentation. In doing so, it critically examines the proposition that experimentation involves network governance based on shared normative goals at fostering system change towards sustainability, which is common within the sustainability transitions literature. Drawing on on transport governance literature, the research adapts Bulkeley and Kern's (2006) typology of governance modes to examine how municipal government, civil society and private sector actors – alone and in partnership – govern automobility, busmobility, velomobility and public space. These modes capture the broader 'baseline' governance context in which actors collaborate in specific instances of temporary experiment partnerships (Lowndes and Skelcher 1998; Bradford and Bramwell 2014). The actor relations or 'governance logics' of these partnerships is analysed in line with the classic typology of hierarchical, market and network governance (Powell 2003; Lowndes and Skelcher 1998; Evans 2012).

By examining the extent to which experimentation has been transformative (RQ1.1) , and what municipal institutions and resources (RQ1.2) and governance institutions (RQ1.3)

explains this, integration of findings to answer Primary RQ1 will allow theory-building regarding municipal capacity for transformative experimentation and how it varies across space. A remaining issue is that because experimentation can be expected to result in (only) incremental reconfiguration of urban mobility systems, Primary RQ1 by itself will be unable to answer what this means for the 'big picture', in terms of urban transitions away from automobility (and contemporary crises like the need for deep decarbonisation). Thus, in parallel, Primary RQ2 draws on a synthesis of literature in transport studies (Bertolini 2017; Næss and Vogel 2012) and on automobility (Urry 2004; Schwanen 2016) to examine how urban mobility systems have evolved over time, both in terms of quantitative 'proxy' indicators (Primary RQ2) and path-dependent spatial, infrastructural and governance structure of the broader city-region. Whether transformative experimentation, that incrementally reconfigures urban mobility systems, can ultimately contribute to transitions or 'system shifts' away from automobility, is addressed in an exploratory manner with Primary RQ2.1.

3 METHODOLOGY

3.1 Causal-analytical approach

This section introduces critical realism as the philosophy of science that the PhD research is grounded in, which is linked to the analytical framework used to examine causality.

3.1.1 Philosophy of science

Critical realism is one of three major orientations within the philosophy of science, with the others being positivism and social constructivism (Alvesson and Sköldberg 2009). The positivist position regarding scientific truth and method as objective and value-free has been discredited within the social sciences, as empirical work has proven that even our scientific knowledge is socially constructed (Latour and Woolgar 1979), thus causing the philosophical orientation of social constructivism to rise to prominence. Critical realism in many ways represents a philosophical 'middle ground' between positivism and constructivism, as critical realists argue that reality exists independently of the human mind and its subjectivity, but also acknowledge that our knowledge of the world is socially constructed. Critical realism rejects radical social constructivist claims of ontological relativism but is compatible with constructivist claims at the epistemological level (Alvesson and Sköldberg 2009). Critical realism was first developed by Bhaskar (1975), who argued for a 'layered' conceptualisation of reality in three domains: the real, the actual, and the empirical. The empirical consists of what we experience or can observe as researchers; the actual is where events happen whether we experience them (or can observe them) or not, and the real domain is that which can produce events in the world – a deep dimension of so-called 'generative mechanisms' (Danemark et al. 2002). The role of critical realist science is to investigate the relationships between empirical data, what 'actually' happens, and underlying causal mechanisms that produce change in society – with a central emphasis on theory, generalisation and explanation (*ibid.*). I subscribe to this ontological position and the critical realist argument that although our knowledge of

reality is limited, developing and testing theories seeking to explain events and processes in the 'real world' is fruitful, which many variants of social constructivism do not.

3.1.2 Causal-analytical framework

Figure 3.1 presents the analytical framework that was used to examine causality with respect to the RQs.

Primary RQ1   **Primary RQ2**

CONTEXT

MUNICIPAL CAPACITY

→ Municipal institutions (**RQ1.2**)
→ Municipal resources (**RQ1.2**)
→ Governance institutions (**RQ1.3**)

… as shaped by both exogenous drivers and endogenous strategies in the context of multi-scalar governance.

MECHANISM

EXPERIMENTATION

Urban mobility experimentation

OUTCOME

TRANSFORMATIVE IMPACT

Outcomes (**RQ1.1**):

Embedding (stabilisation, circulation, scaling up, institutionalisation)

Transformative impact (mobility flows, new institutions, city-wide spatial expansion)

EMERGENT CHANGE IN SYSTEM

URBAN MOBILITY TRANSITION

Change in high-level indicators (**RQ2.1**):
Mode shift
Externalities: CO_2 emissions, safety
Reconfiguration of private car use

STABILITY IN SYSTEM

DEVELOPMENT PATH

Path-dependencies (**RQ2.2**):
Material: public transport, spatial structure
Institutional: governance, civil society

Figure 3.1. Causal-analytical framework for the RQs.

Primary RQ1 examines experimentation as a causal mechanism (as defined in section 2.5.1). Primary RQ1 studies the interrelation of Context, Mechanism and Outcome.

Municipal institutions and resources, and governance institutions, as shaped by the interplay of endogenous strategies and exogenous drivers (section 2.5.2), are understood as the Context in which experimentation as a Mechanism is undertaken. The Outcomes generated by experimentation reflect the Context in which it was undertaken. The research considers what Context factors enabled or constrained embedding of experimental configurations and longer-term transformative impacts. Experimentation as Mechanism is understood as a 'constant', i.e. the same basic causal Mechanism deployed in different Contexts (Bristol and NYC mobility systems) generates different Outcomes. Primary RQ1 seeks to explain how difference in Outcomes in the Bristol and NYC contexts were caused by differences in Context factors. The objective of Primary RQ1 is to contribute to theory-building regarding Context factors influencing municipal capacity for transformative experimentation.

The Context-Mechanism-Outcome framing is loosely inspired by realist evaluation, a strand of policy evaluation theory that draws on critical realism (Pawson and Tilley 1997). The central focus of critical realist philosophy is theorisation to uncover 'generative' causal mechanisms that produce change in the 'real domain' (Danemark et al. 2002). However, the shortcoming of critical realism is that the conceptualisation of what mechanisms are is vague (Alvesson and Sköldberg 2009; Melia 2019) and methodological approaches to uncovering mechanisms are underdeveloped (Yeung 1997). In the existing literature, there are no articulations of what generative mechanisms might be for urban transitions and experimentation – Sorrell's (2018) critical realist critique of the MLP is no exception. Thus I understand experimentation as a basic causal mechanism that operates in the actual domain, not as a generative mechanism in the real domain.

To uncover causal mechanisms, Sorrell (2018, p.1278) advocates asking critical realist questions like: "What makes X possible?...What does the existence of the object or practice presuppose? Could object A exist without B?" that are intimately linked to the "assessment of whether particular entities, mechanisms and causal powers are necessary to explain the observations or merely contingent to those observations". I adopt this approach through counterfactual thinking, along the lines of: *Would the transformative impact(s) generated by this trajectory of experimentation have been possible without enabling Context factor*

X? Might this trajectory of experimentation have produced transformative impacts were it not for the existence of Context factor Y?

Primary RQ2 examines urban mobility transitions as a phenomenon distinct from transformative experimentation (section 2.5.3). It examines the interplay of experimentation as a dynamic of change in urban mobility systems, and path-dependencies as a dynamic that is stabilising systems. In line with critical realist ontology (Sorrell 2018; Næss and Vogel 2012), the behaviour of urban mobility systems is understood as complex and emergent: the interaction between constituent elements of systems generates emergent causal properties that is different to the simple sum of the properties of these entities. This complexity means that although trends with respect to mobility flows (RQ2.1), 'proxy' indicators of transitions (RQ2.2) and literature on context-specific path-dependencies (RQ2.2) can be observed in the empirical domain, they do not reflect mechanisms operating in the real domain of the urban mobility system. While causal claims are made for Primary RQ1 based on analysis of mechanisms in the actual domain, analysis for Primary RQ2 is restricted to the empirical domain and does not make causal claims, rather relying on interpretive assessment based on best-available evidence.

3.2   Overview of the research design

This research employs a comparative case study method, examining two cases over two decades (1996/7-2016), collecting data on urban mobility experiments (RQ1.1), municipal government (RQ1.2 and RQ1.3), and urban mobility systems (Primary RQ2).

Primary RQ1, *How has multi-scalar governance caused municipal capacity for transformative experimentation to differ in Bristol and New York City between 1996/7 and 2016?,* compares municipal capacity, using municipal governments as the primary units of analysis. The comparison is based on operationalisation of fiscal autonomy as a variable capturing differing multi-scalar governance contexts, based on a proposition derived from existing research that reliance on external competitive funding for mobility experimentation was the decisive factor influencing municipal capacity.

The two cases are Bristol City Council (hereafter BCC) and the Government of the City of New York (hereafter NYC city government). BCC has a low degree of fiscal autonomy, chosen as a representative case of the limited capacity of UK municipalities, that confirmed the proposition of existing research. NYC city government was chosen as a contrasting and 'critical case' for testing this proposition, as a municipality with a high degree of fiscal autonomy and a likely case of strong municipal capacity for transformative experimentation. The comparative approach is further grounded in 'comparative urbanism' as a methodological orientation within urban studies: Bristol and NYC are compared as 'cities in a world of cities', where experimentation is understood as a repeated governing mechanism associated with shared conditions of 'sustainability entrepreneurialism' and purposive reconfiguration away from automobility.

Primary RQ2, *To what extent has there been a transition away from automobility in Bristol and New York City, between 1996/7 and 2016?,* and its sub-questions compares urban mobility transitions, using urban mobility systems as the primary unit of analysis. The analysis draws on mobility statistics and secondary research.

The research triangulates between qualitative and quantitative data from:

- Hundreds of documents produced by public, private and civil society actors; as well as academic research, online media, and grey literature;

- 48 semi-structured interviews;

- Descriptive analysis of mobility and financial statistics.

Three weeks of fieldwork took place in both Bristol and NYC during 2018 and 2019, when face-to-face interviews were conducted. Fieldwork allowed for observation of infrastructures and services (e.g. visiting experiment sites, riding buses, spending time in public spaces, using cycling infrastructure) and sites of governance (e.g. attending citizen consultation events, visiting bus depots). These activities were useful to gain a material sense of the design and scope of experiment configurations (e.g. quality of bus services, maintenance quality of public spaces), relative to the images and discourse used to depict experiments within online sources.

Two qualitative large-N databases were constructed from a total of N=108 urban mobility experiments across Bristol (N=47) and NYC (N=61). The databases contain information on embedding outcomes, funding sources, partner organisations, governance modes and governance logics that can be attributed to each experiment. These databases provide the empirical basis for examining 'experimentation' as referred to in all of the RQs, and are listed in Appendix A. Eight experiments were chosen for in-depth study, serving as embedded units of analysis.

3.3 Comparative case study method

Case studies investigate "a contemporary phenomenon in depth and within its real-life context using multiple sources of evidence" and with prior theoretical guidance (Yin 2009, p.100). I adopt a comparative case study method based on the argument that theory-building regarding municipal capacity for transformative experimentation is best furthered through analysing how such capacity varies across space (Grin et al. 2017; Hansen and Coenen 2015; Sengers et al. 2019).

My method comprises a multiple-case design with embedded units of analysis (Yin 2009, p.46), inspired by Ehnert et al.'s (2018) study of urban transitions. Scientific understanding of phenomena can be strengthened through combining large-N and small-n analysis (Tashakkori and Teddlie 2010): my research design combines qualitative data on a large-N sample that can also be described quantitatively, with qualitative small-n analysis of specific experiments in-depth. Municipal governments are the primary units of analysis for the two cases: Bristol City Council and NYC city government. Embedded within each case, I study four experiments in-depth (Figure 3.2).
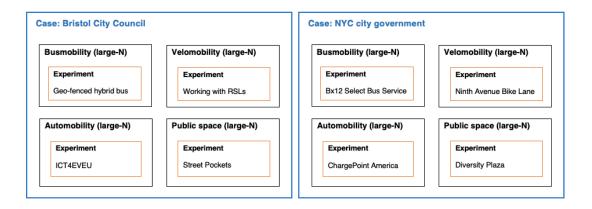
Figure 3.2. Units of analysis embedded within Bristol and NYC case studies.

3.3.1 Primary unit of analysis: municipal government

Comparative research across different politico-administrative contexts is complicated by the fact that what administrative units constitute 'local' government varies widely (Wolman 2008). Comparing municipal entrepreneurialism in different contexts, Lauermann (2018, p.211) argues that "the 'municipal' label is a widely used legal designation; across national systems it can describe political institutions ranging from autonomous city-states to departments nested inside a national government", thus presenting this as a term that can circumvent the thorny issue of defining local government. I follow Lauermann's approach. Bristol City Council (BCC) is a 'unitary authority' within the UK system of local government, which provide all types of municipal services (HM Government 2021). NYC city government is classed as a municipal government within the US taxonomy of local government (NLC 2016), with a similar range of service provision.

3.3.2 BCC as a representative case of limited municipal capacity

BCC was selected as a case for an initial pilot study. The pilot study explored urban mobility experimentation undertaken by BCC and the Municipality of Ljubljana (Slovenia), to investigate the influence of EU funding programmes. Ljubljana was chosen as a contrasting case to Bristol, to explore how municipal capacity differed in a post-socialist context with a lower degree of municipal resources and greater reliance on EU

funding. The study found that BCC had greater capacity for locally-determined experimentation than the Municipality of Ljubljana. However, I found that BCC's capacity was still significantly limited by its reliance on competitive EU and UK government funding, in line with previous research findings that experimentation in UK and other European cities is a precarious, 'stop-and-start' process limited by multi-scalar funding landscapes (Schwanen 2015; Ehnert et al. 2018; Hodson et al. 2018). BCC appeared to be a representative case of the limited capacity of UK municipalities. The pilot study thus confirmed the established problematic of project-based experimentation (section 2.3.1), but did not point to novel directions for research.

3.3.3 Criteria for selecting a contrasting non-European case

Because urban mobility experimentation appeared to be strongly shaped by funding landscapes specific to the EU and UK, I decided to expand the research beyond the European context. I retained BCC as a case – studied through a second round of fieldwork – and replaced Ljubljana with a non-European case.[17]

The aim was to select a second case with a different multi-scalar governance context (Primary RQ1). Such a 'contrasting case' strategy is an established multiple-case design aiming at 'theoretical replication', i.e. where data collection for one case study is followed by research on another case chosen because theory "predicts contrasting results but for anticipatable reasons" (Yin 2009, p.54). This approach allows case studies to be used to better understand the 'gaps and holes' in existing theory (Yin 2009; Ridder 2017). After studying the Bristol case, the aim was to pursue 'theoretical replication' by re-applying the conceptual framework for RQ1.2 (Figure 2.3) to a different case, for which the results could be predicted to differ: testing the explanatory power of Figure 2.3 in a non-European context. Two criteria for selecting the contrasting case were defined:

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[17] A possible critique would be that the UK is highly centralised compared to other European countries, and thus that contrasting BCC with a municipality located in a more decentralised EU country would have been productive. This is countered by the fact that Ehnert et al. (2018) found that projectification of funding was a significant issue also in Swedish and German cities, i.e. located in highly decentralised EU countries. I was interested in exploring a more extreme contrast to BCC, than another European case.

1. The second case should capture a non-European context with a different mobility funding landscape.

2. The second case should be a likely case of *greater* municipal capacity for transformative experimentation, to contrast with initial findings regarding BCC.

Existing research suggested that among the components of the theoretical framework, *municipal resources* was the decisive factor determining municipal capacity, specifically the degree of reliance on external funding (section 2.3.1). Identifying a contrasting case required operationalising this proposition in the form of a concrete variable. The objective of Primary RQ1 was translated into a focus on *fiscal autonomy* of municipal government as a variable. Fiscal autonomy refers to the degree of discretion a subnational government has in raising the revenues necessary to fund its operations, from sources including intergovernmental transfers to municipal revenue generation through local taxation; and the discretion of municipal government for borrowing (Dardanelli 2019). Municipal governments that "depend on transfers from senior levels of government have less fiscal autonomy than those that rely more heavily on own-source revenues" (Slack 2017, p.4).

BCC represents a case with a relatively low degree of fiscal autonomy, thus the objective was thus to select a second municipal government with a higher degree of fiscal autonomy.

3.3.4   NYC city government as a 'critical' case

Amongst potential contrasting non-European municipalities, NYC city government was chosen as the second case, because I argue it constitutes a 'critical' case of municipal capacity for transformative experimentation. Critical cases are appropriate for testing or 'confronting' existing theory (Yin 2009; Flyvbjerg 2006; Ridder 2017). Following Flyvbjerg's (2006) approach, a critical case strategy involves looking for 'most likely' or 'least likely' cases that either clearly confirm or irrefutably falsify propositions examined. This strategy proposes the following logic for generalizing from individual cases: "if this [the proposition] is (not) valid for this case, then it applies to all (no) cases" (*ibid*, p.230);

with Flyvbjerg further arguing that "cases of the 'most likely' type are especially well suited to falsification of propositions, whereas 'least likely' cases are most appropriate to tests of verification" (p.231).

NYC city government was selected as a critical case to test the proposition that: municipal capacity is limited by reliance on external funding for experimentation, as a decisive factor. The NYC case did not only meet the selection criteria for the contrasting case, but represents a 'least likely' case for verifying this proposition because:

1. NYC city government enjoys a *high degree of fiscal autonomy,* both relative to BCC and relative to other large cities globally. Local fiscal autonomy is measured by subnational tax revenues as a share of total national tax revenues (Blöchliger and Rabesona 2009), which captures the extent to which subnational governments can raise (and retain) tax revenues independently of national government. The fiscal autonomy of UK local government is below the average for OECD member countries at 4.8%, whereas for US local government it is higher than average at 14.1% (Blöchliger and Rabesona 2009).[18] As shown in Table 3.1, only 27% of the NYC municipal budget relies on intergovernmental transfers, in contrast to an average of 59% for local governments in England.[19] NYC city government enjoys a high degree of fiscal autonomy also when compared with seven other 'global cities' including London and Paris: NYC has the highest municipal tax revenues per capita among all cities, and ranks third in the share of own-source municipal revenues (Slack 2016).[20]

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[18] Table 2 in the source cited.

[19] 2009-10 averages for local governments in England (Amin-Smith et al. 2016a), are cited for BCC in Table 3.1, because figures specific to BCC could only be found for 2017. These 2017 figures had a higher proportion of own-source revenues, because the national reform allowing municipalities to retain business rates (tax on local businesses) had begun to take effect on BCC finances. However, this reform was only introduced in 2013, and thus the 2009-10 figures are more reflective of BCC finances between 1996-2016 overall.

[20] Slack (2016) analysed the fiscal autonomy of city governments in London, Berlin, Frankfurt, Madrid, New York City, Paris and Tokyo.

Table 3.1. Fiscal autonomy of Bristol City Council and NYC city government.

Case study	Share of municipal budget stemming from…	
	Own-source revenues	Intergovernmental transfers
Bristol City Council (2009-10 average for local authorities in England; Amin-Smith et al. 2016a)	41%	59%
NYC city government (2017 revenue budget; IBO 2017)	73%	27%

2. NYC city government is widely-cited as an *exemplar of strong municipal capacity for transformative urban mobility experimentation* (chapter 1), thus not a likely case of limited municipal capacity. As detailed in section 4.4.2, established narratives suggested that the NYC case was rich in terms of data on municipal institutions, including aspects beyond the debate about project-based experimentation, such as innovative evaluation approaches and low-cost implementation approaches. Beyond being a 'least likely' case by virtue of fiscal autonomy, NYC city government was thus deemed a suitable case for generating and examining *rival* explanations (Yin 2009; Ridder 2017) to the proposition that municipal capacity was limited by reliance on external funding.

To summarise, BCC was selected as a case verifying the proposition that municipal capacity for transformative experimentation is limited by reliance on external funding, as a decisive factor; and as a representative case of the limited capacity of UK municipalities. To test existing theory, NYC city government was chosen as a second, critical case of the 'least likely' type for verifying the proposition. My description of the NYC case above justifies the possibility of generalising along the critical case logic:

> If municipal capacity is (fundamentally) limited by reliance on external funding (as a decisive factor) even in NYC, then municipal capacity is limited by this factor in most cities.

3.3.5 An approach grounded in 'comparative urbanism'

In the popular imagination of cities, population size is often understood as the signifier of comparability. As a large city with a wealthy population funding the city government's coffers, NYC may seem like an overtly extreme contrast to Bristol, a mid-sized regional centre that is financially-dependent on its national government. Within positivist social science this comparison would not be defensible, because the basis of causal explanation would depend on controlling for variables other than fiscal autonomy. Similarly, traditional approaches to studying urban governance have focused on comparison between cases that are 'most similar' or 'most different' in some aspects, while controlling for others (Denters and Mossberger 2016).

Clearly, my unorthodox comparison of Bristol and NYC qualifies neither as a 'most similar' or 'most different' design. My comparison is compatible with critical realism, however, which rejects positivist identification of contextless relations between variables, and instead favours contextualised comparison, in-depth case studies and re-interpretation of theory (Bergene 2015; Danemark et al. 2002; Sorrell 2018). My comparative approach is grounded in 'comparative urbanism' as an alternative methodological orientation within urban studies (Robinson 2010, 2015).

The theoretical frame of 'comparative urbanism' emanates from a postcolonial critique of the dominance of urban theory from the Global North (Robinson 2010; 2015), where theories developed on the basis of European and North American empirical phenomena are deployed as variables in comparative research designs. Robinson (2010, p.3) argues that this has restricted "comparisons primarily to cities that are already assumed to have certain specified commonalities" – reflected in the dominance of 'most similar' designs comparing Global North cities, while 'othering' cities in the Global South (*ibid.*). Robinson (2015) argues that the tendency to compare similar Global North cities limits the prospect of building theories that account for urban processes as *global* phenomena, i.e. potentially shared across Global North and South. Interpreting the comparative urbanism approach in this way, my comparison of Bristol and NYC is orthodox: based in a London institution, I test UK- and Euro-centric theories (chapter 2) for the US context.

However, in my view, comparative urbanism does not need to wholly reject North-North comparisons. Robinson's (2002) early work critiqued the focus on 'global' cities specifically (Sassen 1991), in how these cities were understood as the centres of economic activity, innovation and creativity, leaving a large number of cities globally 'off the map'. I agree with this: urban research tends to privilege the study of a particular set of large cities (Schuermans 2009). We can note the tendency to compare mobility governance in NYC with London (Frug 2010; Rode and da Cruz 2018). Consultancy-generated indices ranking cities on 'sustainable mobility' typically privilege those with substantial rail networks, as purportedly associated with economic competitiveness (McKinsey & Company 2018). In contrast, there is little existing research on urban mobility in Bristol – likely reflecting the assumption that there is little of note about mobility in this smaller city, which lacks mass transit infrastructure. Bristol is typically compared with other UK cities (Burton et al. 2019; Taylor Buck and While 2017), or with US cities of a similar population size (Davies and Pill 2012; DiGaetano 1997). Robinson (2005) argued that research should resist analysing cities according to pre-defined categories, and try to instead understand 'ordinary' cities – a term borrowed from Amin and Graham (1997) who contended that all cities feature agglomeration-related innovation and connected to global flows of ideas and capital. This line of (earlier) debate certainly invites comparison along the lines of my approach, which understands Bristol and NYC as cities undistinguished by conventional categories.

Bristol and NYC are conceived as cities existing 'in a world of cities' (Robinson 2010). Following Robinson's (2015) taxonomy of comparative strategies, my design can be described as a 'composed comparison': a bespoke effort to test and extend theory by putting it in conversation with a different geographical context. My comparison examines experimentation as a "repeated instance" or urban phenomenon "with shared conditions of production" (*ibid.*, p.196). My comparative approach is based on the argument that:

1. Urban mobility experimentation as a mechanism – whereby urban actors are seeking to govern urban mobility systems through the introduction of novelties – is basic and universal enough to be readily comparable across contexts;

2. As a governing mechanism, experimentation is adopted within a shared context marked by drivers manifest in diverse cities: automobility as a global system (Urry

2004) in the context of which experimentation is undertaken, which an increasing number of municipalities are seeking to move away from; and the broader desire to purposively reconfigure urban infrastructure, driven by sustainability entrepreneurialism.

The fact that my approach is theoretically grounded in comparative urbanism clarifies why among all the contrasting cases of fiscal autonomy, I chose to compare municipal governments in Bristol and NYC.

3.3.6   Time period of study

This research adopts the perspective of sustainability transitions research in focusing on long-term system change (Köhler et al. 2019), by studying a period spanning two decades.

The time period of study is 1996-2016 for the Bristol case, and 1997-2016 for the NYC case. Since experimentation is understood as a governing mechanism linked to the desire for *purposive* reconfiguration of urban mobility (section 2.5.1), the starting date for the study time period was chosen to align with the emergence of such purposive governance: the year when municipal policy documents first demonstrate a clear commitment to reducing private car use and promotion of non-car modes. For both cases, such commitment could be traced to the mid-1990s. BCC was established as a municipal government in 1996. Although BCC's (2000) first policy strategy for sustainable mobility took a few years to be published, it was justified to mark 1996 as the start date for the study period, because this strategy mentions many experiments undertaken from 1996 onwards. For the NYC case, the first policy strategy related to sustainable mobility was traced to the 1997 *NYC Bicycle Master Plan* (NYCDCP and NYCDOT 1997), so 1997 was chosen as the start date.

2016 was chosen as the end date for both case studies. Because the objective was to examine the outcomes of experimentation, ongoing experiments for which implementation had not been completed were excluded. The review by Kivimaa et al. (2017, p.23) noted that many studies collect data "so soon after [the experiment took

place] that no definite results on the transformative effects were provided", with the authors thus suggesting "the need for further studies that would empirically revisit these experiments after some time has elapsed". As my data collection commenced in 2018, setting 2016 as an end date allowed me to identify experiment outcomes that would have taken several years to manifest.

3.4 Identifying experiments

For each case study, the first step was to identify experiments undertaken during the study period. This section describes how I selected which types of mobility to analyse, the construction of a large-N database for each case, and how a sub-set of experiments was chosen for in-depth study.

3.4.1 Delimiting the analysis to a set of mobilities

As discussed in section 2.5.3, the research seeks to examine *whole-system reconfiguration* of urban mobility systems, but is nonetheless limited to four mobilities: *automobility*, *public space, velomobility* and *busmobility*.

Two types of experimentation related to automobility were included: 1) experiments seeking to reconfigure private car use, e.g. through sharing, and 2) experiments seeking to mitigate the externalities of automobility, e.g. by improving traffic safety. I also chose to examine mobility in public space (including streets, squares and other similar spaces), because retrofit of physical infrastructure was identified as an important gap in existing research on mobility experimentation.

The focus on velomobility (cycling) and busmobility was based on the Bristol context, for which I collected data first. Velomobility was selected because initial analysis revealed very few experiments related to walking. I chose to focus on busmobility because Bristol has no urban light or heavy rail system, and BCC does not have control over other rail services stopping within municipal boundaries. The fact that NYC city government similarly does

not control rail services operating within its boundaries meant that experimentation with rail services could also justifiably be excluded.

3.4.2 Constructing large-N databases of experiments

The ambition was to capture a comprehensive picture of the mobility experimentation undertaken in Bristol and NYC between 1996/7 and 2016. Two databases were constructed in MS Excel, cataloguing experiments undertaken in each city. These serve as the empirical basis for examining 'experimentation' as referred to in the RQs. The databases contain a total sample of N=108 experiments across both cases: 47 experiments undertaken in Bristol and 61 experiments undertaken in NYC. As shown in Table 3.2, the proportion of experiments related to the four different types of mobility vary across the cases – no attempt at equal proportions was made.

Table 3.2. Large-N sample of experiments analysed.

Type of mobility	Bristol		NYC	
	Number of experiments	**Proportion of case total (n)**	**Number of experiments**	**Proportion of case total (n)**
Busmobility	15	32%	11	18%
Velomobility	12	26%	10	16%
Public space	8	17%	22	36%
Automobility	12	26%	18	30%
Case study total (n)	47	100%	61	100%
Total across cases (N)	108			

Identifying a sample of potential experiments

The databases were constructed through content analysis (text search queries) of documents retrieved online. The issue of terminology was important because I assumed the term 'experiment' would not be used consistently by urban practitioners.[21] I settled on the search terms: 'experiment', 'trial', 'pilot', and 'innovation'. [22]

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[21] Existing systematic reviews have been limited to 'experiment' as a search term (Kivimaa et al. 2017; Sengers et al. 2019), which is understandable considering these only reviewed academic literature.

[22] 'Demonstration' was not included as a search term, because initially I took a strict approach to only qualifying interventions aimed at *testing*, as experiments. As the research progressed, I realised that it was challenging to distinguish

To identify experiments, I analysed:

1. Municipal policy strategies, progress reports, and associated policy studies (documents presenting research and/or an evidence base underlying a strategy). A list of source documents is provided in Appendix C.
   - Search terms: experiment, trial, pilot, innovation.

2. Google search – limited to the 'most relevant' results as defined by Google.
   - Search terms – Bristol case: 'Bristol experiment transport'; 'Bristol trial transport'; 'Bristol pilot transport'; 'Bristol innovation transport'; 'Bristol experiment mobility'; 'Bristol trial mobility'; 'Bristol pilot mobility'; 'Bristol innovation mobility'.

   - Search terms – NYC case: '"New York City" experiment transportation'; '"New York City" trial transportation'; '"New York City" pilot transportation'; '"New York City" innovation transportation'; '"New York City" experiment mobility'; '"New York City" trial mobility'; '"New York City" pilot mobility'; '"New York City" innovation mobility'. 'Transportation' was used to reflect the common use of this term in the US, rather than 'transport'.

3. Scopus search
   - Search terms – Bristol case: ALL (Bristol AND experiment AND transport); ALL (Bristol AND trial AND transport); ALL (Bristol AND pilot AND transport); ALL (Bristol AND innovation AND transport); ALL (Bristol AND experiment AND mobility); ALL (Bristol AND trial AND mobility); ALL (Bristol AND pilot AND mobility); ALL (Bristol AND innovation AND mobility).

   - Search terms – NYC case: ALL ("New York City" AND experiment AND transportation); ALL ("New York City" AND trial AND transportation); ALL ("New York City" AND pilot AND transportation); ALL ("New York City" AND innovation AND transportation); ALL ("New York City" AND experiment AND mobility); ALL ("New York City" AND trial AND mobility);

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between testing and demonstration based on secondary sources. As discussed further below, the databases were iteratively revised. The final databases contain many experiments that are referred to as 'demonstrations', and thus I am confident that my omission of this search term did not skew the sample.

ALL ("New York City" AND pilot AND mobility); ALL ("New York City" AND innovation AND mobility).

All interventions found through Google Search and Scopus were cross-referenced with municipal documents, and the primary source changed to refer to those documents if the same intervention could be identified. Each item was entered into an Excel spreadsheet, noting the: 1) term used to describe the intervention (e.g. 'pilot'), 2) title/description of the intervention, 3) source(s), 4) indicated starting year (of implementation), 5) partner organisations involved (including lead partner), and 6) funding source(s).

Assessing interventions against definition criteria

My definition of an urban mobility experiment is *an intervention in an urban mobility system with the aim of testing a socio-material configuration that is novel in the context of that system*. The Excel databases were assessed against criteria derived from this definition, and each item was only retained if the intervention met these criteria:

1. The intervention involved the case study municipal government, as a formal partner;
2. The intervention related to one of the mobilities examined in the research (automobility, busmobility, velomobility, public space);
3. The intervention had been *implemented* within the study period (rather than just planned);
4. It was a material intervention in the urban mobility system, i.e. it directly altered mobility infrastructures or technologies;
5. The aim of the intervention was to test a configuration, i.e. with some degree of tentativeness, that was novel within the case study context.

This process revealed that operationalising the concept of experimentation as an object of large-N research is challenging. Whether the intervention met the first and second criteria was usually easy to establish from the relevant source. Assessing interventions against the third and fourth criteria required triangulation between different documents.

For the third criterion, frequently there was some media coverage of the intervention that confirmed that the intervention had indeed been implemented. For assessing experiments against the fourth criterion, images of the intervention were informative, as were historical Google Streetview captures of streetscapes.

For the study of urban experiments to be meaningful, researchers must be able to distinguish between experiments and non-tentative policy implementation. The fifth criterion was crucial in this regard, but the most challenging to operationalise. The criterion was revised a few times during the data collection process, which required all the interventions in the database to be reassessed for whether they met the criterion or not.

To assess *novelty*, the pilot study had only qualified interventions as experiments where there was an indication that it was the *first* time that particular configuration was tested in the case study context. For example, a car-sharing experiment implemented in Bristol at a time when there was no operational car-sharing service in the city. This approach was found too stringent, and replaced with a focus on novel *configurations*, drawing attention to subtle changes in social or material elements between 'rounds' of experimentation. For example, even though a public car-sharing service had already been piloted in Bristol, another intervention testing a different car-sharing configuration a few years later also qualified as an experiment – because the configuration was different and within the context of Bristol's mobility system, car-sharing was still a nascent rather than established mobility service. In other words, I judged that there was still a degree of novelty to this second intervention.

To identify tentativeness, I initially required there to be an *explicit* aim of *testing* a configuration. However, this was later relaxed, because sometimes an intervention was not described as such, but clearly involved a degree of tentativeness. These instances were relatively rare, limited primarily to experimentation related to electric vehicles (EV): in both Bristol and NYC, small-scale deployment of EV charging infrastructure was not explicitly labelled as tentative; however, in-depth study of these experiments[23] revealed

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[23] ICT4EVEU project (Bristol) and the ChargePoint America project (NYC), see Appendix A.

that they were implemented with the aim of learning about a novel configuration before more wide-scale deployment in the city. They were thus deemed to qualify as experiments. On the other hand, some interventions featured a novel configuration that was *clearly not* tested in a tentative manner, rather deployed at significant spatial scale and designed to be permanent from the outset. Such interventions were disqualified.[24]

This process reduced the size of the total sample. At this stage of the research process, the databases contained enough information for choosing a smaller set of experiments for in-depth study, as described in the next section. This allowed for sampling and recruitment of interviewees prior to fieldwork.

Revision and finalisation of the databases

The databases were revised iteratively based on triangulation between documents, interviews, academic literature, and government databases (referenced in Appendix A). Initial information regarding the attributes of each experiment was verified through triangulation. This included establishing the embedding outcomes of each experiment (RQ1.1), which resulted in some experiments being added to the, as tracing the outcome of an experiment involved identifying connections to as-yet-unkown experiments that came before it and after it, as experiments 'built' on in each other over time. The process of collecting and analysing this data is described in section 3.5. Revisions to the databases ended when the outcomes of all experiments had been triangulated. Data collection reached a natural point of saturation that suggested that the databases accurately represented the majority of experimentation undertaken in Bristol and NYC during the study period. After this, additional experiments were rarely discovered.

3.4.3 Choosing experiments for in-depth study

From the large-N databases, four experiments for each case (n=8) were chosen for in-depth study. This was judged as the most appropriate way to examine how specific Context factors – municipal institutions and resources (RQ1.2) and governance

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[24] For NYC, this included the omission of a notable intervention: the CitiBike bike-sharing service (Appendix A).

institutions (RQ1.3) – had affected experiment Outcomes, e.g. how the fact that an experiment was organised as a project affected institutionalisation. Experiments were selected (Table 3.3 and 3.4) for in-depth study to:

- Capture a mix of different types of funding and partnerships (Context) and explore possible variation in Outcomes.

- Cover each type of mobility (automobility, busmobility, velomobility, public space); this narrowed down the range of potential choices.

- Examine the influence of different partnership constellations, including experiments involving no partnership (only municipal government involved).

- Cover different funding sources.[25]

It was not possible to cover an identical distribution of experiments across the two cases.

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[25] Funding types in Table 3.3 and 3.4 refer to the primary source of experiment funding – all experiments involving external funding also included municipal contribution. In Table 3.4 below, 'municipal government (only)' refers to experiments were no external funding was involved.

Table 3.3. Bristol experiments chosen for in-depth study.

Funding type	Partnership type		
	None (municipality only)	**Public-private**	**Public-civil society**
European Union	ICT4EVEU – EV charging infrastructure (automobility)		
National government		Geo-fenced hybrid bus (busmobility)	Working with Registered Social Landlords – cycle parking and mobility marketing (velomobility)
Municipal government (only)	Street Pockets – community-led street redesign (public space)		

Table 3.4. NYC experiments chosen for in-depth study.

Funding type	Partnership type		
	None (municipality only)	**Public-private**	**Public-civil society**
Federal government		ChargePoint America project – EV charging infrastructure (automobility)	
State government		Bx12 Select Bus Service – Bus Rapid Transit (busmobility)	
Municipal government (only)	Ninth Avenue Bike Lane – cycling infrastructure (velomobility)		
Philanthropic			Diversity Plaza – pedestrian plaza (public space)

3.6 Within-case data collection and analysis

Three within-case methods were employed: document analysis, semi-structured interviews, and descriptive analysis of statistical data. The process of data collection and analysis is visualised in Figure 3.3 below.

3.6.1 Document analysis

Primary RQ1 draws on analysis of documents produced by: government administrations (local, regional, national, supranational),[26] think tanks, civil society and private sector organisations; as well as academic publications and media reporting. Almost all documents were retrieved online from publicly available sources. Documents were analysed from a critical realist perspective through qualitative content analysis (QCA), rather than coded or from a constructivist perspective. QCA involves extracting, storing and processing data independently of the source text (Gläser and Laudel 2013). Gläser and Laudel (2013) outline the advantages of QCA where research is not focused on meanings expressed within texts, including research seeking to develop causal theory about conditions, mechanisms and outcomes. Following the process proposed by Gläser and Laudel, I derived a set of categories from my theoretical framework and compiled these in separate analysis templates. The relevant data for each category (e.g. organisational form) was then summarised through rephrasing the original text segment. For analysing how transformative trajectories could be explained by enabling or constraining RQ1.2 and RQ1.3 factors, I used a Context-Mechanism-Outcome template.

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[26] Policy strategies; press releases; research, evaluation and case study reports; presentations given by municipal staff at conferences and at public consultation events; national and local legislation; minutes of legislative hearings (NYC City Council) and political meetings (BCC Cabinet); political speeches given by Bristol and NYC Mayors.
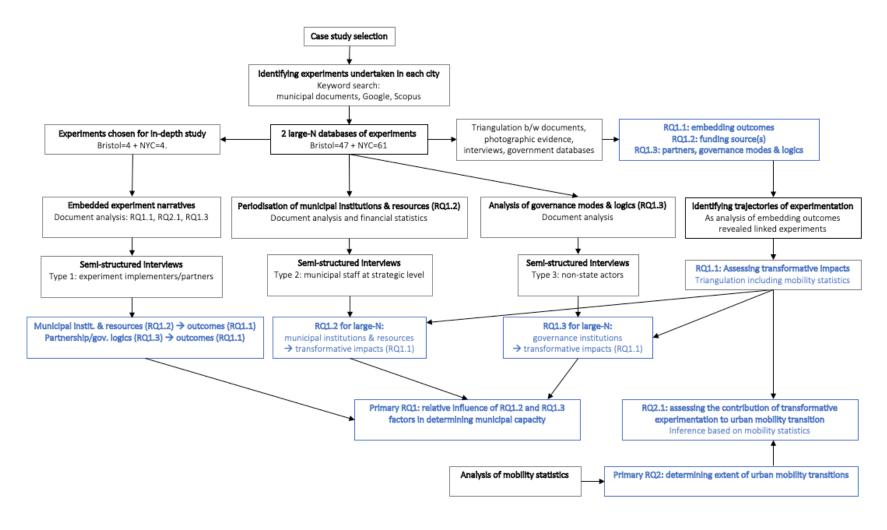
Figure 3.3. Flowchart depicting the data collection and analysis process.

Starting from the third row of Figure 3.3, experiment attributes within the large-N databases were validated with respect to RQ1.1, RQ1.2 and RQ1.3 through triangulation between all the document types mentioned above:

- The evidence based on which different outcomes and impacts were determined is shown in Appendix A for short-term embedding, and provided in-text in section 5.2 and 6.2 for longer-term transformative impacts.

- Identifying how different experimental configurations became *embedded* revealed 'trajectories' of linked experiments (second row), which were visualised in a series of diagrams and with *transformative impacts* generated by the end of the study period (2016) noted for each trajectory.

- Establishing whether an experiment had been made permanent (*stabilisation*) often required analysis of photographs from media reports, Google Streetview.

- Triangulation between documents and open-access geo-coded data (e.g. on the number of locations/spatial extent of a specific type of infrastructure) was often required to establish *scaling up* and transformative *city-wide spatial expansion*.

- *Institutionalisation* was noted based on formal municipal documents, and longer-term transformative impacts in terms *significant new policy or governance institutions* by tracing the evolution and permanence of an institution, e.g. the number of years it had operated and the extent of investment.

- Identifying *circulation* was the most challenging, as this category represents a more indirect outcome where a specific element tested in one experiment became redeployed in another intervention: this was only possible by virtue of in-depth study of trajectories, where the researcher's hypotheses that subsequent, similar interventions were linked were investigated. Establishing circulation relied on interviews; whereas overall, documents were a more important source of data regarding experiment outcomes than interviews.

- It was relatively straight-forward to validate the partner organisations involved in experiments (RQ1.3), although this required triangulation as some partners were often omitted in documents.

- Verifying the mix of experiment funding sources (RQ1.2) was the most challenging aspect, with many of the documents used to compile the initial

large-N database containing only partial information. For the Bristol case, potential experiments were often identified from BCC grant funding applications which helped to clarify funding sources, and interviewees pointed to additional sources that could be easily triangulated. For the NYC case, informants' knowledge regarding funding sources was more limited, and experiments were matched to grant award data obtained from government databases (section 3.5.3).

For the experiments selected for in-depth study (n=8), documents were also analysed to build a case narrative (e.g. chronology, stages of process, causal claims) with respect to municipal institutions, resources and governance institutions; prior to interviews.

Documents were analysed to inform periodisation of municipal institutions and resources (second row, Figure 3.3). Periodisation is a common technique in the social sciences which refers to a process of dividing a time interval into parts, for example by dividing "an entire era into smaller periods that share some homogeneity within them" (Barros Rands 2008, p.210). Homogenous periods were identified in relation to the conceptual framework distinguishing between four Types (1/2/3/4) of experimentation (Figure 2.3), with policy documents analysed to understand shifting municipal visions and priorities for experimentation, organisational structures and forms. Analysis of municipal resources was the only instance where attention was paid to discursive narratives, e.g. policy discourse regarding austerity and multi-scalar funding landscapes.

For RQ1.3, documents were first analysed to establish the pre-existing modes of governance (in 1996/7) in relation to automobility, busmobility, velomobility and public space, and and then what type of governance modes characterised experimentation during the study period. Governance modes and likely governance logics (e.g. network partnership) were analysed prior to interviews on experiments studied in-depth; governance logics were identified by applying the empirical markers in Table 2.10. Following interviews and analysis of trajectories, the researcher's knowledge of local governance institutions was so extensive that governance modes and logics could confidently also be identified for almost the entire large-N sample.

3.6.2   Semi-structured interviews

Moving to the third row of Figure 3.3, after an initial round of document analysis, interviews were conducted with a focus on extracting causal claims regarding the interrelation of Context factors and experiment Outcomes. Data from interviews and documents were then triangulated further to answer RQ1.2, RQ1.3 and Primary RQ1.

48 interviews were conducted with 49 informants, including current and former employees of public sector, private sector and civil society organisations, and experts from think tanks or research institutions. A list of interviewees is provided in Appendix D.

Interviewees were selected through purposive sampling (Robson and McCartan 2016): based on document analysis, a list of target informants was drawn up before fieldwork.

Three types of interviews were carried out:

- Type 1: individuals involved in implementing experiments and/or employed at experiment partner organisations

    o Focused on experiments chosen for in-depth study

    o Questions building a detailed narrative for each experiment, including different stages (ideation, design of the configuration, implementation, evaluation); the influence of specific municipal institutions and resources (e.g. funding requirements regarding evaluation) and governance logics; and outcomes.

    o Informants who had been involved with experiments during these different stages, and had knowledge about short-term outcomes: both municipal staff and people working at partner organisations. Often these informants did not have knowledge about the longer-term impacts of the experiment, and thus additional interviews were necessary with informants managing relevant municipal policy programmes, years after the original experiment).

- Type 2: strategic-level municipal government staff

- o Focused on understanding the evolution of municipal institutions and resources (RQ1.2) within the multi-scalar governance context, and how this shaped municipal capacity across the large-N sample.

- o Questions on strategic level policy-making and organisational issues, e.g. evaluation processes, organisational forms, funding flows and securing resources.

- o Informants who had worked within the higher echelons of municipal government, across different years of the study period.

- Type 3: non-state actors

  - o Focused on understanding the evolution of governance modes (RQ1.3), i.e. relations between municipal government and non-state actors. Questions also probed for more critical perspectives on experimentation, including contextual factors that might be missing from municipal narratives.

  - o Informants were primarily from civil society and the private sector. For the Bristol case, academic researchers who had evaluated experiments were interviewed.

The interviews were semi-structured, following an interview guide with ordered questions and topics, as well as unplanned questions and a flexible order of questioning (Valentine 2005). Three interview guides were prepared corresponding to the type of informant (Appendix E). Care was taken to avoid biasing interviewee responses, in neutral phrasing of questions, body language and tone of voice. Yet, many interviewees engaged in more opinionated conversation when it became evident that I was knowledgeable about the professional practice of transport planning, whereas other informants were explicitly political in discussing how experimentation was shaped by power structures across different scales of governance. I found that cautiously positioning myself in a collegial manner, by using professional terminology and expressing empathy for the professional challenges experienced by my interviewees, generated the richest data. I agree with Fontana and Frey's (2005) argument that a post-positivist epistemology means that the interviewing process can never be one of a completely neutral researcher gathering objective data – the questions asked reflect a stance taken by the researcher.

The interviews lasted between 30 minutes to 2 hours, the majority lasted 50-60 minutes. Most interviews were conducted face-to-face in Bristol and NYC. A smaller number were conducted via Skype/FaceTime or telephone (Table 3.5), where the interviewee was no longer based in the respective city. All interviews were audio-recorded.

Table 3.5. Interviews conducted.

Case study context	Number of interviews			
	Face to face	VOIP	Telephone	Total
Bristol	19	2	5	26
NYC	16	2	1	22

Research ethics

The key ethical aspects were related to interviews, where interaction with human participants involved issues of informed consent, confidential participation and anonymity. Approval from the UCL Research Ethics Committee (Project ID 12403/002) was secured before commencing data collection.

Informed consent was obtained in writing for all interviews/participants. There were no adverse events or breaches of confidentiality or anonymity during the research process. Once interviewees had agreed to participate in the research based on a brief description of the project, a Consent Form and accompanying Participant Information Sheet (containing further information about the project, data processing and the participants' rights) was shared before the interview. At the beginning of each interview meeting, the information in the Participant Information Sheet was summarised and the Consent Form was discussed before being signed by the participant. The Consent Form contained several options regarding audio-recording, participants' desired degree of anonymity and permission to use direct quotes from the transcript. Most interviewees opted to not be quoted directly, which limits the number of full quotes provided in the thesis. All participants agreed to the interview being audio-recorded. No participants contacted me to request deletion of any data or to change the terms of their consent.

Analysis of interview data

All interviews were transcribed ad verbatim, with transcripts analysed in two ways. First, qualitative content analysis (as per the previous section) was used to extract factual information (e.g. funding mix, partners involved). Then, the primary method was thematic analysis with both deductive and inductive coding using the NVivo software. Braun and Clarke (2006) make recommendations for improving the rigour of thematic analysis, here I touch on two aspects they highlight: 1) making the epistemological and theoretical approach transparent; and 2) a systematic process for generating and reviewing themes, including criteria for 'what counts' as a theme and rules for discarding themes.

The first aspect is important for the perspective taken on the interview data, i.e. what kind of 'reality' it represents, and how the coding is done. Thematic analysis is compatible with both constructivist and realist, inductive and deductive approaches (Braun and Clarke 2006). As my approach was critical realist, my coding focused on explicit and surface meanings of the text segments (what had been said), rather than on the language used or possible implicit meanings (what may not have been said). In line with the theory-driven nature of critical realist research, my approach was primarily deductive. Prior to analysis, a codebook (see Appendix F) containing over 20 codes was constructed from the theoretical framework. The deductive codes were organised in code families clustered under RQ headings in NVivo. Most of my themes were pre-defined based on these deductive code families, and none of the key deductive codes were discarded as they were found relevant in relation to the data. Simultaneously, new codes were generated inductively, where the interview data revealed interesting factors not captured by the theoretically-derived categories. These were also organised under RQ headings, typically as additional codes under a deductive code family; and in some cases, when similar types of inductive codes were generated, these were then aggregated into a new inductive-only themes (e.g. 'Intra-city politics').

My analysis process began with creating two 'data sets', i.e. separate NVivo folders with the NYC and Bristol interview transcripts. Coding was completed first for the Bristol set, with a first review of internal coherence of the deductive and inductive themes; including the transfer of some codes from one theme to another, and re-coding of some text segments (to another theme) to improve the coherence and distinctiveness of each theme.

In making sense of the data and writing the findings on Bristol (chapter 5), data under some codes were not incorporated in the findings, where such codes did not contain enough data to be counted as a theme;[27] however, the codes were retained within NVivo. The NYC transcripts were then coded, which generated additional inductive codes. A first version of the NYC findings (chapter 6) was then written, and before starting the comparative analysis, I reviewed the themes again. I used the inductive codes generated from the NYC case to analyse Bristol transcripts, which enabled me to 'look back' on the Bristol case through the lens of the NYC case. To gain comparative insights, I also assessed: 1) how the distribution of data within each theme compared across Bristol and NYC, e.g. the number of informants/text segments; 2) how the inductive codes and themes compared across the cases, e.g. what codes contained data for both cases and what codes only contained data from one case; and 3) what codes and themes still did not have much data, after both data sets had been analysed (these were discarded). Final adjustments were then made to the code hierarchy, after which different queries in NVivo allowed me to triangulate interview data and write up the comparative analysis.

3.6.3   Analysis of financial statistics

As a third within-case method, the research included descriptive analysis of statistical data. For the analysis of municipal resources (RQ1.2), triangulation between qualitative data from documents and interviews with quantitative data on funding flows (e.g. grant awards), municipal budgets and expenditures was crucial. I found there was considerable divergence between narratives/perceptions of funding availability and reliance on external funding as expressed in documents and interviews, and trends in funding flows as revealed by financial statistics (section 5.1.2 and 6.1.2). Financial data was compiled from municipal policy strategies and budget documents and national government websites. Sources of financial data are cited in the relevant Figures and Tables, accompanied by a short description of the analysis undertaken by the researcher, which was limited to calculation of (change in) percentage proportions. For the NYC case, findings regarding US federal

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[27] This only happened in relation to inductive themes, e.g. where only one or two interviewees had mentioned a particular issue, that was deemed tangential to the RQs.

government funding draw on analysis of the US Federal Highway Administration (FWHA 2021) database on the CMAQ funding programme,[28] and analysis of New York Metropolitan Transportation Council Annual Obligation reports for federally-funded projects (NYMTC 2007; 2008; 2009a; 2009b; 2011a; 2011b; 2012a; 2012b; 2014b; 2015; 2016).

3.6.4 Analysis of mobility statistics

To answer RQ1.1 and Primary RQ2, the research analysed mobility statistics compiled from a range of government sources; constructing time series covering the entire study period where possible. All sources of mobility data are cited in the relevant Figures and Tables, accompanied by a short description of the analysis undertaken by the researcher, which was limited to calculation of (change in) percentage proportions. As shown in Figure 3.3, mobility statistics were analysed for:

- Assessing 'change in mobility flows' as one type of transformative impact generated by experimentation trajectories (RQ1.1)

  - Assessing this type of impact required extracting data on mobility indicators like trips, mode shares, vehicle speeds, ridership, number of people Killed and Seriously Injured in traffic, etc.

  - Secondary data sourced from municipal reports evaluating experiments, policy documents discussing long-term impacts of experimentation trajectories, peer-reviewed research and government-commissioned academic evaluation reports.

- Determining the extent of urban mobility transitions in Bristol and NYC (Primary RQ2)

  - Analysis of overall changes in high-level indicators, as proxies of urban mobility transitions (commuting modes, emissions, road safety, etc). The time series for high-level indicators were sourced from government statistical databases; notably, the US and UK Census.

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[28] Project MPO=NYMTC; Nonattainment/maintenance area=New York-N. Jersey-L. Island.

- Assessing the contribution of transformative experimentation to urban mobility transitions (RQ2.1)

     o Evidence of transformative impact on mobility flows (RQ1.1) being associated with change in high-level indicators (Primary RQ2) was considered. Where evidence was deemed sufficient, inferences that transformative experimentation had contributed to transitions were made. Sufficient evidence was only found for the Bristol case: there were academic-grade evaluations showing causal association between experimentation trajectories and change in high-level indicators.

Diagnosing the extent of transitions through the lens of path-dependencies (RQ2.2) relied on triangulation between interviewee perceptions and secondary research.

4 INTRODUCTION TO CASE STUDIES

This chapter introduces the case studies, to set the scene for the findings presented in chapters 5, 6, 7 (Primary RQ1) and chapter 8 (Primary RQ2).

The following sections explain baseline differences in multi-scalar governance (section 4.1), shared features of the municipal governments (section 4.2) and convergence and divergence in path-dependencies (section 4.3). Section 4.5 summarises existing empirial narratives regarding each case, discusses 'sustainability entrepreneurialism', taking the reader right up until the start of the study period in 1996/7.

4.1 Multi-scalar governance context

4.1.1 Municipal autonomy in the UK and US

The UK has a two-tier system of government, with multi-scalar politics marked by local-national relations,[29] as well as local-supranational relations with the EU. The UK is a unitary state: national or 'central' government[30] is supreme in that it may create or abolish sub-national units, with these units only able to exercise the powers that national government chooses to delegate to them. Both political and fiscal authority is centralised with UK central government, with limited local autonomy relative to many EU and OECD countries (Ladner et al. 2016). The US is a federal state with three tiers of local, state and federal government (OECD and UCLG 2016). Political and fiscal authority is delegated from federal government to 50 state governments: although the US is thus a relatively decentralised system overall, crucially this does not mean that local autonomy is high, as authority is concentrated with state governments. Local governments in the US

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[29] Between 1994 and 2011, the UK had a regional tier of government, which was abolished in 2011/12. The findings did not reveal any significant influence of regional institutions on mobility experimentation by BCC, thus thus the Bristol case study excludes the regional scale of governance.

[30] These terms are used interchangeable here, in reference to the central government of the UK; technically, 'national' in the UK context can also refer to the devolved governments of England, Scotland, Wales and Northern Ireland.

have no constitutionally defined relationship with federal government – existing purely as 'creatures of the state' (Ross and Levine 2012). US state governments can authorise the creation and abolishment of local government units within their jurisdiction, and state law specifies what local government administrations can and cannot do (Cardozo and Klinger 2017; Frug and Barron 2008).[31] Thus local-state government relations in the US mirror local-central relations in the UK.

Table 4.1. Municipal resource streams in Bristol and NYC.

Type of funding	Bristol City Council	City of New York
General municipal budget		
Local revenues	Council Tax (property tax) Fees and charges	Property, personal income, sales, real estate, and other taxes Fees and charges
Unconditional transfers	Revenue Support Grant, Formula Grant	Negligible (state and federal)
Capital financing	Prudential borrowing from the Public Works Loan Board	Municipal bond issuance
Urban mobility expenditure		
Conditional transfers: block grants (all involving local match-funding)	Integrated Transport Block	Federal: Surface Transportation Program State: Consolidated Local Street and Highway Improvement Program
Private sector contributions	Section 106 agreements	N/A

Table 4.1 shows the funding and financing streams available to BCC and NYC city government. To clarify the public finance terminology used in the remainder of the thesis: 'operational' expenditure is that used to pay for running costs like staff, delivering services and infrastructure maintenance, whereas 'capital' expenditure is that used for investing in physical assets. Reference to 'operational' and 'capital' *funding* means that public money is accounted for as such, and can only be spent for that purpose: the separation exists in municipal budgets and in the ring-fencing of grant funding.[32] Both operational and capital

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[31] Laws differ considerably between states, and thus the remainder of the thesis refers to the specifics of New York State.

[32] These are the terms used in the US; 'operational' expenditure is also the commonly-used term in public accounting. In the UK, 'operational' expenditure is – unusually – referred to as 'revenue' expenditure/funding.

funding is important for experimentation: my findings suggest that operational funding is often more important for implementing an experiment as a temporary intervention, whereas capital funding is needed for construction/procurement to make the configuration permanent or scale it up.

Local governments in England rely on three primary sources of operational funding: council tax (tax levied on residential properties), grant transfers from central government, and business rates.[33] National government has the power to change these funding arrangements. Council tax is collected by local government. Local governments receive national government grants for a range of local functions: the largest transfer is the 'Revenue Support Grant', which is unconditional, allocated by formula, and can be spent according to the discretion of local authorities. The revenue-raising powers of English local government have traditionally been very limited, with intergovernmental transfers accounting for the greatest share of municipal budgets. In addition to unconditional transfers, this also includes conditional transfers or so-called 'block grants', where funding is ring-fenced for a specific service area. For mobility, BCC receives an Integrated Transport Block grant that it can spend on local mobility infrastructure (capital funding), with discretion over what exactly to spend on within this category. The Integrated Transport Block is the key discretionary source of municipal resources that BCC can use for experimentation.

In contrast, US local governments receive negligible unconditional transfers from federal and state government. NYC city government has the powers to raise revenues from a variety of taxes, fees and charges: including property taxes (29% of municipal budget in 2017) and personal income tax (IBO 2017). These own-source revenues account for approximately three-quarters of the municipal budget (Table 3.1). NYC city government has the discretion to regulate its property tax level and (a segment of) the sales tax, but needs New York State government approval to impose and make changes to most of the other revenue-raising instruments listed above; between 1997-2016, the state legislature has frequently rejected Mayoral requests for changes (Berg 2007). The remainder of the

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[33] See footnote to Table 3.1; not discussed further in thesis.

municipal budget is funded through conditional transfers. The US federal government block grant that NYC city government has access to is called the Surface Transportation Program.[34] As discussed below, state government has a limited role in funding the mobility expenditures of NYC city government.

Both municipalities can borrow to finance capital expenditures – however, a significant difference is that NYC city government can borrow to a much greater degree. Subject to debt ceilings, local governments in England are permitted to borrow for capital expenditures from the UK Public Works Loan Board, in the private market, or by issuing municipal bonds – but in practice, local authorities primarily employ the first instrument (Sandford 2020). The US, on the other hand, has a highly developed municipal bond market. NYC city government has a capital budget measured in $USD billions for expenditure on transport infrastructure, with the majority funded through municipal bond issuance (IBO 2017). While most of this capital expenditure is for things like bridge repair, bond issuance has also allowed NYC Mayors to allocate capital funding to policy priorities related to experimentation (chapter 6). NYC city government thus enjoys a more self-controlled source of capital funding, whereas BCC relies on smaller and less certain central government grants for capital funding.

BCC is can raise some private sector contributions towards mobility infrastructure. Section 106 agreements made between municipal government and private property developers relate to Section 106 of the UK Town and Country Planning Act 1990, whereby municipalities may stipulate what 'mitigating actions' make a developer's planning application permissible. Agreements detail what specific improvements need to be made to mobility infrastructure and public spaces around the development site, and how much private developers will contribute financially. Since these agreements can solicit private sector contributions to relatively small-scale interventions like improving walking/cycling infrastructure and installing electric vehicle charging points, they have

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[34] Renamed the Surface Transportation Block Grant in 2015.

occasionally been relevant to experimentation in Bristol (chapter 5). The findings did not reveal a similar mechanism relevant to experimentation in NYC.[35]

4.1.2   Policy-making and funding for urban mobility

I now turn to the multi-scalar governance of urban mobility specifically. To avoid recounting unnecessary details of *de jure* arrangements that do not apply *de facto*, this section describes the realities of multi-scalar governance as revealed by my findings.

The funding flows (black arrows) in Figure 4.1 and 4.2 are numbered in order of importance, with Flow 1 being the most significant source of funding for experimentation. The blue arrows indicate alignment between policy frameworks and funding awards.

Figure 4.1 shows funding flows and policy alignment relevant to mobility experimentation undertaken in Bristol (N=47). All funding flows directly to BCC. In the UK, the national Department for Transport (DfT) periodically publishes national policy strategies (White Papers) setting out priorities for urban mobility, restructuring both formula-based and competitive funding to align with these priorities. BCC produces a municipal vision for urban mobility, including an estimate of the budget it would need for implementation, in a Local Transport Plan (LTP). The LTP process was introduced by the 2000 Local Transport Act, which reformed the multi-scalar governance of urban mobility. Previously local authorities had submitted annual Transport Policies and Programmes statements to request central government funding for individual schemes, but from 2000 local authorities were required to produce 5-year integrated transport strategies called Local Transport Plans (LTPs), which when approved by national government were accompanied by a 5-year funding settlement (Vigar and Stead 2003). This LTP process was intended to ensure the national policy agenda was delivered effectively through local authorities reporting on nationally-defined indicators and targets (Marsden and Bonsall

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[35] 'Special purpose districts' is a NYC city government zoning instrument whereby private developers can receive a floor area bonus in exchange for street improvements. Tax Increment Financing is used for raising private sector contributions for rail infrastructure. I found neither instrument was relevant to NYC experimentation.

2006), but also to provide greater flexibility and continuity of funding for localities (May et al. 2008).

DfT reviews the LTP and allocates BCC an annual Integrated Transport Block grant according to its assessment (Flow 1). All other funding from DfT to BCC flows through competitive funding programmes, for which BCC prepares separate grant applications (Flow 1).
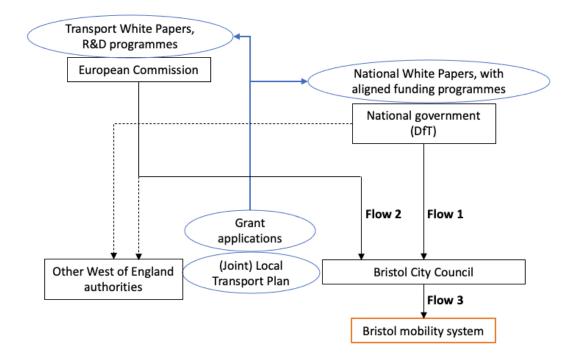
Figure 4.1. Multi-scalar funding flows and policy alignment in the Bristol context.

Since 1995, the European Commission has published a series of Green/White Papers outlining its priorities for urban mobility, and restructured its competitive R&D funding programmes for experimentation (Flow 2) to align with these priorities (Halpern 2014). Due to BCC's reliance on external funding, municipal policy is made not only through preparing an LTP, but also through preparing grant applications proposing experiments that align with national and EU programme criteria. UK competitive funding programmes have continuously varied during the study period – created and abolished within the span of a few years – and are introduced in chapter 5.

To a lesser extent, BCC has also used its discretionary municipal resources (Flow 3) – either from the general municipal budget or from the Integrated Transport Block (Table 4.1). This includes local 'match' funding shares for all types of external grants, e.g. where national government and the EU will fund 70% of a grant, requiring BCC to contribute the remaining 30%. BCC also joins forces with other local authorities to produce Joint Local Transport Plans and joint grant funding applications – this city-regional context is introduced below.

Figure 4.2 shows funding flows and policy alignment relevant to mobility experimentation undertaken in NYC. Direct NYC city government expenditure has been the most significant for urban mobility experimentation (hence Flow 1): the operational and capital expenditure described in Table 4.1. Funding programmes (primarily formula-based) administered by the Federal Highways Administration (FWHA) were the second most important funding source for NYC mobility experimentation (Flow 2), and thereafter funding programmes (primarily competitive) administered by the Federal Transit Administration (FTA, Flow 3).

Starting at the top of Figure 4.2: US federal transport policy is formulated through Acts, i.e. pieces of legislation authorising specific volumes of federal spending on transport funding programmes with broadly defined goals – rather than strategic policy documents, as in the UK. This reflects the fact that US federal government transport policy is not strongly intentional (interview NY20), i.e. it does not involve a cohesive national vision or specific policy objectives and targets for urban mobility (Transportation for America 2015).[36] From 1956, US transport policy was equivalent to the federal 'highway program' that funded the construction of the Interstate Highway System. By 1991, the Interstate System had been completed and the consensus regarding federal transport policy ceased to exist (Dilger 2015; Pew Trusts 2014).

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[36] I am also grateful to Rosalie Singerman Ray, Postdoctoral Research Associate at the University of Connecticut, for her insights on US federal transportation policy.
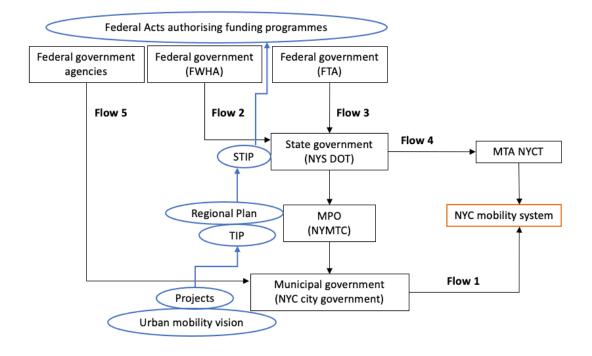
Figure 4.2. Multi-scalar funding flows and policy alignment in the NYC context.

The scope of federal funding programmes that existed between 1997-2016 was established with the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991. ISTEA included – for the first time – dedicated federal funding for non-car modes (Pucher et al. 1999), establishing the Surface Transportation Program and Congestion and Air Quality Mitigation Program (Dilger 1992). The passage of ISTEA vastly increased volumes of federal transport funding flowing to NYC city government and expanded the scope of eligible activities beyond highways (City of New York 2003b).

ISTEA also granted significant additional powers to Metropolitan Planning Organisations (MPOs), which are required entities for the administration of federal transport funding in every urban area with a population of more than 50,000. As shown in Figure 4.2, MPOs are responsible for developing a 20-year Regional Transportation Plan and a linked four-year Transportation Improvement Program (TIP), which also needs to be aligned with a State-Wide Transportation Improvement Program (STIP). All of the initiatives in these plans must align with the requirements of the federal programmes through which they are to be funded. The key function of an MPO is to coordinate the allocation of federal

funding across local government administrations in its area: all projects for which federal funding has been agreed must be listed in the TIP. The MPO that NYC city government belongs to is the New York Metropolitan Transportation Council (NYMTC), made up of NYC (5 Boroughs) and an additional 5 counties part of New York state (Putnam, Westchester, Nassau, Suffolk, Rockland).

There is no requirement for NYC city government to produce a strategic plan for urban mobility for review by federal or state government - in contrast to the UK. NYC city government sets its own vision and based on this, submits specific policy interventions that it hopes to secure federal grant funding for, as discrete 'projects' for consideration by NYMTC. Interview data revealed that these allocations are largely an outcome of political bargaining, with the NYMTC Regional Plan, TIP and STIP being purely bureaucratic documents that are formally required by the federal funding process, rather than substantively meaningful policy processes that influence the policy priorities of NYC city government (interview NY20).[37] This explains why these documents are not discussed further for the NYC case.

The NYMTC-coordinated allocation of federal grant funding, under programmes like Congestion Mitigation and Air Quality (CMAQ), is 'quasi-competitive' between NYC city government and the five other counties part of NYMTC (NY21).[38] The other counties are predominately suburban with higher levels of car use, resulting in 'upstate' versus 'downstate' politics in relation automobility within NYMTC (Derrick et al. 2012). NYMTC is dominated by state government officials, who tend to be more supportive of automobility (Higashide 2019; Derrick et al. 2012). The vast majority of US federal government funding to urban areas flows via state government (in the NYC case, the New York State Department of Transportation or NYS DOT), rather than awarded directly to municipalities (Pew Trusts 2014). This applies to the Federal Highways Administration (FWHA) funding that NYMTC approves for grant awards to NYC city government (Flow

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[37] None of the documents were mentioned by other interviewees.

[38] 'Quasi' because CMAQ allocations are formally based on criteria related to ambient levels of air quality within the different areas part of NYMTC. Rouwangould et al. (2018) find that US state governments operate widely different processes for allocating CMAQ funding to municipalities, illustrating the degree of de facto discretion.

2), and to competitive funding programmes administered by the Federal Transit Administration (FTA, Flow 3) for capital investment in local public transport. As shown in Figure 4.2, only a small proportion of funding flows directly to NYC city government (Flow 5) – in contrast to the Bristol context. Flow 5 represents recently introduced federal programmes that award grants directly to municipal government, bypassing state governments and MPOs.

Public transport in NYC is operated by the Metropolitan Transportation Authority's subsidiary agency New York City Transit (MTA NYCT). NYC city government contributions to the MTA NYCT budget are thus also relevant (Flow 1). The MTA is funded through contributions by both NYC city government and New York state government (Flow 4), in addition to dedicated taxes and fare revenues. Political tensions between NYC city government and NY state government typically centre on the size of their relative contributions (CBC 2020).

Summary

Prior to selecting NYC city government as a second case, I conducted a rapid analysis of the US mobility funding landscape, to see how it compares with the UK's. I found that whereas BCC primarily relied on competitive funding programmes awarding short-term grants, generating uncertainty regarding external funding, US municipalities have access to federal government funding programmes that allocated funding on a formula basis (in addition to competitive programmes). Furthermore, I noted that whereas mobility funding flows directly from national to municipal government in the UK, it flows from federal government to municipalities via state government in the US.

This section confirms these initial findings. However, I have also shown that:

- NYMTC, as an MPO linked to NY state government, plays a central role in controlling the flow of federal funding to NYC city government, *including formula-based funding.*

- Despite NYC city government having greater access to non-competitive formula-based funding relative to BCC, city-state politics and associated politics

within NYMTC means that there is not automatically a greater degree of funding certainty. Even if the US is a less centralised political system than the UK, NYC mobility funding applications are equally subject to politics.

- Another *de facto* difference between BCC and NYC city government is that while BCC's *municipal vision* for urban mobility and associated *scope of experimentation* is scrutinised for alignment with national policy priorities (Figure 4.2), there is no equivalent process influencing NYC city government (Figure 4.3). NYC city government needs to align the grant 'projects' it proposes with the eligibility criteria of federal funding programmes, but overall, US federal and NY state transport policy lacks the intentionality that would systematically condition local visions. This is very different from the UK context, where local visions and implementation are subject to detailed review and monitoring.

4.2   Shared features of municipal governments

Although my comparative approach does not attempt to 'control' for variables, it considers the case features that allow for analytically feasible comparison of municipal government capacity. This section sets out three shared features of BCC and NYC city government: jurisdictional boundaries, administrative structure, and functional powers over mobility. Figures 4.3 and 4.4 provide an overview of the key public sector organisations relevant to the Bristol and NYC case.

4.2.1   Jurisdictional boundaries of municipal government

The jurisdictional boundaries of both municipalities do not encompass the commuting area of the wider city-region. For the purposes of Primary RQ1, I define an urban mobility system as an analytical unit that is spatially delimited to municipal boundaries (section 2.5.1) – and I chose to do so *because* my case study units are non-metropolitan municipal governments. The aligned boundaries of the municipalities was another important aspect of analytic comparability, as it would be more complex to compare capacity for experimentation across a larger city-region with experimentation within a municipal area.
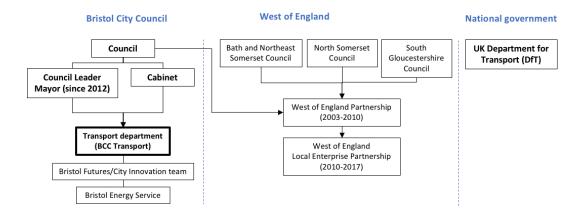
Figure 4.3. Key organisations relevant to the Bristol case.
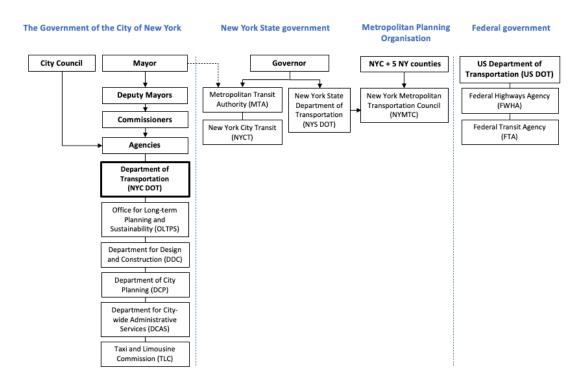

Figure 4.4. Key organisations relevant to the NYC case.

4.2.2   Structure of municipal government

Municipal government in both Bristol and NYC is of a one-tier consolidated structure (Slack and Côté 2014), i.e. there are no nested lower-level administrations. This commonality was important in allowing for analytic comparability.

As per Figure 4.3 and 4.4, the organisations constituting municipal government differ somewhat. BCC is a single organisation for which I examine different sub-units; whereas NYC city government consists of several organisations that play a role in governing the mobility system and which operate as separate municipal agencies, of which I examine a few. For both cases, my analysis centres on each municipality's department for transport (marked in bold within the Figures) – hereafter referred to as 'BCC Transport' and 'NYC DOT' (New York City Department of Transportation). Other units/agencies are introduced in chapter 5 and 6.

As shown in Figure 4.3 and 4.4, both BCC and NYC city government have a Council with political members elected by people living in electoral subdivisions of the respective city. These politicians are called 'councillors' in England and 'Councilmembers' in NYC. The NYC City Council represents the legislative branch of NYC city government, with the power to pass local laws and orders that require municipal agencies to undertake specific actions – independently of the NYC Mayor. The executive branch of NYC city government is headed by a directly-elected Mayor, who holds strong executive decision-making powers over policy and the municipal budget (Berg 2007). The Mayor appoints Deputy Mayors, and Commissioners acting as the head of municipal agencies like NYC DOT.

A difference between the cases is that BCC has had less prominent executive leadership, in line with broader differences between the UK and US (Hambleton 1998). Prior to 2000, BCC functioned through the 'political committee' system of local government in England, without any executive branch. BCC then introduced executive leadership for the first time in 2000, moving to a 'Leader and Cabinet' model of local government, under which councillors elect a Council Leader (Hambleton and Sweeting 2004). In 2012, the first directly-elected Mayor of Bristol assumed office. The Mayor serves for a four-year term, proposes a budget and policy framework that is approved by the full Council, and can take executive decisions within this framework.

4.2.3   Functional powers over urban mobility

BCC and NYC city government have comparable functional powers over transport and spatial planning, and control the city's streets, roads and public spaces. Both municipalities only have partial influence over public transport services, which is another shared feature facilitating analytic comparability. It means the analysis of governance institutions (RQ1.3) examines how BCC and NYC city government have needed to partner with other actors to experiment with busmobility.

Private companies operate bus services within Bristol and city-region. Between 1996 and 2016, one bus company – First Bus West of England (hereafter First Bus) – has dominated the local bus market. Following national privatisation in the 1980s, the provision of local bus services has involved different forms of voluntary partnerships between municipalities and private operators, because neither party controls all aspects (section 2.3.4). BCC controls anything to do with road use and infrastructure (bus priority lanes, bus stops, bus shelters and traffic signals), and structures placed on the pavement. Private bus operators control their own vehicles, equipment, and, depots and technically operate in a 'free market' where they can freely decide on routes, fares and customer service arrangements.

Within NYC boundaries, bus services are operated by MTA New York City Transit (hereafter NYCT), which is a public sector authority providing bus services as a public service. NYCT was established as a public benefit corporation under New York state government in 1953. Privatisation of public transport spurred by the Reagan administration did not affect the MTA; bus services in NYC have largely remained publicly-controlled. As in Bristol, governing busmobility necessitates coordination and partnership between NYCT and the NYC DOT as public sector agencies. NYCT operates bus services, owns all bus assets and decides on routes and schedules. Like BCC, the NYC DOT controls the street-based aspects of the bus system like priority lanes, bus stops/shelters and traffic signals. As indicated in Figure 4.4, the MTA and NYCT are *de facto* controlled by the state government (Berg 2007). The MTA is governed by a 21-member board, with members representing NYC and other New York State counties appointed by the State Governor; and the MTA budget is voted on by the State legislature

(Derrick et al. 2012). Multi-scalar politics thus shape governance institutions for busmobility in both Bristol (local-national) and NYC (city-state).

4.3 Path-dependencies in urban mobility systems

This section describes the path-dependencies (section 2.5.3) that characterised Bristol and NYC mobility systems at the start of the study period in 1996/7, to contextualise the experimentation that ensued within a longer-term perspective. This begins to answer RQ2.2, which is returned to in chapter 8.

Table 4.2 summarises convergent and divergent developments in Bristol and NYC: the decades noted serve to highlight how path-dependencies have evolved within the context of a shared history of automobility and its alternatives. We can sketch a common arc of development. In the 1950s and 1960s, automobility rose to dominate in both cities, with quickly growing private car use and decreasing public transport use, walking and cycling. In the 1970s and 1980s, a wave of neoliberal state restructuring was accompanied by deindustrialisation, suburbanisation, and urban sprawl that further segmented private car use. The 1970s and 1980s also saw the rise of environmental activism, with the birth of civil society organisations campaigning for alternatives to automobility.

Table 4.2. Convergence and divergence in path-dependencies across cases.

Path-dependencies	Convergent development	Divergent development
Public transport systems	1950s-1960s: Rise of automobility, increase in car use and road-building; public transport becomes unfashionable	1960s: Public investment in rail system – present in NYC, absent in Bristol 1980s: Privatisation of public transport in the UK/Bristol – absent in NYC
City-regional governance	No effective city-regional structure for integrated mobility and land use planning; urban vs. suburban politics of automobility	1960s: NYC – MTA established, Bristol – no PTE established
Spatial structure and commuting flows	1970s-1990s: de-industrialisation, suburbanisation, inner city decline, sprawl and 'edge city' development	Greater impact of sprawl on commuting patterns, in Bristol

Civil society activism	1970s: Emergence of civil society organisations (CSO) focused on cycling and anti-car campaigning	1980s-1990s: Bristol – cycling CSO professionalised and morphed into infrastructure delivery organisation; NYC – CSO remained focused on campaigning Lack of notable CSOs focused on car-free public space in Bristol – in NYC, professionalised CSO focused on working with private sector

4.3.1 Public transport systems

The most obvious point of divergence is that Bristol's public transport system is much weaker than NYC's. Bristol is unusual for a UK city of its size in that there is no tram or metro system, and is also known for its poor-quality bus services. By comparison, NYC's network of bus and subway services is one of the most extensive globally. This divergence can be traced to how policy-makers made decisions about: 1) privatisation of public transport, as already discussed; and 2) public investment in rail services, during the post-war decades marked by competition between automobility and public transport.

Although Bristol and NYC began to be reshaped to accommodate the car before WWII (Hasegawa 1992; Geels 2005), it was the 1950s and 1960s that segmented the rise of automobility. In the US and the UK, national and local policy shifted to favour private car ownership and suburbanisation (Young 2015; Buchanan 2015). Both mobility systems were transformed by extensive road-building and grade-separation of pedestrians and vehicles (Priest and Cobb 1980; Caro 2015).

The rise of automobility caused public transport to become unfashionable and neglected. At this point, a crucial divergence was that while rail services in Bristol were decimated, in NYC there was massive public investment in the subway. Bristol's tramway network was entirely abandoned by local decision-makers (Reith-Banks et al. 2018), and the national government-orchestrated 'Beeching cuts' to rationalise railway services led to the closure of services across the Bristol city-region (Canning 2019; Lake 2009). Efforts to develop a

new mass transit system for Bristol from the 1970s onwards have never succeeded.[39] Faced with declining maintenance and chronic underfunding of the subway in the 1950s and 1960s, NYC decision-makers took a radically different approach. New York state government supported a large funding increase to revamp and *expand* the subway system; which set infrastructure investment on the course that would produce the public transport system that existed in 1997 (NYC Council Speaker 2019). As a result, after declining up until the 1970s, NYC subway ridership stabilised during the 1980s and was growing by the mid-1990s (Schaller 2007a).

4.3.2 City-regional governance

Both the UK and US Census uses daily commuting flows - crossing municipal boundaries - to define city-regions.[40] Neither in the Bristol or NYC context was there an effective governance structure covering the city-region, in 1996/7 nor in 2016.

BCC was established as a municipal government in 1996, following the abolishment of Avon County Council (ACC): a two-tier county administration that covered Bristol as well as parts of the surrounding city-region, subsuming four 'district councils' including BCC. ACC effectively siphoned power from Bristol as a city, including BCC control over transport planning (DiGaetano and Klemanski 1999). Coordination between the constituent councils and ACC was poor, and the two-tier structure meant that capacity for integrated mobility and land use planning was weak (Boddy et al. 2004). ACC did not have significant powers over privatised public transport (Parsons 2018): in this respect, the path-dependency that distinguishes the Bristol city-region is that a 'Passenger Transport Executive' (PTE) was never established. The 1960s Labour government introduced PTEs as a new type of public authority serving large urban conurbations and

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[39] In the 1980s, private entrepreneurs set up a company called Advanced Transport for Avon to plan a metro system for Bristol. The company tried to circumvent the lack of a city-regional public authority, with the capacity to champion such a system, by seeking private financing and sidelining local decision-makers, to instead align itself with the Thatcher government. Ultimately, the effort failed in 1992 (Parsons 2018).
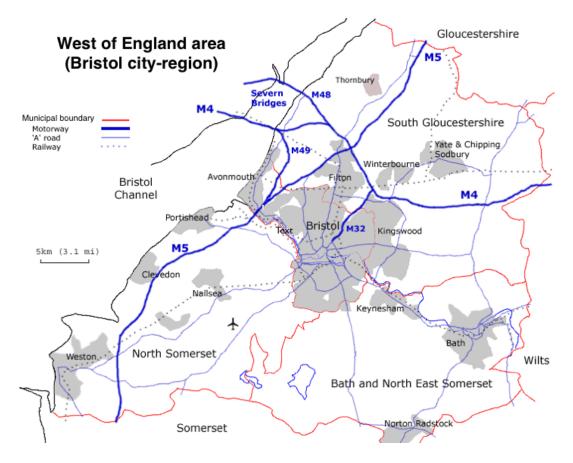
[40] Based on the UK Census, 'travel to work areas' are calculated to approximate 'self-contained local labour market areas, where the majority of an area's resident workforce work, and where the majority of the workforce live' (ONS 2015b). Commuting flow data collected in the US Census Bureau (2019) American Community Survey is used to define 'metropolitan statistical areas'.

with responsibility for integrated planning (PTEG 1993; PTEG 2008). During the 1970s, seven PTEs were established for UK city-regions, of comparable size to the Bristol city-region, but never for ACC.[41] This path-dependency partly explains why other UK city-regions had better rail and bus services by 1996 (Marsden and May 2006): among other advantages, PTEs enjoy greater access to capital funding for infrastructure expansion (PTEG 2005). The UK has a weak tradition of city-regional governance (Docherty et al. 2009), but PTEs are an exception.

The abolishment of ACC meant that there was no city-regional governance structure *whatsoever*. ACC was replaced by four unitary authorities: BCC, South Gloucestershire Council, North Somerset Council, and Bath and North East Somerset Council. The map below (Figure 4.5) shows the boundaries of each authority in red, with these areas combined representing the former extent of ACC (i.e. the outer red boundary) – which during the study period came to be called the 'West of England area'. This area represents the Bristol city-region as referred to in the thesis. Bristol is the economic centre: the population within municipal boundaries is approximately 463,400 (BCC 2020b), whereas the city-regional population is approximately 1.1 million.[42] Figure 4.5 shows the built-up urban area in grey, revealing that BCC is surrounded by rural and suburban local authorities. Unsurprisingly, these areas have much higher levels of private car use and the surrounding authorities have had different priorities in relation to automobility. Figure 4.5 only shows railway lines, but bus services also operate across local authority boundaries. For BCC to negotiate with First Bus as the dominant operator, it must often involve the other West of England authorities. During the study period these authorities formed new types of governance networks under the West of England banner (Figure 4.3), yet these did not constitute a proper city-regional governance structure for mobility and land use planning.

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[41] PTEs were created for Greater Manchester, Merseyside, South Yorkshire, Strathclycde, Tyne and Wear, West Midlands, and West Yorkshire.

[42] West of England Combined Authority website (https://www.westofengland-ca.gov.uk/), accessed 25.03.2021.
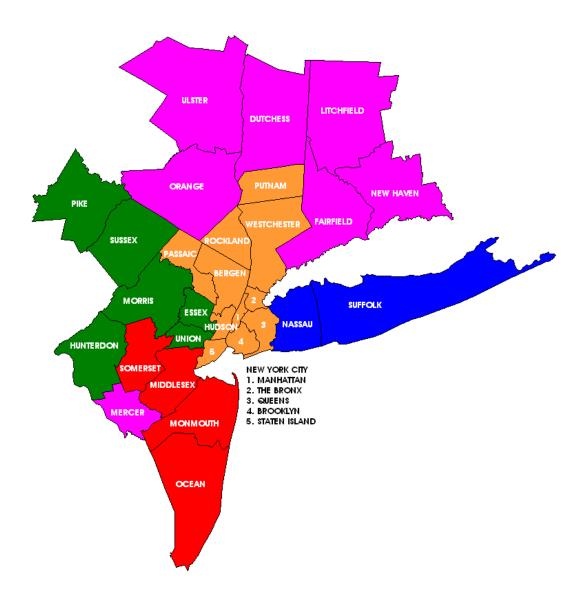
Figure 4.5. Map of Bristol within the West of England city-region. Image source: adapted by author from Wikimedia (user: Steinsky), https://commons.wikimedia.org/w/index.php?curid=756807.

NYC has a population of approximately 8.4 million (NYCDCP 2021), as the economic centre of the New York city-region of 22 million.[43] This is a continuously urbanised 'megacity' that stretches across different parts of the states of New York, New Jersey, Connecticut and Pennsylvania, with a high degree of economic integration and density of commuting flows (NYCDCP 2019). In Figure 4.6, NYC municipal boundaries are represented by the five NYC Boroughs marked 1-5; the remaining areas represent the other counties of the city-region.[44]

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[43] 2019 estimated population of the 'Combined Statistical Area' of New York-Newark-Bridgeport (NY-NJ-CT-PA), which is one of the metropolitan classsifications defined by the US Census Bureau (2021), and which I define the NYC city-region in relation to.

[44] The map represents the 'Combined Statistical Area' (footnote above).

Figure 4.6. Map of the NYC city-region, with constituent counties. Image source: public domain, https://commons.wikimedia.org/w/index.php?curid=176446.

There has never been a governance structure spanning the NYC city-region. Each county marked in Figure 4.6 is governed by one or more local administrations. Indeed, Ross and Levine (2012, p.222) cite the NYC city-region as a prime example of the metropolitan fragmentation that is common across the US. The relative advantage that the NYC city-region *does* have is that the MTA operates rail services across the orange, blue and purple areas in Figure 4.6, thus providing a single governance structure capable of shaping an integrated mass transit system for city-regional commuting. The large-scale investment in

NYC public transport from the 1960s was enabled by the creation of new governance structures. New York state government first created New York City Transit (NYCT) in 1953 as a public authority to manage NYC bus and subway routes; and then established the MTA in 1968 as a regional, state-controlled entity that subsumed NYCT (NYC Council Speaker 2019). Like the UK PTEs, the MTA has greater access to capital funding than municipal government could borrow alone (Berg 2007).

Both the UK and the US have weak traditions of city-regional governance. However, a key divergence is that in NYC, the existence of the MTA has meant that public transport services have at least been governed in an integrated manner across the city-region, whereas in Bristol no such structure has existed.

4.3.3   Spatial structure and commuting flows

The spatial structure of city-regions, in particular residential and employment locations, determines commuting patterns. Bristol and NYC attract significant inward commuting from surrounding areas (ONS 2015a; NYCDCP 2019). Yet neither BCC nor NYC city government can directly control these flows, e.g. the number of commuters and whether they drive in or take public transport.

Deindustrialisation in both Bristol and NYC during the 1970s drove an increase in unemployment and decline in the population with municipal boundaries (Tallon 2007; Berg 2007). Employment within the respective city-regions decentralised between the 1970s and 1990s. Employment growth took place largely outside Bristol, with the fastest growth in the newly-developing 'North Fringe' area stradling the Bristol and South Gloucestershire boundary (Boddy 2003).[45] Tallon has characterised this area as an 'edge city' (following Garreau 1991): nested between the M4 and M5 motorways, it includes a mix of suburban housing, shopping complexes, business parks and manufacturing

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[45] Figure 4.5 shows how the Bristol's built-up area extends across the BCC boundary into South Gloucestershire, including the 'North Fringe' around the place marked as 'Filton'.

facilities.[46] This area beyond BCC's jurisdiction became a major commuting destination, but was poorly accessible by public transport and designed with the car in mind. Located in present-day South Gloucestershire, the North Fringe was enabled by the permissive planning policy of former Northavon Council and lack of integrated planning by Avon County Council, under the Thatcher government's deregulated planning system (Boddy et al. 2004).

'Edge city' development also took place within the NYC city-region during the 1980s and 1990s, including many areas of Long Island and New Jersey originally described by Garreau (1991). However, in Bristol, such sprawl had a more significant impact in segmenting inward commuting to the city centre by private car. In the NYC city-region, office sprawl was less extreme, with Manhattan remaining the prime employment centre in the 1980s and 1990s (Lang and LeFurgy 2003; Bram and McKay 2005). There was thus not the same decentralisation of commuting beyond NYC city government boundaries.

4.3.4 Civil society activism

The two most important civil society organisations (CSO) campaigning for sustainable mobility in Bristol and NYC were born in the 1970s. These CSOs played an important role in relation to mobility experimentation after 1996/7.

The 1970s was a decade of burgeoning environmental movements in the UK and US. This and the 1973 oil crisis led to many sustainable mobility-focused CSOs being established in the UK (Goldbuff and Aldred 2011). In Bristol, grassroots campaigning group Cyclebag was established in 1977 (Brownlee 2011). Cyclebag converted a disused railway line running between Bristol and Bath into a cycling route, known as the Bristol and Bath Railway Path, which still is a major link in the city-regional cycling network (BCyC 2019). Cyclebag also successfully pushed Avon County Council to establish a team focused on cycling in the 1980s, which began to experiment with cycling infrastructure configurations entirely new to the UK (B12; Brownlee 2011). These are considered

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[46] Garreau (1991) argued that the majority of US office growth was occurring at city edges, outside traditional Central Business Districts. The strength of Garreau's 'edge city' concept has been debated (Lang and LeFurgy 2003); but for the purposes of this research, it illustrates the path-dependency of car-dependent development.

landmark events in the history of UK cycling policy, because Cyclebag later morphed from a campaigning group into a more professionalised CSO called Sustrans (established in 1984), which began focusing on delivering the National Cycle Network of cycle routes with national government funding (Golbuff and Aldred 2011; Ragnarsdottir 2007). Sustrans has continued to be headquartered in Bristol and play an important role in local mobility governance, however.

In 1973, Transportation Alternatives (T.A.) was established in NYC as a CSO, inspired by the US environmental movement (Furness 2010) and the oil crisis (Komanoff 2012). T.A. had a slow start as a radical group focused on cycle campaigning and direct action, only starting to grow in membership and resources from the late 1980s (*ibid.*). In the early 1990s, T.A. began producing 'shadow policy' seeking to influence municipal government, and played a role in helping NYC city government secure its first CMAQ grants for cycling infrastructure (T.A. 2013; Komanoff 2012). Despite successful critique of municipal government, at the start of the NYC study period in 1997, T.A. remained a campaigning group with only a handful of employees (Friss 2019). During the study period, its influence increased exponentially.

Sustrans and Transportation Alternatives reflects the transnational history of bicycle-focused counterculture movements (Furness 2010) in Bristol and NYC as 'cities in a world of cities'. The key divergence between the cases is that T.A. remained a campaigning CSO advancing critique of municipal policy, rather than becoming professionalised and morphing into a 'delivery' organisations like Sustrans.

If civil society in Bristol was more professionalised vis-à-vis cycle campaigning, the opposite was true in relation to public space. Bristol has a 'grassroots' culture related to car-free 'street parties' (Brownlee 2011), but there are no notable CSOs focused on public space. In NYC, Project for Public Spaces (PPS) was founded in 1975 as an urbanist 'think and do thank' (PPS 2012). NYC city government cut spending on the maintenance of public space drastically from its fiscal crisis in the mid-1970s, which consequently fell into increasing neglect (Krinsky and Simonet 2017). In response, public space management of by civil society and the private sector expanded. PPS' philosophy of 'community

stewardship' is rooted in this era: that diverse actors local to a neighbourhood were best placed to manage and maintain public spaces, rather than city government (NY01). PPS was heavily involved in the development of NYC Business Improvement Districts (BIDs) (NY05).[47] Initially, BIDs were encouraged by NYC city government to maintain pedestrian infrastructure that the city had recently invested to improve. In the 1980s, their number grew quickly and their role expanding to supplementing city services for sanitation and security, incorporating also improving 'quality of life' through activities like events programming in the 1990s (Gross 2013). By the 1990s, PPS had professionalised into one of the foremost place-making consultancies globally. From 1997-2016, BIDs played a major role in public space experimentation in NYC, as did PPS.

4.4 Sustainability entrepreneurialism

As discussed in section 3.3, my comparison between Bristol and NYC is also grounded in the argument that experimentation can be examined as a repeated governing mechanism with shared conditions of production. I argue that in Bristol and NYC, urban mobility experimentation emerged in the shared context of 'sustainability entrepreneurialism'. Making this argument requires connecting three trends: state restructuring in the 1970s and 1980s, that led to the rise of municipal entrepreneurialism in the 1990s, and the subsequent merging of new sustainability agendas with entrepreneurialism after 1996/7.

4.4.1 State restructuring and municipal entrepreneurialism

Both Bristol and NYC was marked by neoliberal state restructuring during the 1980s Thatcher-Reagan era. The Thatcher government cut funding to UK municipalities and encouraged interlocal competition (section 2.3.3). The restructuring of NYC city government began already with its 1975 fiscal crisis. Muncipal budget deficits had

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[47] BIDs are non-profit organisations overseen by the NYC Small Business Services agency (2021), which defines them as "a geographical area where local stakeholders oversee and fund the maintenance, improvement, and promotion of their commercial district". BIDs are governed by a board cosisting of local property owners, merchants, residents and elected officials. The majority share of BID budgets are funded by a fee billed on property owners within the distric - in essence, BIDs fund themselves through those interested in the economic performance of an area, to provide services that enhance the interests of those same stakeholders.

continued to grow vastly during the preceding decade, culminating in a 1975 federal government act NYC city government with a package of loans, attached to conditions that the city government institute severe austerity cuts (Phillips-Fein 2017). Scholars of NYC politics argue that the impact of the fiscal crisis on the city's governance ever since cannot be overemphasised, and that NYC city government restructuring in the aftermath of the crisis can be understood as the ground-zero of US austerity politics (Phillips-Fein 2017; Brash 2003; Peck 2012).

These shifts towards competition states spurred municipal entrepreneurialism. By the mid-1990s, Bristol and NYC had begun to reinvent themselves as post-industrial cities, with population decline beginning to reverse. BCC and NYC city government began pursuing a range of 'speculative' entrepreneurial practices to attract inward investment (section 2.2.5), e.g. through private-public partnerships for real estate development (DiGaetano 1997; Griffiths et al. 1999; Brash 2011). The point here is that at the start of the study period in 1996/7, a desire for greater economic and population growth was at the centre of local politics in Bristol and NYC, with municipal governments looking for innovative ways to ensure the upward trajectory of urban renewal would continue.

4.4.2 Experimentation in the context of sustainability entrepreneurialism

Existing literature has pointed to the co-existence of entrepreneurial growth and sustainability agendas in Bristol and NYC.

The Bristol case: alternative networked entrepreneurialism?

Bristol is known as one of the UK's 'greenest' and 'smartest' cities because of its environmentally-minded population, municipal policies and active civil society, awarded as the European Green Capital of 2015 by the European Commission and the UK's leading city within Huawei's 2016 Smart Cities Index (BCC 2016a). BCC had invested considerably in digital innovation (Cosgrave et al. 2014), with 'smart city' agendas merging with sustainability agendas in the early 2000s (Burton et al. 2019), evolving public-private digital infrastructure investments (Brown 2014; Taylor Buck and While 2017).

Bristol was one of the first UK cities to become involved in the Local Agenda 21 process (Brownlee 2011). Since the 1970s, the city has had a high density of sustainability-oriented grassroots initiatives and civil society organisations focused on sustainable energy and mobility, that influenced the development of municipal sustainability policies (Brownlee 2011; Torrens et al. 2018). Torrens et al.'s (2018) study of Bristol's energy system found that whereas early experimentation was primarily led by civil society, from the late 1990s BCC took a more active role in leading experimentation processes. Existing research points to the influence of new tri-sector governance networks (including BCC, civil society and the private sector) from the early 2000s, which morphed into the Bristol Green Capital Partnership as a formal network organisation (Brownlee 2011; Ersoy and Larner 2019; Ersoy and Hall 2020) that by 2017 had over 700 member organisations (Bristol 2015 Ltd 2015c) - probably making it one of the largest of its kind in the UK. When BCC and the Partnership won the European Green Capital award, Bristol's first elected Mayor George Ferguson oversaw 2015 as a year of cultural programming that mobilised the city 'as spectacle' (Harper 2016; Ersoy and Larner 2019). Ferguson's vision for Bristol was more explicitly entrepreneurial and focused on experimentation, evoking the city as a 'laboratory' (R. Booth and Morris 2013; Byrne 2014a; Byrne 2014b; Wainwright 2013). In summary, existing narratives about sustainability transitions in Bristol have centred on civil society and network governance, and only in the 2010s come to focus on the role of government, including BCC and the Bristol Mayor as a political leader.

Scholars have linked BCC's sustainability agenda with entrepreneurialism. Torrens et al. (2018) argue that from the late 1990s, BCC adopted an entrepreneurial practice of 'leveraging' the city's wealth of civil society experimentation to position itself as a national and international sustainability leader and compete with other cities for investment. With this, they appear to critique BCC of neoliberal 'policy boosterism' (citing McCann 2013). Others have argued that the Bristol Green Capital Partnership and European Green Capital year have presented opportunities for genuinely progressive change (Pancost 2016; Ersoy and Hall 2020). Ersoy and Larner (2019) argue that urban entrepreneurialism should be reinterpreted as being about more than socially-exclusionary growth politics,

because Bristol illustrates the possibility of ideologically-alternative entrepreneurialism coproduced between multiple actors in context-specific ways.

Municipal government did undertake some mobility experiments prior to 1996: Avon County Council and BCC experimented with novel cycling infrastructure (section 4.3.4), busmobility (e.g. 'Park and Ride' services; Mathers 1999), and pedestrianisation of public spaces in the city centre, e.g. Queen Square (BCC 2001b). Thus experimentation was not an entirely new governing mechanism at the start of the study period, but became more predominately adopted in the immediate aftermath of BCC's establishment in 1996.

The NYC case: PlaNYC and 'tactical urbanism' as global exemplars

As mentioned in chapter 1, there are ubiquitous narratives about the NYC case within urbanist media, and as put in circulation by the political memoir-manifestos of Janette Sadik-Khan (Sadik-Khan and Solomonow 2016), former Mayor Michael Bloomberg (Bloomberg and Pope 2017) and former Deputy Mayor Dan Doctoroff (2017). These narratives dominate existing understanding of NYC mobility experimentation, as there is little academic research: Luberoff's (2016) in-depth case study and Level's (2019) PhD thesis are valuable exceptions, albeit primarily empirical works.

NYC city government did experiment prior to the mid-1990s: for example, with pedestrianisation in the 1960s (MCNY 2011) and segregated cycle lanes and bus priority lanes in the 1980s (Schwartz and Rosen 2015). Yet it was in the mid-2000s that experimentation was adopted as the preferred mechanism for governing urban mobility, and NYC became known as a 'green' city. NYC city government during the Bloomberg administration is associated with two globally-circulating exemplars: PlaNYC, a long-term policy strategy focused on sustainable infrastructure (ICLEI 2010), and 'tactical urbanism' to reconfigure street space (chapter 1). Prior to the publication of PlaNYC in 2007, NYC was seen as a laggard on sustainability policies compared to other US cities (Angotti 2008). Bloomberg as NYC Mayor in many ways exemplifies the theoretical debate on sustainability-oriented entrepreneurialism (section 2.2.5): critiqued as a proponent of speculative entrepreneurial practices during his first term, assisted by Doctoroff in

developing regeneration mega-projects, rezoning the city to worsen inequality and housing affordability, and adopting a private sector management ethos (Brash 2011; Mattern 2016). Doctoroff later came to see sustainable infrastructure and 'liveability' as the key to NYC's competitiveness, and sustainability and entrepreneurialism agendas merged with PlaNYC (chapter 6).

The Bloomberg administration emphasised 'data-driven' policy-making. Correa d'Almeida's (2018) edited book on NYC city government describes this as a shift towards a 'smarter' municipal bureaucracy providing public services more efficiently. Miao (2019) cites this as a case-in-point of the urban 'intrapreneurialism' concept proposed by Phelps and Miao (2019). Existing narratives argue that Bloomberg's data-driven governing approach supported NYC DOT's capacity to pursue transformative mobility experimentation and provided political backing for Sadik-Khan as DOT Commissioner, because the Mayor was more interested in quantitative evidence than short-term negative PR (Sadik-Khan and Solomonow 2016; Luberoff 2016). Indeed, existing narratives very much emphasise the leadership of these two individuals (Schwartz and Rosen 2015). Crucially for this research, the quick-build experimentation approach has been emphasised as low-cost (Sadik-Khan and Solomonow 2016; Luberoff 2016): the narrative has been that 'funding was not an issue'. The role of CSOs like Transportation Alternatives and Project for Public Spaces (section 4.3.4) in contributing to transformative mobility experimentation is only acknowledged in academic research (Luberoff 2016; Levels 2019). Overall, the NYC narrative is one of municipally-led experimentation.

5 GOVERNING THROUGH EXPERIMENTATION IN BRISTOL

This chapter presents findings regarding urban mobility experimentation undertaken in Bristol between 1996 and 2016 (N=47, Table 3.2).

With reference to the causal-analytical framework relating Context, Mechanism and Outcomes (Figure 3.1), section 5.1 describes Context and Mechanism and section 5.2 describes Outcomes. Section 5.1.1, 5.1.2 and 5.1.3 present a periodisation of municipal institutions and resources (RQ1.2) and governance modes (RQ1.3) between 1996 and 2016, and describes the predominant scope of experimentation undertaken during each period. Section 5.1.4 then analyses municipal resources in greater quantitative detail, including the proportion of experiments funded from different sources.

Section 5.2.1 describes the degree to which Bristol experiments resulted in embedding (stabilisation, circulation, scaling up and institutionalisation) and experiments became linked in longer-term trajectories; section 5.2.2 provides a summary of transformative impacts (city-wide spatial expansion, significant new policy or governance institutions, change in mobility flows) generated by these trajectories. The following sections then relate Outcomes and Context, by describing these transformative impacts and *explaining* what Context factors enabled and constrained impacts, discussing busmobility (section 5.2.3), velomobility (5.2.4), public space (5.2.5) and automobiliy (5.2.6) in turn.

Section 5.3 provides a summary of findings for RQ1.1, RQ1.2 and RQ1.3 for the Bristol case, and how different Context factors influenced BCC capacity for transformative experimentation.

All experiments are listed in Appendix A. Detailed narratives for the experiments chosen for in-depth study are provided in Appendix B. Interviews are cited in this chapter as B01, B02, etc. corresponding with the list of interviewees in Appendix D.

5.1 Context and Mechanism

This section describes the evolution of Bristol City Council (BCC) institutions and resources (RQ1.2) and governance institutions (RQ1.3) through a chronological narrative of three periods: 1996-2006, 2007-2011, and 2012-2016. Figure 5.1 depicts the evolution of BCC's approach to experimentation between 1996 and 2016 (with reference to Figure 2.3). Figure 5.1 captures variation in *organisational forms* and the *scope of experimentation* as two municipal institutions. The scope of experimentation in Bristol was predominately determined by external priorities throughout most of the case study period. The first decade (1996-2006) was characterised by a Type 3 approach, with BCC effectively pursuing EU and UK government priorities through a *systemic* approach with permanent organisations. From 2007 to 2011, there was a shift to Type 1 experimentation along these priorities through a more *piecemeal* approach, reliant on temporary organisations. From 2012 to 2016, experimentation remained piecemeal, but shifted to Type 2, as BCC asserted its own vision for urban mobility more strongly.

Table 5.1 provides an overview of how *governance modes* evolved in Bristol, from the governance modes pre-existing in 1996, to the modes characterising experimentation between 1996 and 2016. Comparing these two columns in Table 5.1 shows that there was a *diversification* of governance modes: experiments often necessitated new types of partnerships to test novel configurations. The most notable change was expanded *co-provision*, through BCC contracting-out service delivery or experiment partnerships with private bus operators. Another notable trend was BCC *governing by enabling* through seed-funding civil society-led experiments. Yet Table 5.1 shows that experiments were also undertaken by BCC alone and did not necessarily involve partnership, with persistent governing of car use *by authority*, and to a lesser extent, *governing by provision*.
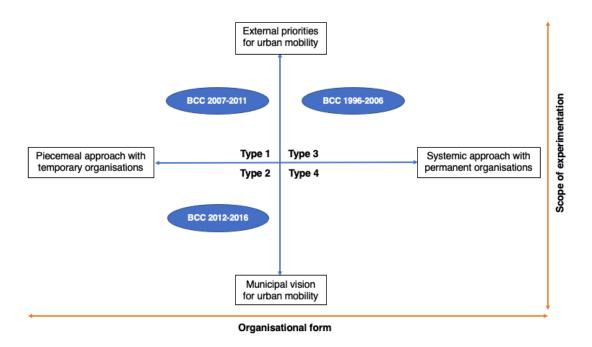
Figure 5.1. BCC's approach to experimentation between 1996 and 2016.

Table 5.1. Diversification of governance modes in Bristol.

Type of mobility	Governance modes		
	Pre-existing (1996)	Experimentation between 1996-2016	
		Dominant mode	Other modes
Busmobility	Provision (Limited) Co-provision with private bus operators	Expanded co-provision with private bus operators	Provision
Velomobility	Provision Co-provision with Sustrans	Expanded co-provision with civil society and private sector	Enabling civil society experiments
Public space	Provision	Provision Co-provision with civil society and private sector	Enabling civil society experiments
Automobility	Authority Provision	Authority	Co-provision Enabling Self-governing - all through public-private partnership
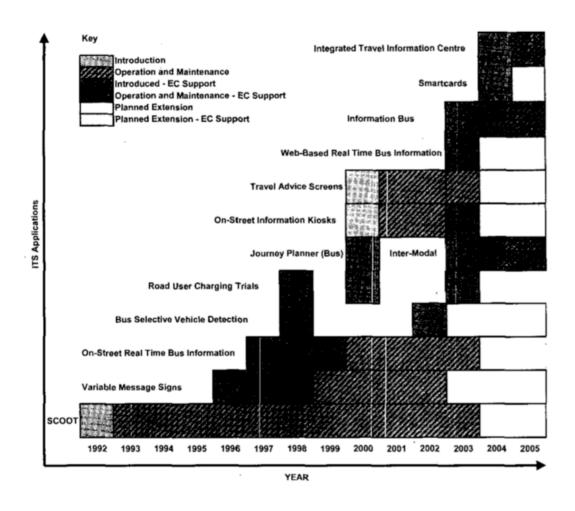
5.1.1 1996-2006: Bristol as a European 'transport laboratory'

Most experiments that were 'seeds' of longer-term transformative impacts can be traced to the period between 1996 and 2006. Experimentation was of **Type 3**: the scope of experimentation was predominately determined by the priorities of external funders, but BCC's approach was effective and systemic in relying on permanent organisations.

Following its establishment in 1996, BCC had the opportunity to develop more ambitious mobility policy, than that of Avon County Council. To attract funding, BCC launched an entrepreneurial agenda of profiling Bristol as a 'laboratory' for sustainable mobility (D'Arcy and Davis 2004, p.266). The Local Agenda 21-influenced *Community Strategy* envisioned Bristol as a 'green capital in Europe' (Bristol Partnership 2003). By the early 2000s, sustainability and entrepreneurialism agendas merged, as described by a former BCC employee:

> "sustainability in Bristol [since the 1960s]… used to be more about people wanting to… slow down or downsize… I think the thing that probably changed the most … is that the leadership and the vision for the city started to recognise that sustainability was also about economic opportunity… creating a city with a high quality of life that could secure and attract investment, so it became a much more strategic issue" (B26).

EU funding was central to **municipal resources** for mobility experimentation (B23; B21; BCC 2000). Securing a *continuous* series of competitive EU grants gave BCC "an opportunity to try innovative things that you wouldn't routinely fund or wouldn't routinely be priorities for funding in a time of scarce resources" (B23). D'Arcy and Davis (2004, p.265) present a chart of EU-funded experiments (Figure 5.2) and conclude that "it is clear… that Bristol could not have advanced to this level of experimentation, demonstration… without this… exposure to [European] best practice".

Figure 5.2. European Commission (EC) funded experimentation with 'Intelligent Transport Systems' in Bristol (D'Arcy and Davis 2004, p.266). Image reproduced with permission of the rights holder, IET.

Experimentation was **organised** in a series of EU Framework Programme-funded projects.[48] In 1999-2000, a decision was made to create a new European Transport team within the BCC Transport department, to apply for and implement EU projects (D'Arcy and Davis 2004). Interviewees pointed to this as institutionalisation of experimentation by giving a special unit responsibilities for innovation (B23). Projects as temporary organisations were thus nested within a permanent organisation, and the capacity built within the European Transport team (B21) resulted in a *systemic* approach. Despite prescriptive EU funding requirements, the European Transport team developed

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[48] CONCERT-ELGAR, CENTAUR, INTERCEPT, PROGRESS, VIVALDI.

evaluation processes that combined insights across projects and were separate from reporting to external funders (BCC 2000; D'Arcy and Davis 2004; B01; B23). BCC also enhanced its evaluation capacity through a partnership with the University of the West of England, Bristol (hereafter UWE): the UWE Centre for Transport and Society was established in 2002, partly motivated by BCCs need for local partners providing independent evaluation of EU projects (B14). The EU VIVALDI project was the first featuring UWE evaluation (CTS 2005), and the BCC-UWE partnership endured up to 2016 and beyond.

The New Labour government's 1998 national transport policy (DETR 1998) advocated for road user charging, public transport (particularly light rail), walking and cycling in urban areas (Vigar and Stead 2003; DETR 2000). As described in section 4.1.2, multi-scalar governance was restructured in 2000, with municipalities required to produce Local Transport Plans (LTP), against which national government awarded 5-year Integrated Transport Block allocations or 'settlements'. Capital funding from national government for local transport schemes increased substantially (Davison and Knowles 2006), strengthening **municipal resources**: BCC's first LTP funding settlement for 2000-2001 nearly doubled 'historic settlement levels' (BCC 2000) and subsequent settlements until 2006 were even greater.

At the core of BCC's (2000) first LTP for 2001-2006 was a planned Light Rapid Transit network, road user charging scheme, with additional priority given to improving bus services and increasing cycling levels – all in line with national policy. Several novelties that the LTP was seeking to introduce were integrated into a successful funding application to the EC CIVITAS funding programme for 'demonstrations' of sustainable mobility policies: BCC led a consortium implementing the CIVITAS VIVALDI project from 2002 and 2006, which providing **resources** to undertake 8 different experiments (B24). The fact that LTP priorities were successfully integrated within this externally-funded project illustrates the capacity of the BCC European Transport team to pursue experimentation in line with municipal visions, facilitated also by the broader scope of eligible activities under CIVITAS compared to the Framework Programmes (B23). Overall, however, the **scope of experimentation** was strongly shaped by EU and UK

government priorities - **hence Type 3**. The emphasis of EU funding programmes was technological, focused on 'Intelligent Transport Systems' as reflected in Figure 5.2 (D'Arcy and Davis 2004; DfT 2004), GPS technologies and alternative fuels (EC 1995).

The pre-existing modes for governing **busmobility** were BCC **provision** of priority bus lanes, and **co-provision** of Park & Ride services through public-private partnership; BCC also established a voluntary partnership with dominant local operator First Bus in 1998 (BCC 2000; Mathers 1999). Yet co-provision was limited, as BCC struggled to bring private operators on board with bus service innovation (B15; B13; D'Arcy and Davis 2004). BCC initially used the Park & Ride services as a testbed to experiment with novel configurations, since it had more control over these compared to privately-operated services (D'Arcy and Davis 2004). Experiments with battery-electric, LPG and CNG and hybrid electric bus vehicles were driven by external funders' priorities. EU funding enabled BCC to experiment with technologies like bus priority at traffic signals, real-time information displays at bus stops, camera-based enforcement of bus lanes, online journey planning tools, and smartcard ticketing (Figure 5.2).[49] The 2000 Local Transport Act granted UK local authorities powers to pursue new voluntary Bus Quality Partnerships with private operators; in response, BCC expanded its ambition for **co-provision**. The LTP had planned to test a 'Showcase' bus route in partnership with First Bus, involving a comprehensive package of improvements. BCC managed to resource an experiment through the EU VIVALDI project: testing the Showcase configuration integrating bus priority and information technologies tested in earlier experiments, and a new type of partnership agreement between BCC and First Bus (VIVALDI 2005).

The 'West of England Partnership' was established in 2003 as a voluntary structure for joint transport policy-making among BCC and the other West of England authorities. Experimentation was largely undertaken by BCC without partnering with other authorities. However, by summer 2005 BCC had gotten the other West of England

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[49] This aligned with New Labour's focus on local authority responsibilities for coordinating information provision for bus passengers and 'integrated ticketing' that would be interoperable across privately-operated bus services (DETR 2000).

authorities to commit to upscaling the Showcase bus configuration within the city-region (VIVALDI 2006; West of England Partnership 2006a).

In 1996, BCC governed **velomobility** through **provision** of cycling infrastructure and **co-provision** through infrastructure built by Sustrans (CSO introduced in section 4.3.4). BCC's (2000) LTP included an infrastructural vision for a Strategic Cycle Network,[50] but experimentation focused on 'soft' interventions to encourage cycling, influenced by the UK government's 'Smarter Choices' philosophy that focused on promoting individual behaviour change (Golbuff and Aldred 2011; Cairns et al. 2004). To test these novelties, BCC expanded partnership with CSOs and private sector consultancies, contracting them to deliver interventions (**co-provision**). One strand encouraged cycle commuting by engaging with major employers: BCC introduced workplace 'travel planning' in 1997-8, and set up a 'Bristol Green Commuter Club' network (Enoch et al. 2007; Anable et al. 2004). Another strand focused on 'personalised travel planning' (PTP), seeking to promote cycling through face-to-face engagement with individual residents. There were two PTP approaches dominating the national market: the TravelSmart approach delivered in partnership between Sustrans and private company Socialdata, and the approach by transport consultancy Steer Davies Gleave (Parker et al. 2007). The former was tested by BCC, Sustrans and Socialdata as a VIVALDI experiment; the latter was then tested in 2006. Experimentation with employer engagement and PTP would come to have transformative impacts in the longer-term.

Experimentation with car-sharing *predated* national policy. BCC was an 'early adopter' of car clubs within the UK context (Cairns et al. 2004; Barnes et al. 2015; Roberts 2016). In 1999, BCC seed-funded a resident-led association experimenting with Bristol's first car club. The club was relaunched in 2002 as Bristol City Car Club, through a VIVALDI experiment testing a new configuration, where private operator Smart Moves was awarded seed-funding by BCC. This laid the ground for development of a mature local car-sharing market by 2016. From having primarily governed automobility by **authority** and

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[50] The importance of Sustrans-provided infrastructure is evidenced by the Network map: Sustrans had built the Bristol-Bath Railway Path that formed a key route (section 4.3.4), and 'National Cycling Network' routes across the city-region.

provision prior to 1996, for these experiments BCC adopted an approach of governing by **enabling** civil society and private actors.

Home zones are traffic-calmed streets within residential neighbourhoods that are designed to be shared by all mobility modes, although with pedestrian priority. BCC had implemented such zones in the mid-1990s (Sherwin, Parkhurst, et al. 2006b), prior to UK government launching a Home Zone Challenge Fund to support their local introduction (DETR 1998; Biddulph 2003; DfT 2007). BCC's first LTP launched a home zone pilot programme funded through the Council's own resources, which tested home zones in Horfield and Henbury neighbourhoods; with UK/EU funding for further experiments in the Southville and the 'Dings' neighbourhoods. BCC had governed public space through **provision** prior to 1996, exemplified by experimental pedestrianisations of landmarks like Queen Square (BCC 2001b) and College Green (BCC 1991). To pursue its home zones agenda, BCC pivoted to **co-provision**, partnering with private housing developers and Sustrans. Both Southville and the Dings experiments involved retrofitting existing residential areas, which resulted in comparatively high costs (Biddulph 2010). This led a UWE evaluation of the Southville experiment to recommend that municipal investment in retrofit home zones was justified only for deprived areas,; in general, BCC was advised to focus on "encouraging high-quality HZ type investment by the private sector as part of the planning process" (Sherwin et al. 2006a, p.2B2.11). This illustrates the influence of external **evaluation processes** on BCC: UWE recommendations were followed, in that BCC undertook no further home zone experiments and shifted to steering private development.

EU and UK programmes provided funding for several real-life experiments with road charging schemes. However, additional experiments planned within VIVALDI were not implemented, and road user charging was never permanently introduced in Bristol. By 2006, both the proposed light rail network and road user charging had been politically defeated, as the cornerstones of BCC's and New Labour's vision (discussed in chapter 8).

5.1.2   2007-2011: Upscaling bus innovation and the UK's 'cycling city'

From 2007, there was a shift to **Type 1** experimentation, with BCC capacity weakening. The scope of experimentation was still dominated by external priorities, with a shift from EU influence to UK government influence; however, experimentation was more piecemeal with no BCC unit (permanent organisation) in charge of innovation.

After the VIVALDI project ended in 2006, EU influence on mobility experimentation waned, as BCC leadership decided to stop applying for EU-funded projects and disband the European Transport team (B21). This coincided with a shift to coordinated policy formulation within the West of England Partnership and major infrastructure, with a Joint Transport Plans replacing the BCC LTP as a **mobility vision**.[51] The first Joint Local Transport Plan for 2006-2011 contains very few mentions of planned experiments (West of England Partnership 2006a). Policy priorities shifted to scaling up busmobility innovations through national infrastructure investment, in the form of the Greater Bristol Bus Network (GBBN).

To upscale the Showcase configuration of bus service improvements tested in the previous period, BCC used the West of England Partnership as a banner of effective city-regional cooperation to secure £42.3 million in capital funding from the national Local Majors Transport fund (Atkins 2008). GBBN implementation started in 2008 and the complete network opened in March 2012. GBBN brought 10 bus routes within the city-region up to 'showcase standard' (Travelwest 2014a): scaling up configurations tested in early EU projects, including real-time information, traffic signal priority and camera-based bus lane enforcement. GBBN also reshaped busmobility **co-provision**. The 2008 Local Transport Act made it easier for local authorities to introduce 'Quality Partnership Schemes' (DfT 2013b): *statutory* partnerships with private bus operators, which legally require partners to deliver commitments specified in agreements. Quality Partnership Schemes (QPS) between the West of England authorities and First Bus were introduced

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[51] One interviewee commented that the VIVALDI project ended at a time of decreasing national funding, and that there was insufficient funding to retain all staff that had worked on the project (B23). Data on operational funding trends do not support this statement (Figure 5.5). It appears likely that policy priorities shifted from experimentation to city-regional infrastructure, supported by the fact that staff who had worked within the BCC European Transport Team moved over to form the West of England Partnership's transport team (B21).

for each GBBN route (Travelwest 2014a), marking a shift from *voluntary* partnerships. Bus priority and information technologies were institutionalised as contractual items within the GBBN QPS agreements, with BCC agreeing to provide these facilities in exchange for First Bus commitment to certain fares, punctuality, vehicle standards, etc.

Innovation in smartcard ticketing demonstrates that QPS were not a 'silver bullet' for getting private operators to cooperate, however. The QPS agreements also required bus operators to provide smartcard-compatible ticketing machines. However, despite BCC calling for First Bus to introduce this facility from 2008, the operator only did so in 2014 (BBC 2013a). Motivated by frustration with poor First Bus services to its campus, UWE developed its own ULink bus service in partnership with rival operator Wessex Connect, featuring experimental smartcard ticketing (B13). BCC took advantage of this by launching another smartcard trial through **co-provision** with Wessex Connect in 2009. The West of England Partnership then secured funding linked to the government's new Integrated Ticketing Strategy (DfT 2009), to develop this into a city-regional ticketing system eventually launched as the Travelwest Travel Card.

Experimentation, rather than upscaling, focused on **velomobility**. Bristol was awarded the title of England's first 'Cycling City', as a result of a grant award by Cycling England (2010), an independent body funded by DfT. Cycling England established six 'Cycling Demonstration Towns', with an explicit focus on harvesting 'what works' lessons from local experiments about cycling promotion. The 'Greater Bristol' area - based on a joint bid by BCC and South Gloucestershire Council - was awarded funding under Phase II of this competitive funding programme. Match funding by the local authorities brought the Cycling City budget to £22.8 million: equivalent to £16 per capita per annum (BCC 2011b), which was a nationally unprecedented level of funding for local cycling interventions. The funding was to be spent over 2.5 years between 2008 and 2011, with Cycling City organised as a project with associated management practices (BCC 2008).

The award from Cycling England included both capital and operational funding, which allowed the Cycling City project to implement both 'hard' cycling infrastructure and 'soft' interventions aimed at behaviour change (BCC 2011b). Experimentation focused on 'soft'

interventions, which Sustrans was contracted to deliver (expanded **co-provision**), e.g. Bikeability cycle training for schoolchildren. The Cycling England funding was relatively flexible in scope, illustrated by BCC's ability to experiment with non-profit organisations, e.g. to test 'All Abilities' cycle training for disabled children, and establish a Community Grants Fund, that channelled over £100,000 of national funding to neighbourhood-level activities (BCC 2011b). This marked the emergence of BCC **governing by enabling** civil society through seed-funding, including for the Bristol Bike Project: a partnership between volunteers and Bristol Refugee Rights to develop an 'earn-a-bike' programme, training refugees to refurbish and maintain bikes.

BCC also used Cycling City funding for an experiment testing 20mph speed limit zones in two residential neighbourhoods (**governing by authority**). The experiment reflected a trend for 20mph limits across UK localities (ROSPA 2017) following national policy encouraging their introduction (DETR 2000). The zones were later made permanent and the Council voted for city-wide expansion of 20mph speed limits. The 20mph experiment is a rare example of BCC leveraging in-house capacity to internally design and undertake an **evaluation process** (BCC 2012a). Overall, the evaluation process for the Cycling City project was almost entirely shaped externally by Cycling England: the parameters were set on harvesting quantitative data on 'what works' in terms of cycling mode shift, with the entire national Cycling City and Towns funding programme evaluated by UWE and Sustrans (Cope et al. 2017). In contrast, BCC conducted its own 'not great' internal evaluation of Cycling City interventions (B03; BCC2011b).

The **scope of experimentation** within the Cycling City project reflected the continued influence of the national 'Smarter Choices' agenda. Steer Davies Gleave was contracted to deliver personalised travel planning (expanded **co-provision**), scaling up the company's approach to further residential areas. Engagement with large employers to promote cycle commuting was also scaled up. The workplace travel planning approach established during the previous period was developed into an experiment with a new configuration – with a larger 'menu' of support available to employers, such as recruitment of individual employees to act as Workplace Cycling Champions (BCC 2011b). As Cycling City was a joint project between BCC and South Gloucestershire Council, engagement extended

employers located beyond BCC boundaries, in the 'edge city' of the North Fringe (section 4.3.3). While most of the Cycling City budget was spent on cycling infrastructure rather than 'soft' interventions (Melia 2013), the cost-effectiveness of the project in delivering infrastructure has been critiqued by local commentators (Lake 2015; Peace 2009b). The key point here is that the **scope of experimentation** featured limited infrastructural *innovation*. New infrastructure was limited to cycle lanes painted on pavements, off-street paths along green spaces, and signage (B02; B05). There was no experimentation with novel configurations, e.g. on-street protected cycle lanes. Although Cycling England funding was relatively flexible and there was no *direct imposition* of national priorities, experimentation nevertheless reflected the 'Smarter Choices' agenda.

The Cycling City project ended in 2011. This high-profile investment in Bristol was undermined by the challenges posed by short-term funding. The overall approach was **piecemeal:** the components of the project were put together in great haste and had to be delivered within a short time-frame, with the Cycling England board micro-managing project delivery in Bristol (B02; Peace 2009a). The Cycling City project reinforced BCC's tendency for contracting-out to non-state actors (**co-provision**). When assembling the project team over a short time frame, BCC relied on Sustrans to hire short-term staff for the community-oriented and employer-oriented engagement aspects – this meant that many fixed-term staff were let go after the project funding expired (B02).

5.1.3   2012-2016: Green Capital in the midst of national austerity

2012 marked a shift to **Type 2 experimentation,** primarily determined by municipal rather than external priorities. This period saw contradictory trends: as austerity politics was weakening **municipal resources**, Bristol's newly-elected Mayor and status as the European Green Capital of 2015 asserted a new **municipal vision**. However, BCC's approach continued to be piecemeal: there were many different streams of activity that were not tied together, with continued reliance on temporary organisations.

A Coalition government between the Conservative Party and Liberal Democrats set in motion a significant restructuring of the UK state in 2010. The government chose to deal

with the impact of the Great Recession by launching a severe austerity programme, including drastic cuts in operational funding to local authorities (Revenue Support Grant) and capital funding for mobility (Integrated Transport Block). These cuts only began to seriously affect **BCC's resources** for mobility experimentation from 2016 (next section). However, the squeeze on BCC's operational expenditure still constrained municipal capacity, as described below. The Coalition government shifted the national transport policy focus to local economic growth and 'carbon control' (DfT 2011a), emphasising walking and cycling for short local journeys, and decarbonisation through electrification of the vehicle fleet. The government abolished Cycling England and all existing competitive funding programmes run by DfT (Butcher 2010a; 2010b), and replaced them with a new competitive programme called the Local Sustainable Transport Fund (LSTF).

The West of England Partnership's (2011) *Joint Local Transport Plan 2011-2026* was brief compared to previous LTPs, citing austerity cuts as a dampener on ambitions.[52] Things turned around, however, as BCC secured £18.25 million in LSTF capital and operational grants between 2011 and 2016. The funding was competitive and awarded in several rounds, so there was no funding certainty,[53] but nevertheless this provided six years of continuous external funding for experimentation and upscaling. Since the city-regional **mobility vision** was not comprehensive, BCC priorities were reflected in LSTF-funded activities, organised in a *programme* with four themes, each with nested projects (Bartle et al. 2016). While BCC's LSTF programme was framed around national objectives of economic growth and decarbonisation, in practice it included many of BCC's pre-existing priorities that were 'repackaged' to fit these objectives. Implementation 'on the ground' was divorced from the high-level LSTF objectives (B01), revolving around management

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[52] In 2011, the Partnership was replaced by a West of England Local Enterprise Partnership (LEP) required by national government, but I found no experiments associated with the LEP.

[53] BCC received £5 million for Key Commuter routes in 2011-12 (DfT 2012a), the West of England authorities were later awarded a combined grant worth £24 million of which the BCC share was £9.25 million (BCC 2015a); BCC was awarded a £4 million operational grant for sustaining activities in 2015-16 (DfT 2014b); and another £2.2 million from the Sustainable Travel Transition Year Fund (DfT 2016b) to extend LSTF activities beyond 2016.

objectives linked to delivering the individual project-based interventions (Bartle et al. 2016).

LSTF funding enabled BCC to expand support for car-sharing, scale up bus service innovations, and Cycling City experiments with children's cycle training and cycling promotion through engagement with major employers - all through **continued co-provision**. The LSTF programme featured the same partnership and organisational model as Cycling City, with a large pool of fixed-term staff and contracting out,[54] as an endogenous strategy to cope with austerity (B03). The **evaluation process** for the LSTF programme was once again determined and organised externally: to strengthen their funding application by demonstrating a rigorous evaluation approach, the West of England authorities contracted UWE (B03) to evaluate the programme (B01; Bartle et al. 2016) based on a nationally stipulated framework (Hiblin et al. 2016).

The Coalition government committed to decentralising power to local authorities and sought to trigger referenda on the introduction of directly-elected mayors in large cities (DCLG 2011). Bristol was the only city to vote yes in such a referendum in 2012, and subsequently the city's first elected Mayor, George Ferguson, assumed office that year. Ferguson is an architect, who had been involved in Bristol's environmental activism since the 1960s and co-founded Sustrans (Brownlee 2011). As Mayor, Ferguson was publicly critical of how automobility dominated in Bristol and expressed support for cycling and car-free streets (Booth and Morris 2013; Byrne 2014a; Byrne 2014b; Wainwright 2013). Ferguson explicitly evoked Bristol as a 'laboratory' and 'testbed' (*ibid.*), discursively embracing experimentation as a preferred governing mechanism. As shown in chapter 1, the Mayoral *Vision for Bristol* (BCC 2013b) propose 'open streets' interventions mimicking NYC; it also repeatedly emphasises 'innovation' as a policy philosophy, as does BCC's (2015c) *Cycle Strategy* bearing Ferguson's mark. The impact of the Mayor's 'open streets' agenda was limited to a 2014 experiment called 'Make Sunday Special', testing a series of temporary pedestrianisations of Bristol's Old City streets for one Sunday a month

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[54] Sustrans delivered community engagement activities such as school-focused programmes and the Active Neighbourhoods Fund (B17), while Steer Davies Gleave delivered the employer engagement component and personalised travel planning (Steer n.d.).

between June and October: this was cancelled in 2017. Ferguson had a more significant influence in championing the city-wide upscaling of 20mph zones and new restrictions on car parking in the form of Resident Parking Zones (RPZ).

Ferguson actively supported Bristol's 'green capital' agenda, which by 2007 had formalised as a Bristol Green Capital Partnership (BGCP) organisation with public, private and civil society members, with an explicit mission of winning the European Commission's European Green Capital award (Brownlee 2011). Membership of BGCP grew quickly to over 200 organisations in 2013 (Bristol 2015 Ltd 2015c). In May 2013, Bristol was announced as the European Green Capital of 2015. Under Ferguson, **sustainability entrepreneurialism** and the Green Capital award took on a new explicit focus on Bristol as a sustainability exemplar and global 'green' economic competitiveness (BCC 2013b; BBC 2013b). BCC established Bristol 2015 Ltd as a separate company to manage the Green Capital year, with three objectives: 1) demonstrate leadership through exchange of sustainability expertise between cities (BGCP n.d.; KPMG 2016), 2) building a "global profile to support appropriate exports, inwards investment, tourism and economic growth", and 3) empowering communities (Bundred 2016, p.8).

My overall finding regarding Bristol's European Green Capital year was that it was not particularly significant for mobility experimentation. Perhaps foremost, Bristol Green Capital was about 'the city as spectacle' (Harper 2016): was packed with sustainability-infused cultural programming (Ersoy and Larner 2019; Bristol 2015 Ltd 2016a). The influence that the Green Capital year *did* have resulted from Bristol 2015 Ltd securing a £7 million exceptional grant from the UK Department for Energy and Climate Change (HM Treasury 2014). This included funding for catalysing 'grassroots' action, to meet the Green Capital year's third objective on local empowerment. BCC again diverted national funding to support civil society initiatives, including a competitive Strategic Grants Fund that awarded £2 million to larger non-profit organisations (BCC 2014d). BCC (2015a) used the same approach for the LSTF programme, setting up an Active Neighbourhoods Fund allocating 42 grants totalling £758,000. Combined, these grant funds represented an expanded agenda of **governing by enabling** civil society. Grants were awarded with full discretion by BCC to a broad range of grassroots initiatives rooted in Bristol's social

economy, including play streets, community-designed 'parklets' and cycle parking for social housing estates. Thus neither the Mayor's 'green growth' entrepreneurialism nor the Coalition government's growth agenda filtered down to mobility experimentation.

Finally, BCC experimented with electric vehicle (EV) charging networks, in alignment with national priorities.[55] EV policy was managed by 'Bristol Futures', an innovation-focused BCC department established in 2010 to institutionalise past experimentation with digital inclusion (B29; B26). Bristol Futures spearheaded BCC's well-known 'smart city' agenda (section 4.4.2), but in practice, this did not have significant tangible impact on Bristol's mobility system by 2016.[56] The impact of Bristol Futures was limited to EV experimentation. As a permanent organisation, it had the capacity to pursue a systematic approach, managing new forms of **co-provision** through public-private partnership. Bristol Futures first tested publicly-accessible charging points drawing on private Section 106 contributions, and then blended external grants to launch a city-regional EV charging network named Source West, including LSTF funding for physical infrastructure, and an EU-funded project called ICT4EVEU that developed the network software (Spalding 2015; Barnes et al. 2015).

By 2016, BCC had incrementally transformed busmobility and velomobility by expanding many trajectories of experimentation launched in the late 1990s and early 2000s, enabled a wide range of civil society experiments and kickstarted infrastructure supporting EV consumer uptake. However, post-2016, austerity continued to dismantle BCC capacity, with major cuts to mobility expenditure and restructuring of the BCC Transport team through voluntary severance (BCC 2017a).

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[55] The previous government had begun promoting consumer uptake of electric vehicles (hybrid electric, plug-in, battery electric) following the 2008 Climate Change Act, establishing the Office for Low Emission Vehicles in 2009.

[56] Despite 'smart mobility' being included as a focus area within BCC strategies (Advancing Sustainability LLP 2011), there were no experiments linked to this. Beyond 2016, Bristol Futures was restructured as the BCC City Innovation team, which began to lead mobility experimentation with electric, shared and/or autonomous vehicles.

5.1.4 Evolution of municipal resources

BCC was selected as a case because of its low fiscal autonomy and a high degree of reliance on intergovernmental transfers (referred to as 'external funding' here). Table 5.2 confirms this: the majority of experiments (77%) were funded primarily through external grants, whereas approximately one-quarter were funded through resources that BCC had discretion over.[57] Non-state contributions refers to ad-hoc philanthropic or private sector contributions to experiments for which national and/or EU funding had already been secured. For at least 43% of experiments (excluding the category with non-state contributions), EU grants were part of the funding mix, which reflects EU influence on mobility experimentation between 1996 and 2006.

Table 5.2. Funding sources for Bristol experiments.

	National grants	EU grants	National + EU grants	National and/or EU grants with non-state contributions	Discretionary municipal resources
Total number of experiments	10	14	6	6	11
Total as proportion of N=47	21 %	30 %	13 %	13 %	23 %

Table 5.3. Capital funding for mobility expenditures in Bristol and the city-region. Data source: author's calculation, average of annual capital budgets for 2001/2-2004/5, figures from BCC (2002; 2004); 2006/7-2010/11 figures from Travelwest (2011a); author's calculation,average of annual capital budgets for 2011/12 (Travelwest 2012), 2013/14 (Travelwest 2013a) and 2014/15 (Travelwest 2015).

Funding source for capital expenditure	BCC Local Transport Plan 2001/2-2004/5	West of England Joint Local Transport Plan 2006/7-2010/11	West of England Joint Local Transport Plan 2011/12, 2013-14, 2014/15*
All DfT grants	80 %	84 %	66 %
BCC resources	16 %	12 %	13 %
Other grants	4 %	4 %	21 %

* 2012/2013 excluded as data with relevant breakdown was not available.

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[57] All externally-funded experiments involved BCC match-funding. The 'discretionary municipal resources' category thus refers to experiments where no competitive grant funding was involved, only funds over which BCC exercises discretion (including from the 'Integrated Transport Block' allocated by national government, Table 4.1).

As shown in Table 5.3, data on BCC's capital expenditure on mobility confirms the reliance on external funding, with external grants accounting for over 80% of local capital spending across different time periods.[58] The 'other grants' figure for 2001/2-2004/5 represents EU funding: the small overall proportion of this funding source (4%) for capital expenditures highlights how EU funding was important for experimentation as a specific activity. Reliance on UK government funding did not necessarily decrease between 2011-2015: the 'other grants' figure for 2006/7-2014/15 includes all non-central government grants as well as private sector contributions, with the larger share (21%) between 2011/12 and 2015/15 reflecting greater private contributions through Section 106 agreements, likely linked to investment in GBBN and Metrobus.
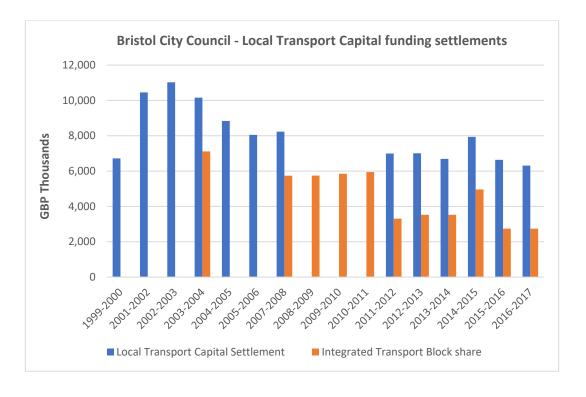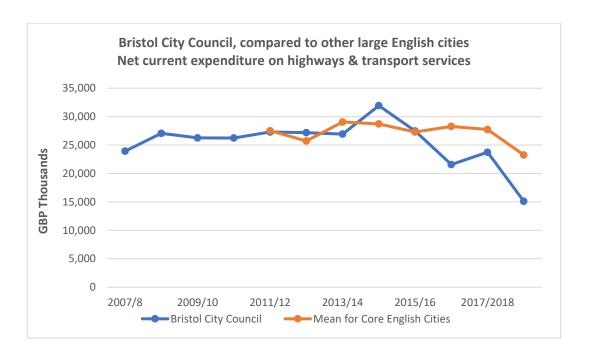
Figure 5.3. Capital funding for mobility awarded to BCC by UK central government. Data source: compiled by author, 1999-2000 to 2005-2006 figures from BCC (2000; 2001a; 2002; 2003a; 2005), 2007-

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[58] In Table 5.3, the 'BCC resources' category refers to municipal own-source revenues, i.e. excluding all types of intergovernmental grant transfers (whereas municipal resources in Table 5.2 includes Integrated Transport Block expenditure as a national government transfer). Table 5.3 figures for 2001/2-2004/5 are for the Bristol mobility system as delineated by BCC boundaries. From 2006/7 onwards the figures are for spending by all the West of England local authorities, i.e. for the wider city-region, as data for expenditure within Bristol boundaries was not available.

BCC's general availability of resources decreased from the early 2000s to 2016. BCC's key source of discretionary municipal resources for mobility experiments is the Integrated Transport Block (section 4.1), which is tied to capital funding settlements between central and local government as part of the Local Transport Plan process. Figure 5.3 shows how BCC's annual capital settlement reduced by 40% between 2001-2 and 2016-17, with the 2016-17 Integrated Transport Block allocation reduced by 61% compared to the 2003-2004 allocation.[59] The higher levels of funding between 2001-2002 and 2010-2011 reflect the Local Transport Plan process and Integrated Transport Block as the cornerstones of New Labour's transport policy.[60] Discretionary municipal resources were thus at their greatest level during Type 3 experimentation between 1996 and 2006, when BCC capacity was most effective. The reduced allocations from 2011-2012 reflect the Coalition government's cuts to the Integrated Transport Block.

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[59] In nominal terms, not taking into account inflation. The Local Transport Capital funding settlement includes a (highway) Maintenance block and Integrated Transport Block, with the latter representing the majority share. Where the column for the Integrated Transport Block share is not shown in Figure 5.3, data has not been available. Data for 2006-7 is missing from the figure, as it was not available.

[60] The settlement for 1999-2000 is lower than the following years, since the LTP reform had only just been launched.

Figure 5.4. BCC mobility expenditure from 2007 to 2018. Data source: Department for Communities and Local Government Revenue Summary Outturn, retrieved from Local Government Association (LGA 2020b).

Operational funding from central government (Revenue Support Grant) was also drastically cut. There was a 25% real-terms reduction in the spending power of local authorities in England between 2010-11 and 2015-16 (NAO 2014), and transport spending by local authorities declined significantly (Gray and Barford 2018). BCC dealt with austerity pressures primarily through efficiency savings and organisational restructuring (Bundred 2017; Meegan et al. 2014), but still cut spending on local services by 31% between 2009/10 and 2016/17 (Amin-Smith et al. 2016b).

As discussed, because BCC secured continuous competitive funding between 2011 and 2016, this cushioned the impact of funding cuts. As shown in Figure 5.4, austerity began to severely impact BCC operational expenditures on mobility only after the 2015/16 fiscal year, with a 45% reduction from 2015/16 to 2018/19.[61] This explains why austerity cuts were cited as a factor related to the embedding outcomes of experiments ending in 2016. Mismatch between capital and operational funding levels still posed problems for BCC

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[61] Author's calculation based on data presented in Figure 5.4.

between 2012 and 2016. There was a 27% reduction in BCC full-time permanent employees between 2012 and 2017.[62] Reduced operational funding contributed to an increased reliance on competitive UK government funding and short-term staff: from 2010, approximately half of 70 BCC Transport staff were funded through external sources (B21). BCC's LSTF programme illustrates the growing mismatch between capital and operational funding for UK local authorities from 2010 (Abrantes and Ellerton 2015), in undermining municipal capacity for transformative experimentation.

5.2   Outcomes

Having described Context and Mechanism, this section describes the Outcomes of experimentation in Bristol. This section answers RQ1.1 for the Bristol case: *To what extent and in what ways have experiments resulted in embedding and transformative impacts?*

5.2.1   Embedding and trajectories of experimentation

The degree to which configurations tested in experiments were embedded within Bristol's mobility system is summarised in Table 5.4. Out of 47 experiments, the outcomes of 3 experiments remained unknown.[63]

My findings demonstrate that through the embedding of novelties, experiments can change urban mobility systems in enduring ways, both materially and institutionally. Only 3 out of 47 experiments (6%) resulted in no embedding. *Stabilisation* refers to instances where a configuration is made permanent or extended in use at its original scope and scale, *circulation* refers to instances where specific elements circulated from an experiment to a subsequent experiment; *scaling up* refers to spatial expansion of a configuration in its entirety; and *institutionalisation* to formation of new, or change to existing, municipal institutions (Table 2.7). The majority of experimental configurations (53%) were subject

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[62] Author's calculation based on Q4 2012 and Q4 2017 data from LGA (2020c).

[63] No evidence could be found: all three experiments involved testing of alternative fuel buses within the CENTAUR project (1996-1999).

to *stabilisation.* Approximately one-third of all experiments resulted in circulation, scaling up and/or institutionalisation.

Table 5.4. Embedding outcomes from Bristol experiments.

	Stabilisation	Circulation	Scaling up	Institutionalisation	None	Unknown
Total no. of experiments w/ outcome	25	15	17	17	3	3
Proportion of N(=47) w/ outcome	53 %	32 %	36 %	36 %	6 %	6 %

A single experiment often resulted in multiple different outcomes. 17% of experiments resulted *only* in stabilisation, as the least significant type of embedding for generating longer-term transformative impact. 72% of experiments resulted in other combinations of embedding (e.g. stabilisation and scaling up, or no stabilisation but scaling up and institutionalisation). This means that the vast majority of experiments resulted in things tested being re-used in another experiment, expansion to a larger area, or an organisational or policy change within municipal government. My findings contrast with the narrative in existing literature that experiments remain 'isolated projects' with limited impact (picked up in chapter 9).

The data on outcomes shown in Table 5.4 is visualised in Figures 5.5, 5.6, 5.7 and 5.8 (following pages). Each Figure is divided in different *strands* of experimentation, shown at the left-hand side: for example, 'bus priority technologies' and 'information technologies'. Beyond the outcomes of individual experiments, the Figures show that for *some but not all strands,* experiments became 'linked' to one another over time through the process of embedding, forming *trajectories* of experimentation. These trajectories as 'chains of impact' emerged as an inductive finding, in investigating the 'history' of an experiment forwards and backwards in time. The way in which experiments and other experimental or non-experimental configurations[64] became 'linked' is visualised by arrows: these do not signify that one experiment was undertaken *because of* a preceding one, in the sense of linear

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[64] Non-experimental configuration in the Figures refer to configurations of non-tentative policy implementation.

causality, but instead illustrate the agency of municipal government in making specific decisions about embedding.[65] For example, in Figure 5.5, BCC reused the equipment tested for smartcard ticketing on the Park & Ride service (VIVALDI project) by integrating it into a configuration testing a different type of smartcard ticketing on Wessex Connect buses - an instance of *circulation.*

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[65] Examining the detailed chain of evidence in Appendix A will help clarify the meaning of the arrows and types of embedding shown.

Busmobility

Bus priority technologies

Stabilisation Institutionalisation

Selective Vehicle Detection (ELGAR) → Scaling up

Camera ANPR bus lane enforcement (VIVALDI) — Integrated

Stabilisation — Showcase Bus Route (VIVALDI) — Scaling up Institutionalisation

Circulation — Greater Bristol Bus Network

Information technologies

Stabilisation Institutionalisation

Park & Ride real-time information (ELGAR) → Circulation → City centre real-time information (CENTAUR) → Scaling up

Integrated into

Stabilisation Institutionalisation

Variable Messaging Signs promoting Park & Ride (ELGAR) → Scaling up

Online bus journey planner (INTERCEPT) → Circulation → Intermodal trip planner (VIVALDI) → Circulation → Travelwest Trip Planner

Stabilisation

Smart ticketing

Smartcard ticketing for Park & Ride (VIVALDI) — Circulation

ULink Smartcard (UWE/Wessex Bus)

Smartcard trial with Wessex Connect — Circulation — LSTF Travelwest Travel Card

Low-emission vehicles

Battery electric bus (CENTAUR)

Hybrid electric bus (VIVALDI)

Stabilisation — Geo-fenced hybrid bus

LPG bus (CENTAUR)

CNG bus (CENTAUR)

Experiment led by BCC

Experiment not involving BCC**

Linked non-experiment configuration

** Not included in N=47, but shown here as it was an important 'link' within a trajectory.

Time (1996-2016)

Figure 5.5. Outcomes of Bristol experimentation with busmobility.

Figure 5.6. Outcomes of Bristol experimentation with velomobility.

Public space

Home Zones

Stabilisation
Henbury Home Zone

Stabilisation
Southville Home Zone

Institutionalisation →

Stabilisation
Horfield Home Zone

Stabilisation
The Dings Home Zone

Temporary pedestrianisation

Stabilisation
Make Sunday Special

Scaling up →

Play streets

Playing Out 2010 trial

Circulation →

Playing Out TPSO trial

Scaling up Institutionalisation

Temporary Play Street Order

Community-led street redesign

Stabilisation
Street Pockets (Green Capital)

Circulation →

Community Corners

Time (1996-2016) →

Experiment led by BCC

Experiment involving, but not led by, BCC

Linked non-experiment configuration

Figure 5.7. Outcomes of Bristol experimentation with public space.

Figure 5.8. Outcomes of Bristol experimentation with automobility.
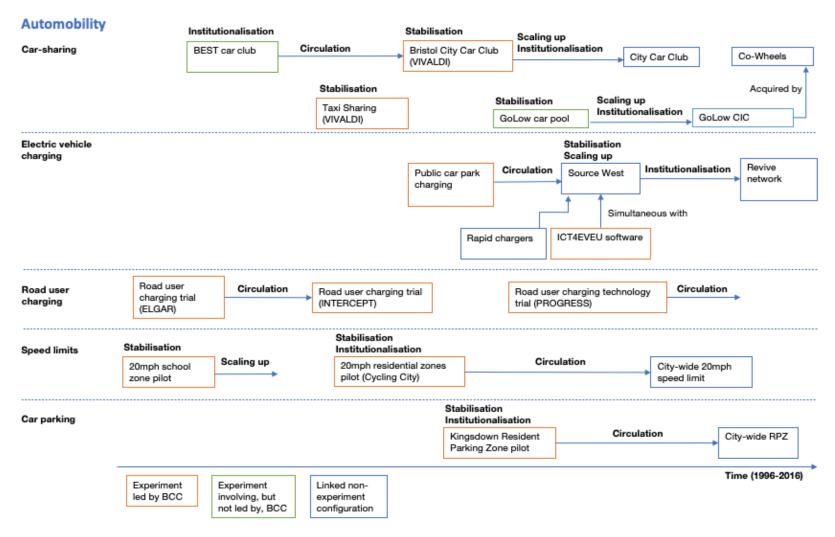
The Figures above show that in some instances, scaling up or institutionalisation occurred directly after a single experiment.[66] Table 5.5 below summarises the embedding patterns characterising the longer trajectories of experimentation. Across four types of mobility, a common pattern is observed, where trajectories involved a couple 'rounds' of experiments testing different elements or configurations (with some configurations *not* stabilised, initially), with circulation of elements and the assembly of these in a 'working' configuration that was judged appropriate to be institutionalised and scaled up.

Table 5.5. Patterns of embedding for Bristol experimentation.

Type of mobility	Predominant pattern of embedding
Busmobility	*Bus information and priority technologies*: testing and **circulation** of elements later assembled in 'working' configuration (Showcase bus service) that was **institutionalised** (Bus Quality Partnership Scheme) and **scaled up.** *Smart ticketing*: testing of configuration not found to work sufficiently well, but some elements **circulate** in subsequent rounds of experiments, before a working configuration is developed for permanent use (Travelwest Travel Card)
Velomobility	*Individual mobility marketing and employer engagement*: two rounds of experiments testing different configurations (of personalised travel planning), **circulation** of elements to two different working configurations that were **institutionalised** in policy.
Public space	*Play streets*: Testing of a configuration that was not stabilised, **circulation** of elements to another experiment, with a working configuration **institutionalised** in a regulatory process (Temporary Play Street Order) and **scaled up** through this process.
Automobility	*Car-sharing*: testing of a configuration that was not stabilised, **circulation** of elements to working configuration (City Car Club), that was **institutionalised** in BCC policy and **scaled up** through the private market; or testing of working configuration directly **institutionalised** and **scaled up** in new social enterprise and later **scaled up** further through private market *EV charging*: testing of elements in separate experiments, which then **circulated** (or were pursued simultaneously) to become integrated within working configuration (Source West), which was **scaled up** and **institutionalised** in BCC policy, eventually resulted in the launch of a second-generation configuration.

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[66] For example, experiments with 20mph residential zones and Resident Parking Zones.

The impact of experiments judged to be 'working configurations' rested on assembling a configuration that 'works' in a technological and operational sense, and successfully shaped the behaviour of bus passengers, commuters or drivers. This is discussed further in chapter 9. For example, experiments exemplifying 'working configurations' include the *Showcase bus route* in the VIVALDI project, *employer engagement to promote cycling* in the Cycling City project, and the *Source West EV charging network:* these configurations had a transformative impact on Bristol's mobility system – as detailed in the next section. These configurations were developed through preceding experiments testing different elements, these elements then circulating to other interventions and eventually becoming integrated into yet another novel configuration that was tested and judged to 'work'. At that point, the configuration became institutionalised, and scaled up through municipal investment: the patterns in Table 5.5 suggest that *institutionalisation* and *scaling up* have gone hand in hand. In summary, the prevalent pattern of embedding can be characterised as:

Circulation → Working configuration → Institutionalisation → Scaling up

Considering the common understanding of innovation, this makes sense: actors test out a couple of different versions, before settling on a design and then expanding it more widely. We can draw some parallels between this pattern and that of niche-level dynamics as theorised in socio-technical transition theories - this is discussed further in chapter 9.

5.2.2 Summary of transformative impacts

Crucially, the Bristol findings show that *it is the ability to sustain a trajectory of experimentation over time that is central to municipal capacity for transformative experimentation,* rather than the outcome of any single experiment. I found that *some but not all* trajectories of linked experiments generated *transformative impacts* in the longer-term. In considering the cumulative, longer-term impacts that different trajectories generated in Bristol by 2016, I inductively arrived at three categories of transformative impact: city-wide spatial expansion, significant new policy and governance institutions, and change in mobility flows (Table 2.8). The second category captures institutional change, whereas the first and third category capture material change in the urban mobility system (mobility

infrastructures, technologies and flows). Table 5.6 below summarises the transformative impacts that some trajectories generated over the longer-term. This does not include strands or trajectories of experimentation that *did not* generate transformative impacts.

Table 5.6. Summary of transformative impacts from Bristol experimentation.

Strand/trajectory of experimentation	Transformative impact		
	City-wide spatial expansion	Significant new policy or governance institutions	Change in mobility flows
Bus priority and information technologies	Y – real-time information only	Y – Greater Bristol Bus Network, Quality Partnership Schemes	Y – increase in bus ridership
Cycle training for children			Y – increase in cycling to school
Bristol Bike Project		Y – cooperative broadening cycling culture	
Employer engagement to promote cycling		Y – multi-sector networks for sustainable commuting Y – outsourced delivery of behaviour change policies	Y – increase in cycle commuting
Play streets	Y – 49 locations by 2017	Y – Temporary Play Street Order, Playing Out CIC	
Car-sharing	Y – car club parking bays	Y – established local market, regular financial contributions from private developers	
20mph speed limits	Y – majority of roads within municipal limits		Y – reduced vehicle speeds, traffic injuries
Resident Parking Zones	Y – 16 zones across the city		
EV charging network		Y – Source West network, EV municipalism/Revive network	

In what follows, I discuss transformative impacts for busmobility, velomobility, public space and automobility experimentation, in turn – including:

- Description of transformative impacts indicated in Table 5.6.

- For select trajectories, what factors explain the (lack of) transformative impact. This is limited to the types of experimentation for which there was enough causal evidence to rigorously explain Outcomes as linked to Context.[67]

5.2.3   Busmobility: growing ridership, continued lack of municipal control

Bus priority and information technologies: what explains transformative impact?

Experimentation with bus priority and information technologies starting in the late 1990s launched a trajectory that transformed busmobility in Bristol by 2016. Traffic signal priority, camera-based enforcement of bus lanes and real-time information tested within early EU projects were integrated into the Showcase bus service configuration tested within the VIVALDI project, and scaled up to 10 bus routes as part of the Greater Bristol Bus Network (GBBN). The GBBN configuration is an example of similar bus service upgrades implemented across Europe, referred to as 'Bus with High Level of Service' (BHLS).[68] GBBN only improved a select number of routes, i.e. there was no city-wide expansion.[69]

Nevertheless, GBBN constitutes a significant new policy institution, as the first programmatic BCC effort to improve fully-private bus services in coordination with other West of England authorities. The GBBN Quality Partnership Schemes constituted a significant new governance institution, shifting busmobility governance to a formalised and hierarchical mode from the preceding voluntary partnerships between BCC and First Bus.[70] The GBBN Partnership approach was also adapted and redeployed for the Metrobus BRT services, beyond 2016. As described in section 5.1.2, expansion of bus priority and information technologies was achieved through institutionalisation of these

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[67] Other strands of experimentation that did not have transformative impacts are bike-sharing, home zones, temporary pedestrianisation ('Make Sunday Special') and road user charging - details are provided in Appendix A.

[68] BHLS services typically include priority bus lanes, a traffic management system allowing buses to have priority at traffic lights (referred to as 'Selective Vehicle Detection' in this chapter, and 'Transit Signal Priority' as the US term in chapter 6), high-capacity bus vehicles (often of a low-floor and multiple-door design that allows passengers to quickly get on and off the bus), greater spacing between bus stops, and off-board payment systems Service' (Finn et al. 2011).

[69] The only element scaled up city-wide was real-time information at bus stops, through the LSTF programme capability (Bartle et al. 2016). Approximately a quarter of bus stops in Bristol had real-time information in 2018 (B05).

[70] The GBBN Quality Partnership Schemes are significant because six such statutory quality partnerships had been established in Britain by 2015 (Taylor and Sloman 2016), i.e. rare assertions of local authority regulation.

elements as contractual items within the Partnership Scheme agreements. In essence, technological experimentation foregrounded BCC governing a broader range of bus service elements, like information provision, within the privatised local bus market.

This trajectory of experimentation also had a transformative impact on mobility flows. All GBBN routes were launched by March 2012. On GBBN routes operated by First Bus, passenger numbers increased by 17.6% between 2008/9 before launch, and 2013/14 after launch (Travelwest 2014a). GBBN bus user satisfaction surveys show an increase in the percentage of passengers satisfied with the overall quality of the bus service from 46% in 2007 to 73% in 2011/12 (Travelwest 2014c). As shown in Figure 5.9, bus ridership in Bristol as a whole increased by 31% between 2009/10 and 2016/17, against a national trend of decline. In 2017/18, Bristol had the fifth highest number of bus passenger journeys among all local authorities in England, outside London (DfT 2019a). On balance, the evidence suggests that GBBN contributed to the overall increase in city-wide bus ridership.[71]

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[71] There is some debate. One expert interviewee doubted the quality of GBBN user satisfaction data, and that GBBN had increased overall ridership (B13). An industry report suggests that ridership growth in Bristol might be attributable to congestion, which may have pushed drivers to switch to bus use (UTG 2019). However, UWE researchers have concluded that "measures introduced in the GBBN and [LSTF] WEST projects are associated with a marked improvement in the way in which people in Greater Bristol view the bus network and have been accompanied by growth in passenger numbers following many years of decline" (Clayton 2015, p.11). This is partly based on evaluation of LSTF service upgrades including real-time information, which showed increases in user satisfaction (Bartle et al. 2016). GBBN upgrades have not necessarily been the primary causal driver of city-wide growth in bus ridership, but the evidence is compelling enough to conclude it did contribute.
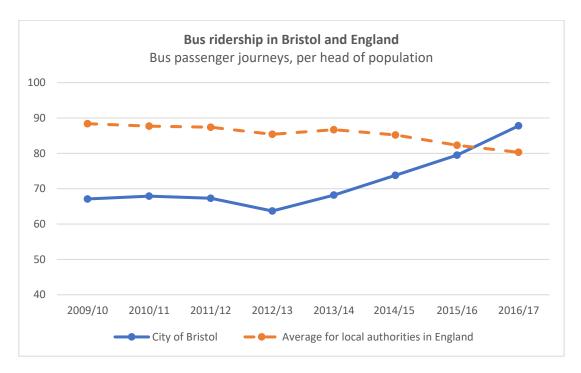
Figure 5.9. Bus ridership trends in Bristol. Data source: DfT (2019b).

The Context factors enabling the transformative trajectory are summarised in Table 5.7, based on the discussion in sections 5.1.1, 5.1.2 and 5.1.3. Table 5.7 is structured in terms of the different phases/patterns of embedding identified in section 5.2.2 (Table 5.5).

Table 5.7. Context factors enabling transformative impacts of Bristol experimentation with BHLS.

Context factors	Phase of trajectory		
	Testing elements (EU projects in the late 1990s)	Experiment establishing working configuration (VIVALDI Showcase service)	Expansion following experiment (GBBN, LSTF)
Municipal institutions and resources	European Transport team: securing continuous series of EU grants	European Transport team: packaging BCC Local Transport Plan priorities into VIVALDI funding application Extensive evaluation, resourced by VIVALDI, reporting ridership increase	Securing support from other West of England authorities, central government funding through frame of competitive city-region
Governance institutions	Governing by co-provision: using the Council-controlled Park&Ride service to test elements	Governing by co-provision: voluntary partnership with First Bus	Governing by co-provision: statutory Quality Partnership Scheme with bus operators

Despite growing bus ridership, experimentation with smart ticketing did not generate transformative impacts, demonstrating BCC's continued lack of capacity to spur innovation in other aspects of bus services.

Despite the West of England authorities eventually managing to launch a city-regional smartcard around 2013 (section 5.1.1), this was not transformative, as the card could only be used for specific types of tickets, rather than offering fully integrated ticketing across the city-region. By 2016, BCC was far from achieving its 2000 vision - and that of successive national governments - for bus ticketing, with most journeys still paid by cash and involving paper tickets (Clayton 2015).

Since 2000, considerable efforts across the UK were invested in developing technological standards for smartcards interoperable across different transport operators (Blythe 2004). Private bus operators resisted integrated ticketing, because coordinating ticket types and fare structures across operators was perceived as a competition threat (Bray 2015). The findings for Bristol align with these broader trends. Successful development of the city-regional smartcard took many rounds of experimentation by BCC, illustrating the practical challenges of aligning novel technological standards with obdurate systems (obduracy as an inductive factor, chapter 7). Drawing on section 5.1.1, the key factor constraining transformative impact was the privatised bus market and reluctance of First Bus to cooperate, only equipping its buses for smartcard payment after many rounds of public investment had gone into R&D. By the time the Travelwest Travel Card developed by the West of England authorities could finally be used on First Bus services, smartcard payments were already becoming outdated.[72]

For ticketing, governing by co-provision through Quality Partnership Agreements was not as successful as it had been for the GBBN trajectory. The smartcard trajectory illustrates the broader challenges faced by UK local authorities to push forward

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[72] As smartcard technology began to become more outdated, First Bus launched mobile ticketing in 2015 and contactless ticketing in 2017 - but these systems are not interoperable with other bus operators.

busmobility innovation, in the context of a fragmented governance landscape where private operators cannot be forced to contribute (Preston et al. 2008; Taylor and Sloman 2016).

Low-emission buses: what explains lack of transformative impact?

BCC's agenda for low-emission buses was less prominent: unsurprisingly, since a clear coordinating role for local authorities in relation to bus vehicle technologies was not promoted by UK central government in the early 2000s, as it was for information provision and ticketing. Experiments within early EU projects (1996-2006) did not result in any embedding and BCC did not pursue this strand of experimentation much further.[73]

One exception was an experiment with a 'geo-fenced' hybrid electric bus technology during the 2015 European Green Capital year, one of the Bristol experiments chosen for in-depth study (Appendix B). This experiment resulted in *stabilisation,* with buses still in operation in 2019, but no further embedding nor transformative impacts. The 'geo-fenced' technology allows the bus to switch to 100% electric power within a GPS-designated low-emission zone, and the overall configuration was very expensive compared to conventional hybrid buses. First Bus cited the prohibitive cost as the key reason for lack of upscaling (B19), although a local expert cited the challenge of fitting different types of hybrid bus vehicles to context-specific topographical and operational contexts (B14, obduracy as an inductive factor). However, the specific technological configuration - inappropriate to the local context and with a presumed lack of 'scalability' from the outset - was pre-determined by UK DfT, which decided to award BCC extra funding for this experiment to share in the PR limelight of European Green Capital. The lack of embedding can be explained by the prescriptive nature of this 'one-off' national grant. This experiment is the only one undertaken in Bristol where the prescriptive nature of external funding determined the specific configuration to be tested *and* where this actually prevented embedding.

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[73] This is not a comprehensive account of experimentation with low-emission buses in Bristol, which mostly has been undertaken by the private sector (GENeco 2016).

5.2.4 Velomobility: increasing cycling levels and broadening cycling culture

Transformative impacts: cycle training and Bristol Bike Project

Expansion of BikeAbility cycle training for schoolchildren had a transformative impact on mobility flows: the percentage of children cycling to school increased from 1.5% to 3% for all participating schools and from 3.2% to 9.1% for schools with more intensive engagement (Cope et al. 2017). Sustrans data suggests that engagement with schools between 2012-2015 resulted in a 4.4% increase in cycling to school and 13.6% decrease in children being driven to school (Bristol 2015 Ltd 2015b). Governing by co-provision through partnership with Sustrans was thus an effective strategy, in this instance.

Bristol Bike Project, the grassroots initiative seed-funded by BCC, evolved into a significant new governance institution. In 2018, the Project celebrated a decade of work as a cooperative with 170 members, 100 volunteers and a public maintenance workshop; having worked with over 2000 people under 'earn-a-bike' and delivering special programmes for schools, young people, women (BBP 2018). The 2011 Census showed that the typical cycle commuter in Bristol was a young, educated white male (BCC 2014a), and previous research suggests that Bristolians perceive cycling as a middle-class phenomenon dominated by 'middle aged men in lycra' (Aldred and Jungnickel 2014). As a long-running institution, the Bristol Bike Project has likely been transformative in broadening the Bristol's cycling culture. This cannot be attributed to BCC seed-funding alone: the Project has evolved into a largely self-sustaining organisation through its bike sales and services offer (BBP 2018). Nevertheless, this experiment demonstrates how BCC's strategy of enabling civil society has contributed to some significant impacts.

Employer engagement: what explains the transformative trajectory?

Experimentation with employer engagement had a transformative impact on velomobility flows and local governance institutions. Interviewees cited employer engagement as one of the most successful aspects of BCC mobility policy, linked to increased cycle commuting within the city (B02; B05; B14). Research on cycling cultures in Bristol also shows the positive impacts of workplace promotion on cycle commuting (Aldred and

Jungnickel 2014). Cycling City engaged 26% of the Bristol workforce. and cycle commuting increased from 10.6% in 2007 to 14.3% in 2011 (Cope et al. 2017). During LSTF, engagement with employees in the North Fringe area resulted in statistically significant increases in cycling mode share (2%) and decreases in car use (2.3%) (Bartle and Chatterjee 2018). Since these evaluations indicate causal association between employer engagement and increased cycle commuting, we can conclude that experimentation contributed to transformative change in mobility flows.

This trajectory of experimentation also reshaped the governance of velomobility. It institutionalised policy delivery outsourced to private sector consultancies: by 2019, Steer Davies Gleave had delivered the majority of behaviour change interventions for West of England authorities for 10 years, with a dedicated team (Geelan 2019). Further, engagement with major employers in the North Fringe transformed the 'commuter clubs' established by BCC and South Gloucestershire Council in the late 1990s into new multi-sector employer networks focused on sustainable commuting. The North Bristol SusCom network,[74] in particular, was a significant legacy of BCC's employer engagement activities (B02). Academic evaluation found that SusCom became increasingly active during the LSTF programme, delivering activities on behalf of BCC and South Gloucestershire Council, and acting as the coordinator vis-à-vis their member businesses (Bartle and Chatterjee 2018). Since 2015, SusCom has taken on a broader role within city-regional mobility governance – contributing financially with match-funding (BCC 2014c) and lobbying for 'greater transport powers and funding' for the Bristol city-region (North Bristol SusCom 2017).

The Context factors enabling the transformative trajectory are summarised in Table 5.8, based on the discussion in section 5.1.2, 5.1.2 and 5.1.3.

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[74] Comprising private and public sector organisations across the North Fringe area, employing over 40,000 people.

Table 5.8. Context factors enabling transformative impacts of Bristol experimentation with 'employer engagement' to promote cycling.

Context factors	Phase of trajectory		
	Testing elements (VIVALDI and SDG PTP experiments)	**Experiment establishing working configuration (Workplace Cycling Champions)**	**Expansion following experiment (employer engagement)**
Municipal institutions and resources	European Transport team: securing EU funding, investing BCC discretionary resources, testing alternative PTP approaches Extensive evaluation by Sustrans, reporting cycling increase	Securing UK Cycling City funding, match-funding from employers Drawing on established policy of workplace 'travel planning' and 'commuter clubs', integrating wide range of elements into new configuration	Packaging configuration into UK government LSTF funding bid; match-funding from employers Using joint bid for national funding to extend BCC governing into wider city-region (North Fringe)
Governance institutions	Co-provision through contracting-out: partnership with Sustrans, SDG	Co-provision through contracting-out: market partnership with SDG to deliver PTP; with Lifecycle UK to deliver cycle training, parking	Co-provision: institutionalised outsourcing to SDG 'Sustainable Travel Field Team'

Cycle parking: austerity constraining transformative impact

Experiments with cycle parking did not generate significant longer-term impact. While BCC installed on-street cycle parking spaces between 1996-2016 (e.g. 'Sheffield stands'), innovative cycle parking configurations appropriate for different residential typologies were not expanded. An experiment ideated by BCC staff, supported by the LSTF Active Neighbourhoods Fund, tested how access to cycle parking could be improved for social housing tenants, who often lack private outdoor space or communal parking facilities. This experiment, 'Working with Registered Social Landlords', was studied in-depth (Appendix B). Over 250 cycle parking places were provided in 35 secure facilities across Bristol; although these were retained (*stabilisation*), there was no further embedding on this configuration. Despite further unmet demand from tenants and the experiment being seen as 'very positive' within the Council, the configuration was not expanded because of limited 'scalability' and financial viability. Limited scalability was linked to the

configuration involving costly bespoke infrastructure tailored to individual housing estate typologies, and the need for BCC to employ specific officers to engage with communities, in order to deliver the infrastructure. The experiment ended in 2016 with the expiry of LSTF funding and the onset of deeper austerity, requiring further community engagement to be funded through external grants. Similarly, another experiment funded by the LSTF Neighbourhoods Fund, testing Bristol's first 'Bikehangar' cycle parking shelter, was initially scaled up beyond 2016 but also abandoned due to austerity cuts by April 2019. This demonstrates how austerity politics limited BCC capacity to engage with socially disadvantaged groups and provide basic mobility infrastructures, towards the end of the study period.

5.2.5   Public space: limited transformation of Bristol streets

Public space and street space was transformed to a limited extent in Bristol. Experimentation with home zones did not result in transformative impacts (Appendix A).

Play Streets: a transformative model from Bristol

Experimentation with *play streets* was the only public space-related trajectory with transformative impact. To return to the experiment with play streets introduced in chapter 1, BCC seed-funding enabled the organisers to develop a working configuration for play street events and establish themselves as an independent social enterprise (Community Interest Company) called 'Playing Out', with a further BCC-led experiment then resulting in the institutionalisation of a Temporary Play Street Order (TPSO) as a municipal permitting procedure. This enabled communities to apply for temporary street closures easily. TPSO has been made available to Bristol residents as an annual application process since 2013 and the number of play street events grew gradually within the city, with 49 locations with several events annually in 2017-18. I argue this constitutes city-wide expansion and thus TPSO also constitutes a significant new policy institution: for example, University of Bristol (2020) researchers found that Bristol has more street-play schemes than any other UK city, and Playing Out has grown into a nationally emulated model (Ferguson 2019). These transformative impacts cannot be *entirely* attributed to

BCC's strategy of governing by enabling, but BCC did support Playing Out financially with £180,000 in grant awards and commissioning 2010-2016.

Street Pockets: what explains the lack of transformative impact?

Despite the Playing Out model expanding city-wide, the overall transformation of Bristol's streets and public spaces between 1996 and 2016 was limited. The public space experiment studied in-depth was 'Street Pockets' (Appendix B), which tested parklets on residential streets, where parking spaces were converted into public seating with greenery, complemented with public art and paint-based treatments of the street surface to calm traffic. The process involved a high degree of engagement with residents. Sustrans applied for a grant from the European Green Capital Strategic Grants Fund (introduced in section 5.1.3), and led the experiment in 2016, in loose coordination with BCC. The configuration perhaps bears the closest resemblance to 'tactical urbanism' in Bristol, with a 'toolkit' of temporary materials developed by Sustrans. Despite the interventions being made permanent, the configuration was not scaled up or institutionalised: no formal monitoring or evaluation had been undertaken by BCC, three years later. Again, the labour-intensity of this configuration featuring extensive community engagement was the key factor for BCC's hesitance, in the context of austerity pressures on operational expenditures.

5.2.6   Automobility: reconfiguring and regulating car use

Transformative impacts: car-sharing, 20mph limits and Resident Parking Zones

Experimentation resulted in automobility being regulated in new ways: 20mph speed limits and Resident Parking Zones were scaled up city-wide, with an evaluation finding statistically significant reductions in average traffic speeds and a reduction in fatal, serious and slight injuries (Pilkington et al. 2018). For 20mph limits, LSTF funding and the BCC-designed monitoring results were critical in enabling transformative impact. For both experiments, interviewees also cited Mayoral leadership as important (inductive factor, discussed in chapter 7).

Experimentation also incrementally reconfigured private car use. BCC's strategy of governing by enabling through pump-priming car club experiments – including leveraging external grants – paid off in the long-term, resulting in a profitable and diversified local car-sharing market. Smart Moves Ltd, the car club operator that launched in Bristol as one of its first locations, continued to expand nationally. At some point the company was renamed City Car Club, which in 2015 was acquired by one of the world's largest vehicle rental companies, Enterprise. Enterprise continued to operate in Bristol, and other private providers entered the market, including Zipcar and Co-Wheels – the latter acquiring the GoLow non-profit car-pooling service focusing on public sector employers, that was also seed-funded by BCC. The emergence of this car-sharing market is a significant new governance institution, because of the maturity of the Bristol market relative to other UK cities, and the fact that as per BCC planning policy private developers regularly provide financial contributions to support network expansion via section 106 agreements (Melia et al. 2016). The trajectory has resulted in city-wide spatial expansion of car club bays: in 2016, there were approximately 100 across Bristol (*ibid.*).

EV charging: what explains the transformative trajectory?

Experimentation with publicly-accessible electric vehicle (EV) charging from 2011 resulted in the Source West network as a significant new policy institution. This was transformative because an integrated city-regional network was rapidly established, with 200 charging points and 400 members across the West of England in 2015.[75] BCC quickly expanded into a new policy area, and led the other local authorities.

The Context factors enabling the transformative trajectory are summarised in Table 5.9. The EU-funded ICT4EVEU experiment enabled BCC to develop a back-office ICT system that allowed interoperability between charging points provided by different private companies, which enabled the Source West network to be established and grow up until 2019 (studied in-depth, Appendix B). However, when BCC secured further UK

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[75] There were 80 charging locations by 2017 (BCC 2017b), however these were mainly concentrated in Bristol city centre. It is difficult to judge whether this constitutes city-wide expansion, as there are few international benchmarks for charger-to-vehicle ratios (Hirst 2019).

government funding, the Source West configuration was almost entirely redesigned for the launch of the city-region's new 'Revive' network. This was because the interoperability and quality of charging points provided by many different companies continued to pose challenges. To mitigate against such risks in the future, BCC decided to opt for municipal ownership and operations of the Revive network (with contracted suppliers): a kind of 'EV municipalism' mirroring BCC's approach in establishing its own waste and energy companies. With this switch from governing by co-provision to municipal provision, the trajectory thus also generated significant change in local governance institutions.

Table 5.9. Context factors enabling transformative impacts of Bristol experimentation with EV charging infrastructure.

Context factors	Phase of trajectory		
	Testing elements (experiment at public car parks)	**Experiment establishing working configuration (ICT4EVEU/Source West)**	**Expansion following experiment (Revive network)**
Municipal institutions and resources	Bristol Futures: securing private sector contributions via S106 agreement	Bristol Futures: piecing together different grant funding to enable integrated EV charging network configuration EU funding focused on ICT allowed for software development; UK government funding for infrastructure and installation	BCC secured UK government funding: longer Go Ultra Low West programme Institutionalisation in BCC Energy Service
Governance institutions	Co-provision: with private developers	Co-provision: R&D partnership with Charge Your Car	Provision: 'EV municipalism' in municipally-owned charging network

5.3 Summary: municipal capacity for transformative experimentation

With regard to RQ1.1 (section 5.2), the majority of experiments resulted in embedding of some kind, reconfiguring Bristol's mobility system institutionally or materially. Some experiments launched trajectories with longer-term transformative impacts. Thus,

transformative experimentation did occur in Bristol between 1996 and 2016. Here, I summarise the Context factors explaining how and why BCC had the capacity for this.

Starting with RQ1.2, we can summarise findings for *external mobility funding* as an *exogenous driver*. I showed that BCC was indeed reliant on external funding for experimentation, and how the UK/EU funding landscape was far from ideal, in supporting municipal capacity:

- The scope of experimentation was occasionally shaped by narrowly-focused external funding programmes, like the EU funding that influenced experimentation between 1996 and 2006.

- EU and UK government funding drove a reliance on project organising within BCC, because the nature of short-term grants necessitated the use of project management techniques to ensure experiments were implemented on time and budget. Findings on 2007-2016 align with previous research, in that knowledge transfer between projects as temporary organisations and permanent organisations was fraught, with a lack of institutional memory and high staff turnover.

- Evaluation processes were strongly shaped by external funders, who imposed prescriptive data collection frameworks that necessitated external expertise, which BCC found in UWE. The extent to which BCC managed to maintain a 'two-track' process of simultaneous internally- and externally-designed evaluation was limited, overall.

However, section 5.2 explains the influence of Context on actual Outcomes, showing that:

- There is no evidence that project organising constrained embedding or transformative impacts. Although findings suggest that project organising contributed to making Cycling City and LSTF experimentation piecemeal, there is no evidence that this constrained outcomes.

- Only for one experiment is there evidence that external funders' narrow prescriptions on the *scope of experimentation* prevented embedding (geo-fenced hybrid trial), as the configuration tested was inappropriate for the local context.

- Evaluation processes were only important in explaining embedding from three experiments (Showcase bus service, Sustrans PTP and 20mph zones), and not

central to any trajectory. Thus the influence of external funding on transformative impacts *via* evaluation processes was also negligible.

Section 5.2 shows that the constraints of external funding were often effectively managed through BCC's endogenous strategies, which were central to enabling transformative impacts:

- At times, temporary organisations were nested within permanent organisations (European Transport team, Bristol Futures), which made BCC's approach more systemic. The competence of these teams was an important factor enabling transformative impacts.

- EU and UK funding was primarily an enabler of transformative impact. Without this funding, BCC would have achieved less (as per LTP reform in 1999, section 7.2). BCC successfully packaged its own priorities (e.g. funding for upscaling already-tested configurations) within the framework of external funding programmes. The most important sources of UK government funding were generally quite flexible (Cycling City, LSTF, European Green Capital support).

Examining *austerity politics* as another exogenous driver (RQ1.2), my findings show that nationally-imposed reductions in BCC operational expenditure undermined municipal capacity, in contributing to outsourcing, the inability to employ sufficient permanent staff, and piecemeal experimentation between 2012 and 2016. There was no significant constraint on transformative impacts, but austerity cuts did inhibit embedding from some experiments due to the lack of staff for community engagement activities beyond 2016.

Turning to RQ1.3 and governance modes, I found that:

- BCC expansion of *co-provision* with private bus operators through Quality Partnership agreements enabled transformative impacts from the Greater Bristol Bus Network, but were ineffective for smartcard ticketing. Endogenous strategies were thus insufficient to overcome the constraints of the UK's dysfunctional, privatised bus market.

- BCC expansion of *co-provision* for cycling-focused behaviour change interventions, by contracting to CSOs and consultancies, was effective in enabling transformative impacts (employer engagement, cycle training trajectories).

- BCC governing by *enabling*, notably by seed-funding experiments led by CSOs and private companies, enabled transformative impacts for some trajectories (car-sharing, play streets) but not for others (cycle parking, Street Pockets). Bristol findings show that governing through partnership with civil society is not sustained by political will alone, if municipal governments do not have the capacity to marshal financial resources.

6 GOVERNING THROUGH EXPERIMENTATION IN NEW YORK

This chapter presents findings regarding urban mobility experimentation undertaken in NYC between 1997 and 2016 (N=61, Table 3.2) and findings regarding RQ1.1, RQ1.2 and RQ1.3 for the NYC case. The structure is the same as for chapter 5. Interviews are cited as NY01, NY02, etc. corresponding with the list of interviewees in Appendix D.

6.1 Context and Mechanism

This section describes the evolution of NYC city government institutions and resources (RQ1.2) and governance institutions (RQ1.3) through a chronological narrative of two periods: 1997-2006 and 2007-2016. Figure 6.1 below depicts the evolution of NYC city government's approach to experimentation between 1997 and 2016. The analysis of municipal capacity is focused on the NYC Department of Transportation (DOT) as a municipal agency. Throughout the study period, experimentation in NYC was primarily shaped by municipal priorities, rather than those of federal and state government. The first period (1997-2006) was marked by a Type 2 approach, with a more piecemeal approach in the absence of an overarching vision for urban mobility. From 2007, municipal capacity for transformative experimentation grew stronger, with a shift to systemic Type 4 experimentation led by an overarching vision and with permanent organisations.

Table 6.1 summarises how governance evolved in NYC, from pre-existing governance modes in 1997, to the modes characterising experimentation between 1997 and 2016. There was a diversification of modes, but only from 2007. The most notable change was expanded *co-provision*, through NYC DOT partnership with NYCT (MTA bus operating company) and with a broader range of non-profit organisations on managing newly

pedestrianised public spaces. Yet, governing by provision and authority, without partnership, remained significant.
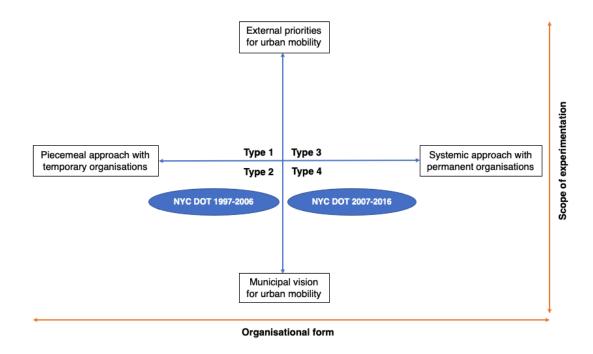
Figure 6.1. NYC DOT's approach to experimentation between 1997 and 2016.

Table 6.1. Diversification of governance modes in NYC.

Type of mobility	Governance modes		
	Pre-existing (1997)	Experimentation between 1997-2016	
		Dominant mode	Other modes
Busmobility	Provision (Limited) Co-provision with NYCT	Expanded co-provision with NYCT	Provision
Velomobility	Provision	Provision	Co-provision
Public space	Co-provision with BIDs	Expanded co-provision with BIDs and other non-profit, private sector organisations	Enabling Authority
Automobility	Authority Provision	Authority Provision	Enabling Provision Self-governing - all through public-private partnership

6.1.1 1997-2006: Piecemeal experimentation under Giuliani and Bloomberg

1997 to 2006 was characterised by **Type 2** experimentation: in line with municipal priorities, but with a piecemeal approach. This period spans two NYC Mayoral administrations: that of Rudy Giuliani, and Michael Bloomberg's first term. NYC DOT was a traditional bureaucracy that governed automobility and velomobility through authority and provision;[76] its agenda for busmobility and public space was limited.

Giuliani served between 1994 and 2001. This was a time of declining **municipal resources**: Giuliani inherited a municipal budget gap of $2.3 billion (Cooper 2007; Powell 2009). As an advocate of fiscal conservatism, the Mayor chose to deal with the deficit through austerity cuts, rather than raising taxes (Cooper 2007) – including significant cuts to NYC DOT's budget and staff.

Giuliani's top priority was crime and policing, whereas mobility was a low priority (NY13). NYC DOT had no overarching **vision for urban mobility** until 2008.[77] The Giuliani administration's mobility policy was framed around facilitating automobility and mitigating safety externalities (City of New York 2001b, p.66).

NYC DOT's **evaluation processes** were unsophisticated relative to later periods, due to a lack of staff competences (NY03). DOT activities are reported with reference to simple descriptive statistics on traffic fatalities (NYCDOT 2005c) and output indicators, e.g. numbers of traffic lights and potholes repaired (City of New York 2001b). Throughout the study period (1997-2016), processes for evaluating experiments were designed internally, with external funding requirements having negligible impact (discussed in section 7.2).

The **scope** of experimentation was shaped by DOT Pedestrian and Bike Projects Group staff, who leveraged federal government funding to pursue their priorities for velomobility

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[76] Based on DOT activities described in Mayor's Management Reports (Appendix C).

[77] Documentation of DOT activities between 1997-2001 is only available through the annual Mayor's Management Reports (Appendix C). The research did not reveal any holistic strategic plan focused on urban mobility after 1997 and prior to 2008, nor could interviewees formerly employed at NYC DOT (NY04; NY19) recall such a strategy.

and public space. The launch of the Congestion and Air Quality Mitigation (CMAQ) funding programme by the federal ISTEA act substantially increased grant funding available to NYC city government for cycling and pedestrian networks (section 4.1.2). The next TEA-21 act[78] in 1998 further expanded grant funding to NYC city government (City of New York 2003b). The flexibility of CMAQ meant that DOT staff could pursue their own priorities.[79] However, in the absence of an overarching municipal vision, reliance on external funding meant that experimentation was organised as a series of self-contained CMAQ-funded projects.

CMAQ funding allowed the development of the NYC Bicycle Master Plan (NYCDCP and NYCDOT 1997). The Plan was the first strategic policy document focused on non-car modes, setting out a city-wide cycling network of 1800 miles, and recommending that city "agencies should implement demonstration projects of innovative bicycle facilities" (*ibid.*, p.52), with a follow-up study featuring specific novel configurations (NYCDCP 1999). Experimentation was posited as the mechanism to introduce novelties, yet it was not until 2005 that cycling experiments were actually undertaken.

Despite the availability of federal funding, pressure on NYC DOT expenditures under Giuliani meant that the Pedestrian and Bike Projects Group developed an **endogenous strategy** of implementing experiments through a 'quick-build' approach, which later came to be labelled 'tactical urbanism' by Lydon and Garcia (2015).[80] The approach uses temporary materials and in-house DOT construction crews[81] to test street design configurations rapidly and cheaply: it was used already in 1998 for an experiment with a new street layout as part of the Grand Concourse Pedestrian Safety Demonstration Project (NYCDOT 2005, p.17). CMAQ-funded studies on pedestrianisation in

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[78] The Transportation Equity Act for the 21st Century (TEA-21) authorised federal spending from 1998-2003, retaining the policy emphasis of ISTEA and increasing funding volumes (Dilger 2015).

[79] Discussed further in section 7.2. Eligible local spending under the CMAQ programme includes different types of interventions that can improve air quality, such as vehicle retrofits and alternative fuels, congestion reduction and traffic flow improvements (including Intelligent Transport Systems technologies), public transport improvements, cyclist and pedestrian facilities, travel demand management, car-sharing.

[80] Many different terms are used to refer to this approach. Interviewees have referred to 'quick-build', 'operational process', 'interim projects'; the latter is also used by Luberoff (2016).

[81] For sidewalk repair, concrete and asphalt work, road markings.

Manhattan (NYCDCP and NYCDOT 2000; City of New York 1997a) detailed 'operational tests' using temporary materials – reflecting how this approach drew on operational funding from the DOT budget, rather than capital funding. The motivations of Randy Wade, the DOT staff member who is credited with first having developed the quick-build approach within the Lower Manhattan Pedestrianization Project (City of New York 1997a; NY06; Fried 2017), are retold by Lydon and Garcia (2015, p.156) as: "Under normal circumstances… [the project] would include a 10-year process to implement a capital construction project. However, there was strong political will to do it faster and less expensively. With this charge Wade… [proceeded] not with permanent infrastructure but with inexpensive and temporary materials". In NYC, permanent street redesigns are (still today) delivered through a slow process of 'capital projects' involving multi-agency coordination overseen by the NYC Department for Design and Construction (NY08). The quote above illustrates how the quick-build approach was developed as an alternative to this process. In addition, the approach was designed to be low-cost, in the context of austerity.

The quick-build approach was used to test a temporary pedestrian plaza at Coenties Slip in Manhattan's Financial District. The motivation to design a low-cost configuration extended to NYC DOT partnering with Business Improvement Districts (BIDs) to cover the management and maintenance costs of the space.[82] As discussed in section 4.3.4, the pre-existing mode of governing public space was **co-provision** between NYC city government and BIDs. For the new quick-build street space reconfigurations, NYC DOT thus leveraged this pre-existing mode to tentatively expanded partnerships with BIDs. The quick-build approach was later applied across the city, however, it took until 2007 for it to become institutionalised.

Mayor Bloomberg succeeded Giuliani in January 2002, serving for three consecutive terms until 2013. The 9/11 terrorist attack caused a shock to **municipal resources**, with $3 billion lost in tax revenues (NYC Comptroller 2002). NYC DOT expenditures grew from

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[82] What is referred to as 'maintenance' for NYC public plazas involves cleaning, taking care of the plants installed, removing chairs and tables for night-time storage, paying for security services; whereas programming involves organising events.

2002 to 2005, however (Figure 6.2). Bloomberg closed the budget gap through modest cuts to city services, instead increasing property taxes (Cooper 2002; Berg 2007). By 2005, the NYC economy had recovered, and city government expenditures had grown considerably (Cardwell 2007). Bloomberg appointed Dan Doctoroff as Deputy Mayor for Economic Development, and together they were preoccupied with mega-projects: neither mobility nor sustainability were policy priorities during Bloomberg's first term.[83]

There was no marked shift from the Giuliani administration, with a continued **Type 2** approach within a traffic engineering paradigm and without an overarching vision.[84] Giuliani had appointed Iris Weinshall as his Transport Commissioner in 2000, who was retained by Bloomberg, and who opposed new DOT targets focused on a shift from private car use to other modes (Weinshall 2007).

From 2002 to 2006, there was little experimentation: the **scope** was limited to congestion mitigation, a six-month experiment with reduced vehicle access to Central Park, and pedestrian safety surrounding schools (**governing by provision and authority**). The latter featured experimentation within the framework of a Safe Routes to School Program institutionalised within NYC DOT from 2004. In 2005, the federal SAFETEA-LU act[85] then introduced a new Safe Routes to School funding programme, which enabled expansion of NYC DOT's Program to schools city-wide (Muennig et al. 2014).

There was a tentative shift in busmobility governance in 2004, with the launch of a 'NYCBRT' planning study to investigate the feasibility of a Bus Rapid Transit (BRT) system (NYCT et al. 2005), in response to plummeting bus ridership and speeds (Orosz and Barr 2010). This laid the ground for later busmobility experimentation. The study was a joint effort, led by the public transport agency and bus operator MTA New York City Transit (NYCT, section 4.2.2), which secured the partnership of NYC DOT and financial support from state and federal government (NY15). Prior to this, NYC DOT's

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[83] As Doctoroff (2017) confesses in his political memoir, he barely knew what sustainability meant, before 2006.

[84] Based on analysis of Mayor's Management Reports 2002-2005 (see Appendix C).

[85] The *Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users* (SAFETEA-LU) authorised federal transport funding programmes for 2005-2009 (Dilger 2015).

involvement with bus planning was minimal, primarily **governing by provison** of bus priority lanes; **co-provision** with NYCT was limited due to poor relations (NY15; NY10), reflecting city-state government tensions (section 4.2.2). By the very nature of BRT, the introduction of this novelty necessitated collaboration between NYC DOT and NYCT, as each agency controlled different elements of proposed service improvements. The NYCBRT study opened up unprecedented collaboration between the two agencies: the study forced NYC DOT and NYCT staff to work closely together and started building informal relationships (NY10), but the new partnership remained tentative during this pre-implementation stage (NY15).

After Bloomberg was re-elected for a second term in January 2006, mobility policy began to change rapidly. Deputy Mayor Doctoroff (2017) was charged with reviewing the ability of NYC's physical infrastructure to accommodate a projected 10% growth in the city's population by 2030. A new Mayoral Office of Long-Term Planning and Sustainability (OLTPS) coordinated this process across city agencies, including NYC DOT. The work evolved into a long-term strategy for sustainable infrastructure, published in 2007 as *PlaNYC: A Greener, Greater New York* (City of New York 2007c). In the lead-up, Doctoroff commissioned a report by US architect Alex Garvin (2006) on how NYC city government could boost housing supply: this recommended protected cycle lanes and pedestrian space reclamations to stimulate private sector real estate development. The Garvin plan became a cornerstone of PlaNYC (Angotti 2008), giving Doctoroff a new perspective on mobility as a strategic priority (Luberoff 2016).

Doctoroff's team began fleshing out a mobility vision for PlaNYC. In 2006, DOT staff experimented with a pedestrian plaza at Willoughby Street in Brooklyn 'overnight' using a quick-build approach, echoing the Coenties Slip plaza implemented in the late 1990s. The visual impact and speed of this street space transformation excited Doctoroff's team (NY06) - it also fell in line with Garvin's recommendations. Doctoroff began questioning the slow pace at which DOT was building the comprehensive cycling network laid out in the 1997 Bicycle Master Plan. Six months later in January 2007, Weinshall resigned as DOT Commissioner – seemingly squeezed out by the new policy priorities (Vesselinovitch 2006; NY11).

6.1.2   2007-2016: Systemic and tactical experimentation under Sadik-Khan

In 2007, there was a shift towards **Type 4** experimentation, with a more systemic approach linked to a comprehensive municipal vision and anchored in permanent organisations. The period until 2016 covers two Mayoral administrations: Bloomberg's second and third term, and that of Bill de Blasio from 2014. With policy agendas seeking to introduce a range of novelties, there was a marked diversification of governance modes.

The Bloomberg administration: sustainability entrepreneurialism and PlaNYC

PlaNYC was published in April 2007. Shortly after, Bloomberg appointed sustainable mobility advocate Janette Sadik-Khan as the new Transport Commissioner (Naparstek 2007c).[86] Before PlaNYC, there had never been a comprehensive NYC masterplan, and environmental sustainability had never been the top policy priority (Angotti 2008). With PlaNYC, the **entrepreneurialism of the Bloomberg administration became wedded with sustainability**: sustainable infrastructure was seen as central for attracting a 'talented' workforce and guaranteeing NYC's competitiveness as a 'world-leading' city in relation to 'competitors' like London (Doctoroff 2017; NYCDCP 2008b).

The initiatives under PlaNYC's 'transportation' theme provided, for the first time, an overarching **municipal vision** for mobility. PlaNYC set high-level goals for 2030, including reducing GHG emissions, improving travel times by adding 'transit capacity', and ensuring that all residents live within a 10-minute walk of an open space (City of New York 2007c, p.13). Foremost, PlaNYC argued for greater investment in maintaining and expanding rail services: the MTA was projecting major budget deficits in 2007, and the Plan lamented the lack of a long-term solution to the MTA's financial sustainability. To close the "monumental funding gap" in the **municipal resources** needed to deliver novel mobility initiatives, PlaNYC proposed that NYC city government "work with the State [government] to create a new regional partnership, the Sustainable Mobility And Regional Transportation (SMART) Financing Authority" (City of New York 2007c, pp.66-67). The idea was that SMART could issue debt against a dedicated revenue stream from a new

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[86] Doctoroff left NYC city government just after PlaNYC was launched.

congestion charging scheme proposed for pilot implementation. Both congestion pricing and SMART proposals had to be passed in the NY State legislature, because NYC city government must have state approval for new taxes or user fees (NY State Senate 2007). The Bloomberg administration ultimately failed to push through congestion charging: despite securing State Governor's support and federal funding for the proposal,[87] it was blocked by state-level politicians citing concern for car-reliant constituents (Schaller 2010). SMART was a radical proposal from a multi-scalar governance perspective: some NY State Assembly members "questioned the creation of a new entity to control the [congestion pricing] funds [revenues]… The Bloomberg-proposed [SMART] Financing Authority would *derive its power from the city and not the state*" (Cohen 2014, pp.69; emphasis added).

PlaNYC determined much of the **scope of experimentation** between 2007 and 2013, expanding NYC DOT policy in four areas:

- Promotion of cycling, including completion of the cycling network outlined in the 1997 Bicycle Master Plan (Transportation initiative 9 in Table 6.2). This created a stronger political mandate for building cycling infrastructure than commitments made in 1997 and 2006, and supported expansion of novel cycle lane configurations that NYC DOT staff were experimenting with at the time, notably the city's first parking-protected cycle lane along Ninth Avenue. This launched a transformative trajectory of experimentation with cycling infrastructure, through **provision** by NYC DOT alone.

- Implementation of 10 BRT routes in partnership with MTA NYCT (segmenting **co-provision**), following from the NYCBRT study developed during the preceding period. This spawned a transformative trajectory of experimentation with upgrading bus routes to a new 'Select Bus Service' standard – launched with a first experiment on the Bx12 route.

- An ambitious initiative to create a public plaza in every NYC community district, based on the blueprint of the recent experiment at Willoughby Street

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[87] The Bloomberg administration's first proposal and a second proposal supported by the State Governor (PCAC 2016) failed to even to make it to a vote in the State legislature. US DOT had chosen NYC as one of five cities for its Congestion Initiative, guaranteeing millions of federal funding under an 'Urban Partnership Agreement', if NYC implemented a congestion charging scheme. This included $326 million in FTA Capital Investment Grants (Section 5309) for Bus Rapid Transit (US DOT 2007).

(introduced above). This expanded the remit of NYC DOT to include public space. A DOT Public Plaza Program translated the PlaNYC goal of every community being within a 10-minute walk of open space, to a goal of providing one public plaza in each of NYC's 59 community districts. This also spawned a transformative trajectory of experimentation.

As shown in Table 6.2, SMART funding was envisioned to complement to municipal funds committed towards PlaNYC initiatives, and thus NYC city government was left with a large funding gap. In particular, the proposed BRT system was largely reliant on SMART funds (Table 6.2, see footnote above) and there was considerable uncertainty regarding how this would be taken forward (City of New York 2008b; 2010d). Pressure on **municipal resources** was compounded by the onset of the Great Recession, leading to deep deficit projections for New York state and city budgets (IBO 2009). Bloomberg embarked on eight rounds of cuts to municipal expenditures between 2009 and 2011, decreasing the NYC DOT expense budget by 7% (Wolf 2011). Municipal capital funding for public plazas (Table 6.2) was also heavily cut (NY01). The MTA faced a $1.2 million deficit in its 2009 operational budget (City of New York 2009c): in response, NYCT severely cut subway and bus services (Neuman 2008).

Table 6.2. Funding sources indicated in PlaNYC for key strands of mobility experimentation, including committed NYC city government funds (City of New York 2007c, pp.150-151) and the gap to be covered by funding from the proposed SMART fund (p.95).

PlaNYC initiative	Sub-initiative	2015 goal	NYC capital, 2007-8 (USD millions)	NYC operational, 2007-8 (USD millions)	Gap covered by SMART
Transportation 9	Build 1800 miles of cycle lanes	820 directional miles completed	$6.2	$8.1	$12
Transportation 4	Initiate and expand BRT	10 routes operational	$46.4	$1.2	$483
Open Space 4	One public plaza in every community	10-15 plazas built	$134.3	N/A	N/A

PlaNYC Progress Reports between 2008 and 2011 emphasise the funding gap for mobility initiatives (City of New York 2008b; 2009c; 2010d; 2011a). However, by 2011, the overarching narrative of NYC city government was that *despite* the constraints of city-state

politics, the city had been resourceful enough to achieve success on its own (City of New York 2011a, p.92):

> "While we are working with state, federal, and regional agencies for a comprehensive solution [to funding the MTA], we will continue to take innovative incremental steps to improve the portions of the transportation network directly under the City's jurisdiction. Even in the face of chronic budget shortfalls… through innovative strategies we have strengthened and expanded transportation choices throughout the city".

This quote summarises NYC city government's **endogenous strategy** in response to the multi-scalar context from 2008. 'Innovative incremental steps under the City's jurisdiction' refers to how DOT chose experimentation as a mechanism for introducing the novelties included in PlaNYC, pursuing intervention in parts of the mobility system within municipal (rather than MTA) control: the city's *streets*, available for experimentation with cycling infrastructure, public space and bus services. The quote also underlines the fact that experimentation post-2007 took place in the context of austerity politics (section 6.1.3). This is noteworthy because existing narratives on NYC mobility experimentation hardly ever emphasise funding as a multi-scalar 'issue', rather, 'tactical urbanism' is emphasised as a low-cost strategy that made resources a non-issue. While NYC city government had sufficient resources for externally-imposed fiscal constraints not to completely *derail* PlaNYC initiatives (Table 6.2), NYC DOT pursued several **endogenous strategies to deal with financial constraints.**

First, the quick-delivery approach to experimentation was expanded: partly driven to speed up implementation, but also motivated by resource constraints. DOT expanded the low-cost approach developed between 1999-2002 and tested again by DOT staff at Willoughby Plaza in 2006,[88] to initial experiments and later upscaling of public plazas, cycling infrastructure and Select Bus Service. For the latter, some have called this 'tactical transit' (TransitCenter 2016b; Garcia and Wall 2019); indeed NYC DOT and NYCT

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[88] The PlaNYC case study on Willoughby Plaza emphasises that the temporary intervention "cost less than $100,000" (City of New York 2007c, p.37), illustrating how the Plaza was adopted as a 'template' partly because of cost.

(2013, p.9) credit the low-cost, quick-build approach as crucial to the success of SBS expansion.

Second, NYC DOT intensified efforts to secure federal funding. DOT applied for competitive federal grants to cover the funding gap left by SMART, and secured a relatively continuous series of FTA grants for the expansion of Select Bus Service. In relation to formula-based funding, DOT adopted a strategy of pushing larger, multi-year projects for CMAQ funding allocation to its Bike and Public Plaza Programs through NYMTC[89] – rather than smaller grants that would quickly be exhausted (NY20).

Third, NYC DOT relied on private sector and philanthropic contributions. As discussed, DOT's first experiment with public plazas in 1999 featured partnerships with BIDs. The experiment at Willoughby Street resurrected this configuration. From 2007, NYC DOT's expanded ambition for public space necessitated a new funding model, and in 2008 the BID partnership model was officially institutionalised within a DOT Public Plaza Program, to which BIDs could apply if they contractually agreed to cover maintenance costs. In the context of austerity politics, NYC city government thus chose to **expand the pre-existing mode of co-provision** and outsourced public space management, to access 'co-funding' from non-state actors (NY06).

The BID partnership model was not only institutionalised for the Public Plaza Program: it also applied to DOT's experiments with pedestrianisation along Manhattan's Broadway, Madison Square and Broadway (see Appendix B), and Sadik-Khan's 'Summer Strees' initiative, an annual car-free event where Park Avenue was closed to traffic on Sundays, with commercial sponsorship from private companies in return for street-based marketing opportunities. As described in chapter 1, these interventions are iconic, but existing narratives rarely acknowledge that they were resourced through public-private partnership. Co-funding of public space experiments by non-state actors also extended to instances where NYC DOT **governed through enabling,** seeking to engage non-state actors in new ways. What evolved into NYC DOT's Weekend Walks, Street Seats and

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[89] The state government-controlled New York Metropolitan Transportation Council that approves the award of federal grants to NYC city government, introduced in section 4.1.2.

Seasonal Streets programmes started with DOT partnering with new types of actors such as more informally-organised resident groups and smaller local businesses on experiments with car-free street events, play streets, parklets and new types of cycle parking.[90] These experiments involved civic fundraising or contributions from BIDs and local businesses.

The **scope of experimentation** came to focus on street space reconfiguration: NYC DOT's (2008e) strategic plan *Sustainable Streets* was launched the year after PlaNYC. This translated PlaNYC's mobility-related initiatives into DOT actions and milestones (City of New York 2013d; Jones 2016), adding novelties to be explored in relation to traffic safety, and public space in the addendum *World Class Streets* strategy (NYCDOT 2008f). Combined, PlaNYC and Sustainable Streets formed the policy framework that shaped experimentation until 2013, and account for the **shift from a piecemeal Type 2 experimentation to a more systemic Type 4 approach.** Linked to the **scope** of Sustainable Streets, DOT continued to experiment with street redesigns to improve traffic safety, e.g. 'Safe Streets for Seniors', and 'school slow speed zones'. NYC DOT's (2010b) *Pedestrian Safety Study and Action Plan* was a major advance in safety data analysis (NY03), launching a further experiment with traffic calming ('Neighborhood Slow Zones'). These strands of experimentation exemplify how **governing by provision and authority** persisted.

Interviewees confirmed the existing narrative (Luberoff 2016; Levels 2019; Sadik-Khan and Solomonow 2016) that Sadik-Khan transformed the organisational structure and culture of NYC DOT to create an environment conducive to innovation, including an emphasis on learning-by-doing and willingness to 'try new things' (NY08; NY17; NY11; NY22). A new DOT Office for Planning and Sustainability was tasked with finding ways to implement the novelties contained in PlaNYC and Sustainable Streets. This Office included three recruits from civil society (from two of the CSOs introduced in section 4.3.4): Andy Wiley-Schwartz recruited from Project for Public Spaces; Jon Orcutt as DOT Director of Policy, a veteran cycling activist who had previously directed Transportation

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[90] See 78th Street Play Street, Williamsburg Walks, Pop-up café experiment - Financial District/Pearl St, Bike 'corral' parking pilot – Smith Street (Appendix A).

Alternatives; and Bruce Schaller as Deputy Commissioner for Planning and Sustainability, an expert-consultant on NYC mobility. Experimentation was adopted as DOT's preferred governing mechanism for introducing novelties identified in policy strategies, due to the confluence of leadership by Sadik-Khan and these professionals who had previously worked outside city government. The 'quick-build' approach was elevated to an agency-wide implementation strategy, influenced by Wiley-Schwart's experience with PPS own quick-build approach and BID partnerships (see section 4.3.4); with Schaller adding an emphasis on data monitoring and evaluation (NY18).[91] To be sure, the Bloomberg administration frequently used 'pilots' for testing policies across multiple policy areas (Chen and Grynbaum 2011; Pasanen 2011). However, the nature and origins of DOT's specific *mobility* experimentation mechanism had little to do with Bloomberg or Sadik-Khan, per se. Rather, it was influenced by ideas circulating within civil society.

The strengthening of municipal capacity was also related to how experimentation was **organised,** with greater reliance on permanent organisations and specific techniques of institutionalisation. The earlier tendency for isolated projects gave way: institutionalisation into *programmes* was widespread across most DOT initiatives during this period. A new Public Space Unit, developed a distinct pattern of institutionalising experiments into application-based programmes through which configurations could be scaled up, generating a *portfolio* of the Public Plaza Program, Weekend Walks Program, Street Seats Program and Seasonal Streets Program. DOT also institutionalised experimentation by codifying street design elements, configurations and implementation processes in a new Street Design Manual (NYC DOT 2009e). This created an innovation 'inventory' and 'pipeline' where configurations would progress from 'pilot' to 'limited' and 'widespread' status, reflecting the scale of implementation across the city; or with configurations sometimes removed after evaluation (Flynn 2010a; Flynn 2010b).

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[91] Wiley-Schwartz essentially 'imported' the BID partnership model into NYC DOT (Levels 2019). PPS' philosophy also extended to *governing by enabling:* that municipal government should encourage non-state actors to initiate change (NY05), which is why public space programmes were institutionalised as application-based programmes (NY01).Prior to being hired by DOT, Schaller (2007b) had advocated for testing Broadway traffic closures and BRT on a pilot basis, to avoid 'paralysis by analysis'.

Experimentation with hydrogen and electric vehicles - also launched by PlaNYC - remained an exception: externally-funded experiments involving OLTPS, the NYC Department for City-wide Administrative Services (DCAS) and the NYC Taxi and Limousine Commission (TLC) were organised as 'one-off' projects. This strand of experimentation was the only one driven by federal and state government technology pushes. To encourage EV uptake among NYC residents, NYC city government focused on **enabling** the private sector, rather than municipal **(co-)provision** of public EV charging infrastructure. By 2010, an EV technology push by the Obama administration's ChargePoint America programme eventually resulted in an experiment with NYC's first publicly-accessible EV charging points in 2010, led by a private company.

Lastly, **evaluation processes** changed during this period, influenced by Bloomberg's emphasis on quantitative data monitoring (NY18; NY08; NY03). Under Schaller's leadership, DOT staff were trained in before-and-after analysis of experiments (NY18). More advanced data collection and analysis approaches were developed: for traffic safety interventions (NY03; NYCDOT 2013b), by developing the capability to harvest traffic data from taxi GPS units (NY18; NYCDOT 2010a) and as reflected in city-wide mobility statistics and policy evaluation data presented in annual *Sustainable Streets Index* reports (NYCDOT 2008d; 2011c; 2012c). The *Measuring the Street* report (NYCDOT 2012b) shows DOT efforts to capture benefits accruing to local businesses, e.g. by using retail sales tax receipts.

The de Blasio administration: upscaling innovations and Vision Zero

Bloomberg's last term ended in 2013, as did Sadik-Khan's stint as Commissioner. Bill de Blasio assumed office as NYC Mayor in January 2014. De Blasio has been critical of the inequality generated by Bloomberg's entrepreneurialism and can be considered the most left-wing Mayor since the 1970s (Philips-Fein 2017).

De Blasio initially distanced himself from the Bloomberg administration's policies, referring to himself as an 'incrementalist' on cycle lanes *contra* Sadik-Khan (Seifman 2012) and raising the prospect of removing the Times Square plazas (Grynbaum and

Flegenheimer 2015). Sustainable mobility advocates were nervous that de Blasio would reverse some of DOT's interventions (NY06; NY11), but this never happened. By the time de Blasio released his campaign 'policy book' (de Blasio 2013; Chen 2013), it contained commitments to expand cycling infrastructure, Select Bus Service, and a 'Vision Zero' goal of zero traffic casualties and injuries (Aaron 2013a). With the *Vision Zero Action Plan* (City of New York 2014c), traffic safety became the cornerstone of the new **municipal vision** for mobility. The Mayoral team launched a new strategy called One New York: A Plan for a Strong and Just City, abbreviated to OneNYC (City of New York 2015b), which committed to the expansion of existing DOT initiatives (mentioned above), in addition to the Vision Zero agenda. NYC DOT (2016f) did not publish a new policy strategy with detailed mobility initiatives until September 2016; despite this, experimentation continued as **Type 4:** OneNYC and the Vision Zero Action Plan formed a comprehensive vision. De Blasio appointed Polly Trottenberg as DOT Commissioner, who restructured DOT somewhat, with the Office for Planning and Sustainability merged into a larger division (NY01). However, DOT continued to rely on permanent **organisational forms.** Existing DOT programmes, the Street Design Manual and evaluation processes remained largely unchanged.

The first three years of the de Blasio administration (2014-2016) primarily featured upscaling. Interviewees remarked that consolidation of the many strands of DOT innovation was necessary, after the rapid experimentation during the previous period (NY04; NY02). The Vision Zero agenda advanced existing DOT traffic safety programmes. The limited **scope of experimentation** emerging out of the Vision Zero Action Plan was very specific, and focused on governing through **provision and authority**: for example, specific safety technologies to be tested in taxis and a 'pilot program' for speed cameras in school zones.

The most notable change was that austerity politics subsided, with an expansion of NYC own-source expenditure on mobility. The Fiscal Year 2015 NYC budget dedicated municipal capital and operational budget to Vision Zero initiatives (City of New York 2014b), making the DOT Bike and Pedestrian Projects group not primarily dependent on federal funding for the first time since 1997 (NY06). From 2012, NYC DOT had

experimented with an alternative funding/partnership model for public plazas, the Neighborhood Plaza Partnership, which supported non-profit organisations in lower-income neighbourhoods to participate in the Public Plaza Program, supported through philanthropic co-funding. The de Blasio administration adopted a more radical approach, with Trottenberg championing the establishment of the OneNYC Plaza Equity Fund (NY02), which provided a municipal budget allocation to plaza partners, i.e. with a shift from co-funding to state funding. This was the most tangible manifestation of de Blasio's social justice focus on NYC mobility.

By 2016, NYC city government had made a big leap in transforming busmobility, velomobility and public space along the lines set out in 2007-8 PlaNYC and Sustainable Streets strategies. To achieve this, NYC DOT transformed from a bureaucracy governing by traditional modes, to managing extensive partnership and co-funding arrangements.

The MTA's declining subway and bus services and severe financing challenges meant that debates about public transport 'crisis' increasingly dominated city-regional mobility policy (Rosenthal et al. 2017; NYC Comptroller 2017). In 2018, MTA NYCT halted expansion of Select Bus Service, citing its financial situation (Meyer 2018). The lack of a sustainable financing model for the MTA – from the SMART/congestion charging proposal until 2016 – illustrates how the 'big picture' issues in relation to NYC's mobility transition and limits of municipal autonomy remained unresolved.
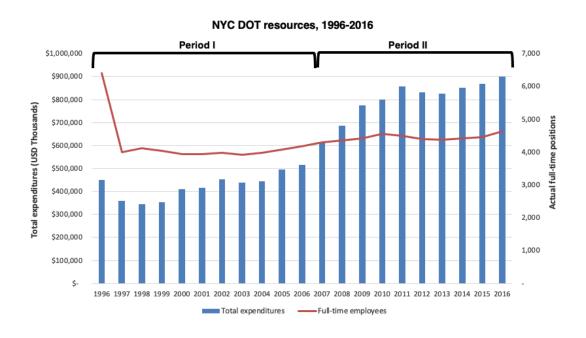
6.1.3   Evolution of municipal resources

Starting with the general availability of resources between 1997-2016, NYC city government did not have significant constraints: the size of municipal government grew substantially. Figure 6.2 shows long-term growth in DOT's expenditures and staff size.[92] The two relevant spending categories for experimentation are 'Highways' and 'Traffic'. Capital expenditures in relation to these also increased: annual expenditures were 188%

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[92] 1996 is included in Figure 6.2 to illustrate Giuliani's cuts. The decrease in employees likely partly reflects the redistribution of some DOT responsibilities to other NYC agencies (Weikaert 2001).
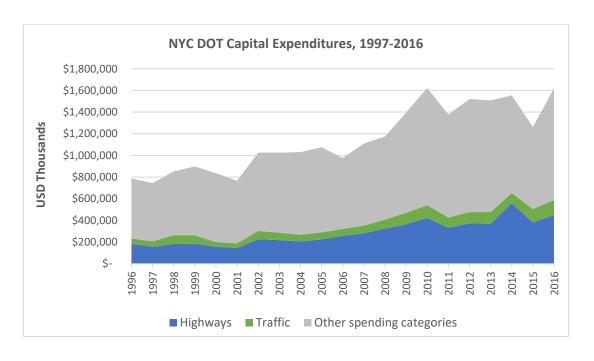
(Highways) and 171% (Traffic) greater in 2016 than in 1997 (Figure 6.3).[93] Bloomberg did cut the DOT budget after the Great Recession, which can be discerned from 2010 as a decrease in staffing (Figure 6.2) and in capital expenditures for Highways and Traffic (Figure 6.3). However, the overall impact of these cuts on DOT resources was modest.

These financial data raise the question: why does other evidence, discussed in the previous section, point to fiscal scarcity as an important constraint shaping mobility experimentation in NYC – when municipal resources in fact grew significantly? One explanation relates to mobility experimentation's reliance on external funding. NYC city government was selected as a case because it enjoys a high degree of fiscal autonomy, based on the proportion of external funding within the *city-wide* municipal budget (Table 3.1). The previous section points to the importance of federal grants, in addition to municipal own-source revenues, in funding experimentation between 1997 and 2016.

Figure 6.2. Evolution of NYC DOT resources between 1996 and 2016. Data source: Independent Budget Office of the City of New York (IBO 2020a; IBO 2020b).

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[93] The other spending categories are bridges, ferries and airports, equipment, gas and electricity; added to highways and traffic categories, these combined make up the 'Total' capital expenditures shown in Figure 6.3.
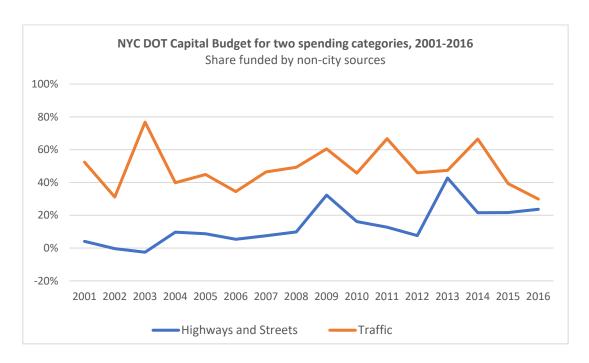
Figure 6.3. Capital expenditures by NYC DOT between 1997 and 2016. Data Source: Independent Budget Office of the City of New York (IBO 2020c).

Analysis of financial statistics confirmed that mobility experimentation *specifically* has been more reliant on external funding. NYC DOT's agency-wide expenditures confirm that the agency's reliance on external funding was low, with state and federal government transfers together accounting for 20% of total annual DOT expenditures, on average between 2001 and 2016.[94] However, from Figure 6.4 showing the capital spending categories most relevant to experimentation, we can see that the share of external funding (federal and state government combined) has been relatively high for Traffic, at an average of 49% for annual budgets between 2001 and 2006, and the share also grew steadily for Highways and Streets (average of 14% for annual budgets). Figure 6.4 suggests that external funding has been important for the introduction and expansion of mobility novelties.

Data on the funding sources for implementation of all 61 NYC experiments confirm that external funding has been important, as shown in Table 6.4. The 'NYC only' category

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[94] Based on NYC DOT expenditure figures as listed in the NYC Executive Budgets referenced for Figure 6.4.

indicates experiments funded by own-source municipal resources – all other categories indicate an external funding source.[95] Table 6.4 shows that 44% of experiments were funded by municipal government alone, however, the majority relied on (partial) external funding. The large-N data confirms the narrative that federal government was the most important external funding source, drawn on by a quarter of experiments. The majority of DOT's programme for developing cycling infrastructure ('Bike Program') was funded by federal programmes like CMAQ (NY06, NY08).[96] Experimentation with and expansion of pedestrian safety configurations and the Public Plaza Program relied on federal CMAQ and Surface Transportation Program (STP) grants, and specific federal programmes like Safe Routes to School and TIGER. Federal Transit Administration (FTA) grants funded the expansion of Select Bus Service (see Appendix G), and CMAQ funding was used to experiment with related technologies like TSP.[97]

NYC DOT Capital Budget for two spending categories, 2001-2016
Share funded by non-city sources

Figure 6.4. External funding share of NYC capital expenditures related to experimentation. Data source: NYC DOT Capital Commitments figures listed in NYC city government Executive Budgets

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[95] All the external funding categories also include NYC city government 'match' funding contributions.

[96] With the proportion cited as high as 80% (Sadik-Khan and Solomonow 2016). NYC DOT secured a series of federal CMAQ grants for bicycle and pedestrian network development in 2005, 2006 and 2007, which DOT staff highlight as significant milestone for cycling policy (Quinn 2016).

[97] This is reflected in the 'Federal government' and 'Federal + MTA' categories for busmobility experiments.

(City of New York 2003c; 2004b; 2005b; 2006b; 2007d; 2008c; 2009d; 2010e; 2011b; 2012b; 2013e; 2014b; 2015c; 2016c; 2017c).

Table 6.3. Funding sources for NYC experiments.

Type of mobility	Federal govt	State govt	MTA	Federal + MTA	Philanthropic /Civic	Private sector*	NYC only
Total number of experiments	15	0	2	4	3	10	27
Proportion of N(=61)	25%	0%	3%	7%	5%	16%	44%

* non-state contributions towards public space *maintenance* by BIDs are not included, since the figures in this table are limited to the source of funding for the *implementation* stage of experiments.

Findings that CMAQ funding was an important enabler of NYC experimentation align with US government research finding that this programme has enabled local sustainable mobility experimentation across the country (FWHA 2009; TRB 2002).

In contrast, Table 6.4 reveals the limited role of state government funding in mobility experimentation by NYC city government (Figure 4.2), although New York state contributed to experimentation through MTA NYCT budget allocations for SBS. The second most important external funding source was private sector actors, notably for public space experimentation, reflecting the BID co-funding model.

In summary, mobility experimentation has been more reliant on external funding, than the NYC DOT-wide or city-wide budgets. Drawing together this and the previous section, we can note that despite absolute increases in DOT expenditures (Figure 6.2 and 6.3), the Department was not free of resource constraints in relation to experimentation. While some NYC interviewees claimed that funding was not 'an issue' for cycling and public space trajectories (NY18), this is because these types of experiments involved very small volumes of expenditure compared to other DOT budget items (e.g. bridge repair, NY20); however, NYC DOT did pursue various endogenous strategies to deal with resource constraints. Among competing budget priorities and resource pressures in the late 1990s and following the Great Recession, experimentation relied on external funding. This is partly explained by the fact that cycling infrastructure and plazas did not have a significant claim on the NYC operational budget until the de Blasio administration (NY16; NY06). However, the discussion also shows that while there has not been objective scarcity of

municipal resources, NYC Mayors have practiced *austerity politics*, which also affected mobility experimentation.

6.2 Outcomes

6.2.1 Embedding and trajectories of experimentation

The degree to which experimental configurations tested in NYC were embedded is summarised in Table 6.4. As with equivalent figures for the Bristol case, each number in the Table represents one outcome of a specific experiment.

Table 6.4. Embedding outcomes of NYC experiments.

	Stabilisation	Circulation	Scaling up	Institutionalisation	None	Unknown
Total no. of experiments w/ outcome	40	19	34	27	2	0
Proportion of (N=61) w/ outcome	66%	31%	56%	44%	3%	0%

Similarly to Bristol, the NYC findings demonstrate how experiments change urban mobility systems in enduring ways, through the embedding of novelties. Only in two instances did experiments result in no embedding whatsoever (3%). Stabilisation was the most prevalent outcome, with 66% of experiments resulting in the configuration tested made permanent or its use was extended in time. Whereas 12% of experiments resulted *only in stabilisation*, 85% of all experiments also resulted in other combinations of embedding. 56% of experiments resulted in scaling up, where the configuration was expanded within NYC. 44% of all experiments resulted in institutionalisation, while 31% resulted in circulation. Most experiments either substantively influenced subsequent experiments/initiatives (circulation) or resulted in significant material or institutional change with respect to urban mobility. Similarly to Bristol, my NYC findings revealed how *some* experiments became 'linked', forming trajectories of experimentation that unfolded over time. The data in Table 6.4 and these trajectories are visualised in Figure 6.5 - 6.10.
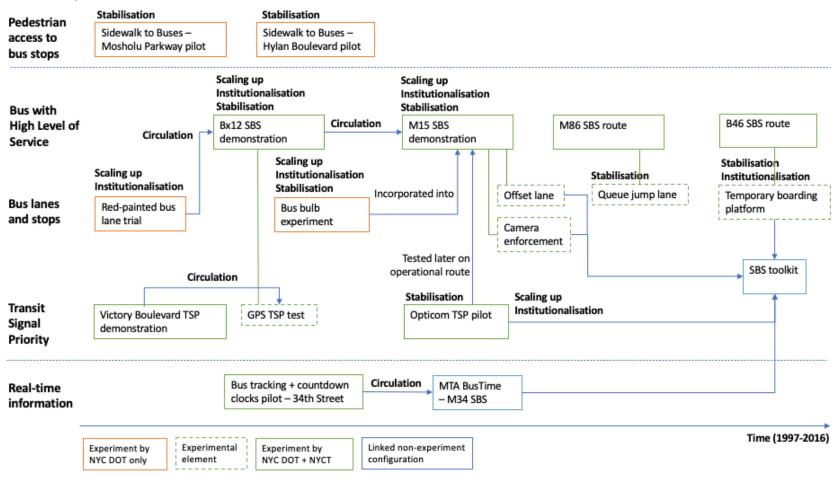
Figure 6.5. Outcomes of NYC experimentation with busmobility.

Velomobility

Cycle lane elements

- Chevron markings → *Scaling up / Institutionalisation* → Class 3 Shared lane
- Green-painted lanes → *Scaling up / Institutionalisation* → Class 2 lanes
- *Stabilisation* → Montgomery Street Bike Box → *Scaling up*

Protected cycle lanes

- *Stabilisation* Tillary Street two-way lane
- *Circulation* → *Stabilisation* Ninth Avenue parking-protected → *Scaling up / Institutionalisation* → Class 1a lane (exclusive signal) → Ninth Avenue extension
- *Circulation* → Grand Street → *Circulation* → *Scaling up / Institutionalisation* → Class 1b lane (mixing zone)
- *Scaling up / Institutionalisation*
- *Stabilisation* Kent Avenue one-way lane → Kent Avenue parking-protected two-way lane → *Scaling up* → Two-way Class 1b lane

Cycle parking

- Bicycle parking shelters → *Scaling up / Institutionalisation* → *Stabilisation* Bike corral – Smith Street → *Scaling up / Institutionalisation* → Bike Corrals Program

Bicycles on public transport

- *Stabilisation* Bike & Ride Pilot → *Scaling up*

Time (1997-2016)

- Experiment led by NYC DOT
- Experiment involving, but not led by, NYC DOT
- Linked non-experiment configuration

Figure 6.6. Outcomes of NYC experimentation with velomobility.

Public space I – plazas
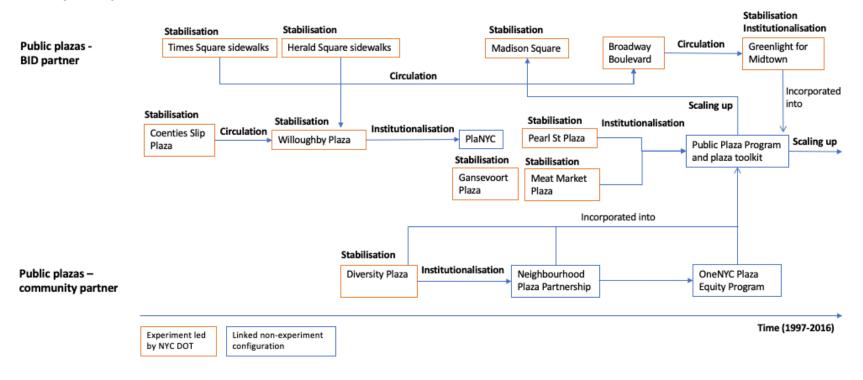
Figure 6.7. Outcomes of NYC experimentation with public plazas.
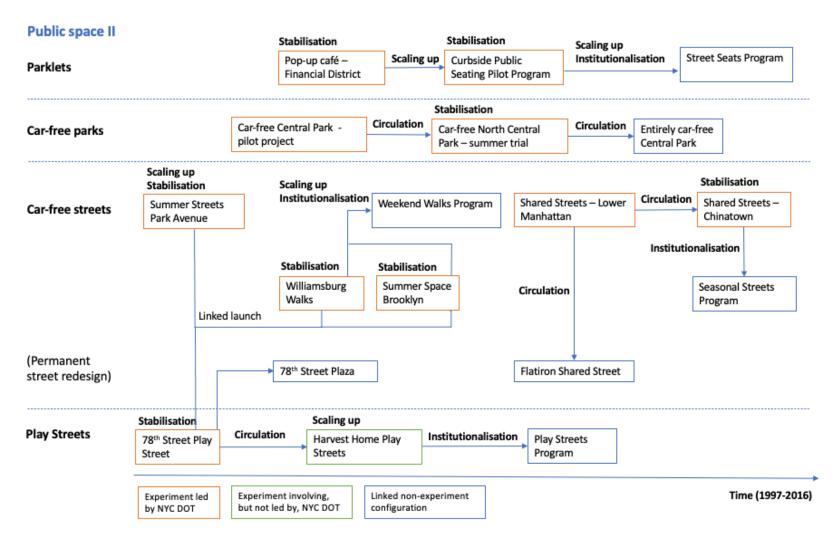
Figure 6.8. Outcomes of NYC experimentation with public space.

Automobility I – traffic safety
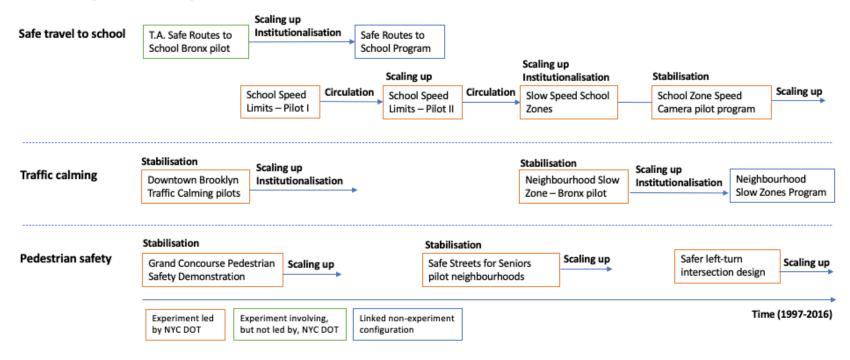
Figure 6.9. Outcomes of NYC experimentation with traffic safety.
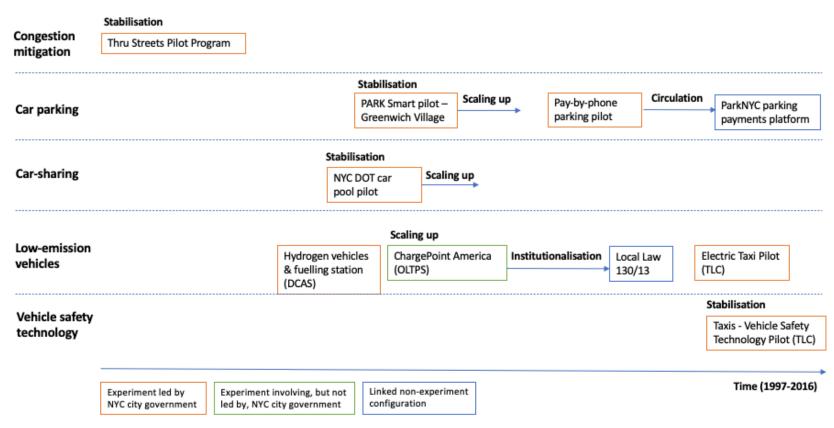
Figure 6.10. Outcomes of NYC experimentation with reconfiguring car use.

My findings for NYC reveal how repeated patterns of embedding, summarised in Table 6.5, were associated with specific municipal 'techniques' of institutionalisation. Similarly to Bristol (chapter 9), experimentation with busmobility, velomobility and public space in NYC exhibits a pattern of:

Circulation → Working configuration → Institutionalisation → Scaling up

Table 6.5. Patterns of embedding for NYC experimentation.

Type of mobility	Predominant pattern of embedding
Busmobility	Testing and **circulation** of elements to assemble 'working' configuration that is **institutionalised.** Novel elements added over time into the Select Bus Service 'toolkit'. Including some codification of configurations in SBS Bus Stop Design Guidelines and DOT Street Design Manual. **Scaling** up of the 'core' configuration of Select Bus Service, while different 'supporting' elements applied for different routes.
Velomobility	Testing and **circulation** of elements to assemble and diversify 'working' configurations: design typologies for different cycle lane 'classes', that were **institutionalised** in Street Design Manual and **scaled up** city-wide, across similar street types (e.g. Class 1a lane for Avenues).
Public space	Testing and **circulation** of elements to assemble 'working' configurations, that were **institutionalised** as DOT application-based programmes, and **scaled up** through these. In the case of public plazas, institutionalisation of elements in the Street Design Manual and NYC local law (Pedestrian Plaza Rules), but also in a DOT plaza 'toolkit' of process and materials institutionalised among staff.
Automobility	More limited circulation and institutionalisation. Testing of novel configuration, sometimes **directly institutionalised** into DOT initiatives or application-based programmes, or **scaled up** without evidence of institutionalisation

Across trajectories related to protected cycle lanes, Select Bus Service and public plazas, trajectories took off with specific experiments that have demonstrated a 'working configuration', i.e. a configuration deemed to integrate all necessary elements and deemed 'successful' following evaluation (discussed further in section 7.2). In the case of cycle lanes, this was the experiment on Ninth Avenue; in the case of SBS, this was the Bx12 route, and in the case of plazas, this was Willoughby Plaza. For some strands of experimentation, preceding these working configurations, there was a process of testing different elements, sometimes circulating between 'rounds' of experiments, allowing for assembly of these elements as part of the configuration. For example, prior to Bx12 SBS,

red-painted bus lanes had been trialled; and prior to Ninth Avenue, a quick-build experiment at Tillary Street had tested a segregated cycle lane using in-house materials.

Working configurations were then institutionalised. Configurations and individual elements were codified within the DOT Street Design Manual: for example, the Manual contains design standards for different types of cycle lanes (indicated in Figure 6.6). For Select Bus Service and public plazas, institutionalisation was marked by elements being added to a 'toolkit' of elements, drawn on by DOT staff for a 'modular' approach to experimentation, with different elements assembled into configurations tested in different experiments.[98]

Table 6.6. Elements included in SBS route configurations.

Launch year	SBS route	Elements in the configuration						
		Priority bus lane	Transit Signal Priority	Off-board payment	Upgraded bus shelters	Camera enforcement	Bus bulbs	Real-time information
2008	Bx12	Kerbside	(later removed)			(added 2010)		
2010	M15	Kerbside Offset	(added 2013)				(added 2012)	
2011	M34	Kerbside Offset						(added 2012)
2012	S79	Kerbside Offset	(added 2015)					
2013	B44	Kerbside Offset	(added 2015)					
2014	M60	Kerbside Offset						
2015	M86	Queue jump only				(after 2015)		
2016	B46	Kerbside Offset					Temporary	
2016	Q70							

Table 6.6 shows the different elements included in SBS routes launched between 2008 and 2016. All of the columns combined display all the elements in DOT's SBS toolkit. Within the Bx12 experiment, certain elements were tested, and the overall configuration was institutionalised. Some elements *circulated* from Bx12 to testing in M15, which also

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[98] 'Toolkits' are referred to by DOT staff and presentations by them. 'Modular' is my choice of term.

tested and institutionalised further elements. In later experiments like the B46 routes, new elements like temporary bus boarding platforms were tested, and institutionalised as part of the toolkit. By referring to the 'modularity' of the toolkit approach, I mean that implementation of different elements for different routes has been selective.

Figure 6.11. Elements within NYC DOT 'plaza toolkit', illustrated with reference to Pearl Street Plaza. Image source: author.

Figure 6.11 illustrates some elements contained within DOT's toolkit for public plazas, with reference to the Pearl Street plaza in Brooklyn (in the summer, there is additional seating). Elements were tested and institutionalised in specific experiments, for example, coloured epoxy gravel in the case of Pearl Street. Comparing Google Street View captures of Coenties Slip Plaza over the years shows how the space has evolved and illustrates the quick-build approach (click the hyperlinks). Looking at Coenties Slip in 2012, we can see a plaza that had been made permanent through 'capital' construction in the early 2000s (*stabilisation*), following its experimental introduction in 1999 (section 6.1.1). Looking at the plaza in 2019, one can see how the plaza was enlarged through a second application of temporary materials or DOT's so-called 'operational' process, in 2013. These two processes – capital construction and the operational process that has been so central to

DOT experimentation – were themselves institutionalised in the Street Design Manual (NYC DOT 2015b).

Once a working configuration was institutionalised, it served as a policy-endorsed 'template', resulting in city-wide upscaling of particular types of public plazas, cycle lanes and bus service upgrades. Across other strands of experimentation with public space and traffic safety,[99] DOT employed a consistent technique of institutionalising experiment configurations into application-based programmes with specific funding and partnership models, through which their expansion could be resourced (section 6.1.2). The distinctiveness of the NYC case is that municipal techniques with respect to institutionalisation have been centrally important (chapter 7).

6.2.2 Summary of transformative impacts

The three categories of transformative impact that were developed inductively through analysis of the Bristol data, were applied also to analyse NYC trajectories and found relevant. Table 6.9 below summarises the transformative impacts generated by trajectories of experimentation displayed in Figures 6.6-6.11 above.

In what follows, I discuss transformative impacts for busmobility, velomobility, public space and automobility experimentation, in turn – including:

- Description of transformative impacts indicated in Table 6.9.

- For select trajectories, what factors explain the (lack of) transformative impact. This is limited to the types of experimentation for which there was enough causal evidence to rigorously explain Outcomes as linked to Context.[100]

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[99] The StreetSeats, Weekend Walks and Play Streets Programs; in addition, this pattern applied also to the Neighborhood Slow Zones and School Slow Zones programmes.

[100] Strands of experimentation that did not have transformative impacts include pedestrian access to bus stops (Figure 6.5), cycle parking and bicycles on public transport (Figure 6.6), parklets and car-free parks (Figure 6.8), congestion mitigation, car-sharing, vehicle safety technology, and hydrogen vehicle and EV taxi experiments (Figure 6.10).

Table 6.7. Summary of transformative impacts from NYC experimentation.

Trajectory of experimentation	Transformative impact		
	City-wide spatial expansion	Significant new policy or governance institutions	Change in mobility flows
Select Bus Service (busmobility)	Y – only red-painted bus lanes, bus bulbs	Y – Select Bus Service Program, NYC DOT as a public transport agency; NYC DOT-NYCT partnership	
Cycling infrastructure (velomobility)	Y – Class 1, 2, 3 lanes; Advanced Stop Boxes	Y – design typologies in Street Design Manual	Y – increase in cycling levels
Public plazas (public space)	Y – 72 plazas by 2016	Y – Public Plaza Program, Pedestrian Plaza Rules; Neighborhood Plaza Partnership, OneNYC Plaza Equity Program; reinforced BID/Conservancy partnership model	
Temporary car-free streets (public space)	Y – 56 Weekend Walks locations by 2016	Y – Weekend Walks Program, Summer Streets	
Travel to school (automobility)	Y – Safe Routes to School; Slow School Zones + speed cameras	Y – Safe Routes to School Program	Y – reduction in injuries, vehicle speeds
Traffic calming (automobility)	Y – Neigborhood Slow Zones	Y – Neigborhood Slow Zones Program	Y – reduction in injuries, casualties
Pedestrian safety (automobility)	Y – Safe Streets for Seniors; left-turn safety improvements	Y – Safe Streets for Seniors Program	Y – reduction in injuries

6.2.3   Busmobility: transforming the status of the humble bus

Select Bus Service: what explains transformative impact?

In a 'subway city', experimentation with Select Bus Service raised the status of busmobility within NYC DOT policy and NYC politics (NY10; NY09; NY17; NYC Council Speaker 2019). Following a first experiment, Select Bus Service was institutionalised as a DOT Program that continued to operate beyond 2016. As discussed in section 6.2.1, the trajectory produced an institutionalised Select Bus Service 'toolkit', linked to upscaling of SBS upgrades to 12 bus routes by 2016 (Figure 6.12). The SBS trajectory generated significant new policy institutions, in extending the remit of NYC DOT as an agency with

a prominent role in governing public transport, and a new governance institution in launching a long-standing partnership with MTA NYCT.
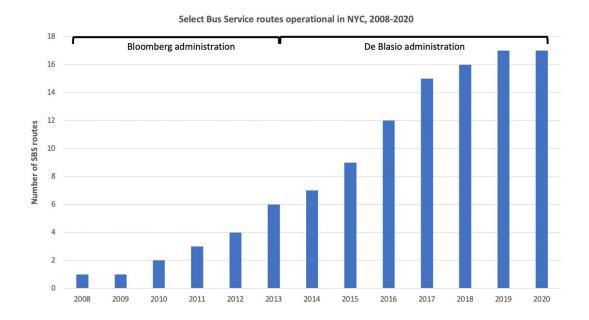
Figure 6.12. Expansion of NYC Select Bus Service.

Table 6.8 below summarises the Context factors that enabled these transformative impacts. As discussed in section 6.1.1, the trajectory tentatively began with the 2004 launch of the NYCBRT study by NYCT and NYC DOT. The study team was tasked with identifying corridors for five BRT corridors for a 'demonstration program' to be implemented within 5 years (McNamara et al. 2006), with this longer-term ambition and **organisational form** made possible by a $25 million dollar allocation for BRT in the MTA (2006) Capital Program. The study evaluated 36 potential corridors, identifying the Bx12 route as a priority corridor, on which the first experiment with SBS was launched (studied in-depth, Appendix B).

Table 6.8. Context factors enabling transformative impacts of NYC SBS.

Context factors	Phase of trajectory		
	Designing the configuration (NYCBRT study)	**Experiment establishing working configuration (Bx12 route)**	**Expansion following experiment (Select Bus Service Program)**
Municipal institutions and resources	Federal CMAQ, NYC city government, NYS DOT funding, MTA Capital Program commitment	PlaNYC political mandate; and municipal funding commitment Low-cost, quick-build implementation approach reliant on DOT operational funds; no external funding meant flexible implementation Structuring SBS as a programme, from which Bx12 demonstration could be launched and then expanded	OneNYC political mandate In response to Great Recession/SMART failure, endogenous strategy of securing CMAQ and competitive FTA grants; further MTA Capital Program funding Low-cost, quick-build implementation approach SBS toolkit approach - flexible route-by-route implementation and integration of new elements after experiments
Governance institutions	Tentative co-provision: NYCT initiative, securing NYC DOT as partner	Governing by co-provision: partnership between NYC DOT and NYCT	Governing by co-provision: partnership between NYC DOT and NYCT
Other/inductive factors		Agency leadership (Sadik-Khan/NYCT)	

PlaNYC gave the SBS programme a stronger political mandate and important additional funding (NY10; NY18). The tentative NYC DOT-NYCT partnership was solidified by a green light given from DOT and NYCT leadership (NY15; NY10; Barr et al. 2010). The Bx12 experiment was implemented using DOT's quick-build approach and drew primarily on municipal operational funds, with close collaboration with NYCT enabling a flexible and resourceful approach. The experiment was chosen to examine city-state politics (anticipated as per the funding and partner mix), but in fact, **governing by co-provision** with MTA NYCT was a key enabling factor. The SBS redesign of the Bx12 route decreased travel times, but according to interviewees the key data on which the experiment was judged a success was customer satisfaction (NY15) and the demonstration that the configuration 'worked': "*the key was showing results… showing that the sky doesn't fall*

in" (NY18). Because the Bx12 experiment was nested within a longer-term programme, plans for additional routes were immediately taken further. The factors and strategies enabling expansion of the Select Bus Service program are described in section 6.1.2 and 6.1.3. Details on how SBS expansion was funded is provided in Appendix G.

The extent to which SBS generated transformative change in busmobility flows is heavily debated because SBS expansion coincided with a decline in city-wide bus ridership and bus speeds. Bus ridership grew strongly from the mid-1990s (NYCDOT 2008d) but declined by 9% between 2000 and 2016, despite population and employment growth, with a steeper decline from 2013 onwards (Figure 6.13). The average speed of NYCT buses city-wide was largely flat between 2000 and 2016 (Figure 6.14).
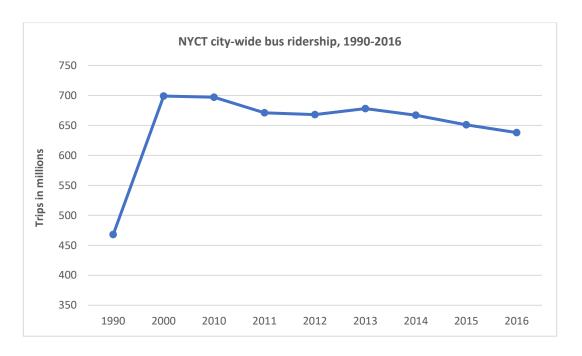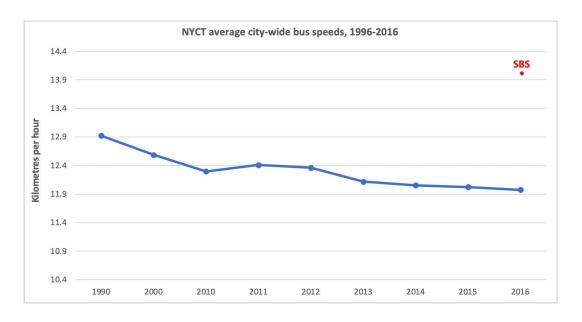
Figure 6.13. Bus ridership trend in NYC. Data source: NYC DOT (2018d).

Figure 6.14. Trend in NYC city-wide bus speeds. The average speed on SBS routes in 2016 is marked as a red dot. Data source: city-wide figures converted from miles per hour from NYC DOT (2018d), SBS figure from NYC Comptroller (2018).

However, it would be difficult to claim that the Select Bus Service Program was entirely unsuccessful: by 2017, SBS routes accounted for 12% of NYC bus ridership, and bus lane miles more than doubled since the 2008 launch (NYCDOT 2017a). Considering evidence regarding the impact of SBS upgrades on the performance of specific routes, it is clear that individual experiments had a positive impact on busmobility flows (Table 6.9). The longer-term impacts across a greater number of SBS routes have been mixed (NYC Comptroller 2018), yet the average decline in ridership on these SBS routes has been smaller compared to the city-wide decline (Figure 6.13) and average speeds are higher for SBS routes than city-wide routes (Figure 6.14). While city-wide trends are shaped by a complex set of factors beyond SBS, it is clear that SBS was not a 'silver bullet' for transforming busmobility in NYC.

Table 6.9. Impact of NYC bus experiments on mobility flows.

SBS route	Evidenced change in mobility flows
Bx12 route (NYCDOT and NYCT 2013)	Travel time savings: 20% change in first year Ridership growth: 10% in first year
M15 route (NYCDOT and NYCT 2013).	Travel time savings: 18% change in first year Ridership growth: 10% in first year
SBS routes implemented 2008-2017 (NYCDOT 2017a)	10-30% faster bus speeds About 10% increase in ridership More reliable service Customer satisfaction of 95% Safer streets/reduction in crashes
Nine SBS routes implemented from 2008-2015 (NYC Comptroller 2018)	Five out of nine SBS routes (M34, M15, B44, M60, Q44) saw a ridership decline in comparison to the year prior to SBS route redesign. On average, ridership declined by 0.2% on these nine routes, compared to a 5% decline in city-wide bus ridership between 2013-16 alone.
Innovative elements	**Evidenced change in mobility flows**
Transit Signal Priority (NYCDOT 2018b)	1-25% improvement in bus travel times on TSP route segments. M15 SBS (Lower Manhattan): 10% average reduction in travel times* B44 SBS (Shore Parkway to Flatbush): 13% average reduction* *Average of AM peak, midday and PM peak travel times along two directions of the route segment

We can thus also consider what constrained the transformative impact of the SBS Program. It was always intended to upgrade a limited set of high-ridership routes rather than routes city-wide: SBS routes represent a tiny proportion of over 300 routes operated by NYCT. Yet, upscaling of novel elements tested as part of the SBS configuration has been limited.[101] NYC politicians and CSOs critiqued DOT's slow expansion elements that have proven to improve bus service within the scope of SBS, e.g. high-quality bus shelters, real-time information, Transit Signal Priority and modified bus stop spacing/service patterns, to a larger number of routes city-wide.[102] Following this argument, the limited impact of SBS on busmobility flows can be explained by NYC DOT's and NYCT's decision to focus on a few routes, rather than comprehensive redesign of the bus network.

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[101] Only red-painted bus lanes, and 'bus bulbs' (kerb extensions to reach bus stops) have expanded city-wide.

[102] Bus stop spacing has not been adjusted for most of NYC's bus network (TransitCenter 2016a). A 2017 reports highlights that priority bus lanes accounted for only 104 miles of the city's 6000 road miles, and that only 22% of bus stops have shelters (NYC Comptroller 2017). The extent of Transit Signal Priority along NYC bus routes remained limited to 5 out of 16 SBS routes in 2016 (NYC DOT 2018b), despite evaluations having proven the benefits of this technology for route performance (Table 6.12; TransitCenter 2018b).

Others remarked that the SBS configuration scores poorly against international BRT standards, because of its lack of bus lanes that are effectively segregated from other traffic (Weinstock et al. 2011),[103] in line with the prevalence of 'BRT-Lite' services across US cities (Vincent 2010). In relation to the early SBS routes, the Pratt Center (2013, p.14) argued that:

> "Funding constraints, the desire to score relatively quick and demonstrable wins, and the reluctance to take on the political challenges of more extensive changes to street infrastructure all led to the strategic decision by MTA and DOT to move forward with SBS, rather than pressing for full-featured BRT".

While I found that DOT adopting a quick-build approach to SBS was an endogenous strategy in response to resource constraints, these constraints only emerged from 2009 *after* the Bx12 experiment, and the BHLS configuration was already designed at the NYCBRT study stage. The Pratt Center's argument regarding funding thus does not ring true. However, the Bx12 experiment illustrates that configurations can become 'locked in' when tested in experiments, i.e. become institutionalised and then expand within a trajectory. The NYCBRT study evaluated 36 potential corridors based on two key criteria: "benefits of BRT implementation in a given corridor" based on existing ridership and potential time savings, and "the potential ease of implementation of BRT in that corridor" considering constraints like traffic impacts and need to remove parking spaces (McNamara et al. 2006, p.6). This screening was done *with a specific configuration in mind:* a BHLS configuration including kerbside bus lanes that were not physically segregated from other traffic. The scope of the Bx12 experiment was thus predetermined. This suggests that *the potential of experiments is only as great as the configurations that they test.*

The Pratt Center's argument on political influence of street design for SBS corridors has credence. Interviewees cited public contestation of BRT lanes, e.g. the need to remove parking spaces, as a key barrier to expansion of the SBS programme (NY10; NY18). Policy documents on SBS repeatedly mention the need to test bus lanes with better segregation

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[103] Indeed, although I refer to SBS as BRT here because that is the term used in NYC policy, in reality the SBS configuration is equivalent to BHLS (Bus with High Level of Service) that was also implemented in Bristol (chapter 5).

from traffic (NYCDOT and NYCT 2009; 2013), but none were tested by 2016 and several plans scrapped due to public contestation (Sadik-Khan and Solomonow 2016; Beaton et al. 2013). The phenomenon of BRT becoming 'watered down' in this way is widespread across US cities (Malouff 2011).

6.2.4 Velomobility: setting NYC on the path of becoming a cycling city
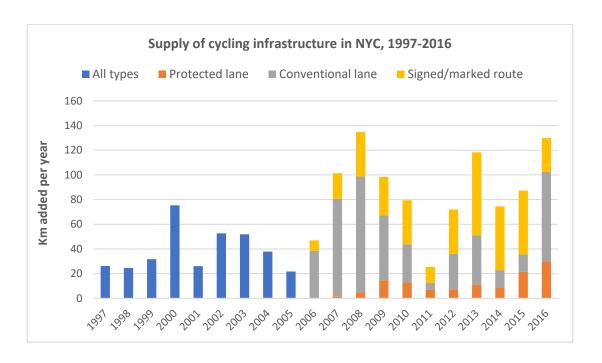
Protected cycle lanes: what explains transformative impact?

Experimentation with cycle lanes generated the greatest spatial transformation. The cycling network expanded from 375 km in 1996 to 1214 km in 2016, an increase of 224%,[104] shown in Figure 6.15. City-wide expansion went hand in hand with the institutionalisation of different cycle lane configurations in the DOT Street Design Manual (section 6.1.2). As shown in Figure 6.6, some cycle lane elements tested in experiments were expanded as part of Class 3 cycle routes shared with other traffic (signed/marked routes in Figure 6.16) and thus of lower quality from the user perspective; other elements were expanded as part of Class 2 lanes.[105] Following the experiment with NYC's first parking-protected cycle lane at Ninth Avenue, Class 1 lanes also expanded.[106] The expansion of the cycling network contributed to transformative change in velomobility flows. Before-and-after analysis of the Ninth Avenue protected cycle lane experiment and subsequent upscaling to Manhattan Avenue indicates significant increases in cyclist volumes (Table 6.10).

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[104] 1996 figure from Wright (2017) converted from miles to kilometres; 2016 figure from source indicated in Figure 6.16.

[105] The 2015 Street Design Manual distinguished between three types of cycle lanes: Class 1 protected cycle lanes (described in footnote below); Class 2 cycle lanes designated through road markings only; and Class 3 routes that are not exclusive to cyclists (divided into 'shared' lanes marked with chevron arrows, and routes indicated through signage only).

[106] Class 1 protected cycle lanes are segregated from traffic, with two variations: protected at intersections using special bicycle traffic signals (Class 1a in Figure 6.6), or unprotected at intersections through designs employing 'mixing zones' (Class 1b in Figure 6.6). Both Class 1a and 1b account for the expansion of protected lanes shown in Figure 6.15.
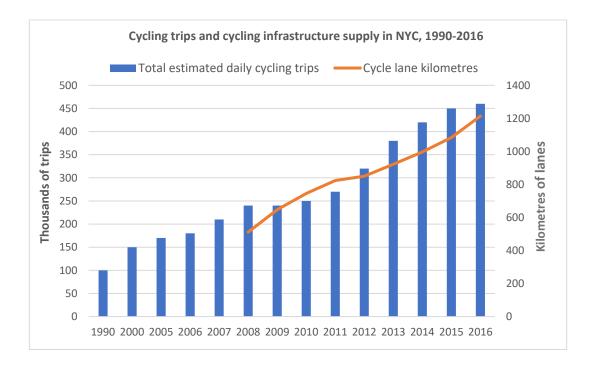
Figure 6.15. Expansion of cycle lanes in NYC. Data source: 1997-2005 figures from Nicaj et al. (2006), 2006-2016 figures from NYC DOT (2017g).

Table 6.10. Impact of NYC cycle lane experiments on mobility flows. Data source: NYCDOT (2014b).

Cycle lane route	Change in cyclist volumes (data prior to implementation, and up to three years after implementation)
Ninth Avenue (16th to 23rd Street, 2007 experiment segment)	65% increase
Eight Avenue (23rd to 34th Street)	9% increase
First Avenue (1st to 34th Street)	160% increase

As shown in Figure 6.16, total city-wide cycling trips increased steadily from the 1990s onwards, with a significant increase from 2007 coinciding with increased infrastructure supply. Cyclist safety improved, with the average number of cyclists Killed or Seriously Injured (KSI) decreasing by 73% from 1996-2000 to 2011-2015 (NYCDOT 2017g). Considering the NYC-specific evidence cited and other studies showing positive association between protected cycle lanes, cycling trips and perceptions of cycling safety

(Pucher and Buehler 2008; Aldred et al. 2016; Deegan 2018), it is safe to assume that trajectories of experimentation have contributed to increasing cycling.

Figure 6.16. Co-evolution of cycling trips and infrastructure supply in NYC. Data source: trip data from NYC DOT (2016a), infrastructure figures for 2008-2013 from NYC DOT (2013a) and figures for 2014-2016 by adding miles implemented during those years, reported in Wright (2017).

Table 6.11 summarises Context factors that enabled these transformative impacts, drawing on section 6.1.1 and 6.1.2. The first experiment with a protected cycle lane in NYC was at Tillary Street in Brooklyn, implemented using a quick-build approach in 2006, and this influenced the experiment with NYC's (and possibly the country's) first experiment with a parking-protected cycle lane along Manhattan's Ninth Avenue (studied in-depth, Appendix B). This was designed to test a scalable cycle lane configuration to kick off the PlaNYC initiative to expand the city-wide network, and was indeed institutionalised as a standardised design and scaled up. In 2007, NYC DOT did not have a sophisticated evaluation process in place for cycle lanes, so the decision to embed the configuration was based on planners observing that the configuration 'worked' operationally, and that the lane was actively used (NY06).

The Ninth Avenue experiment illustrates how endogenous strategies were required to circumvent constraints on infrastructure design imposed by federal funding. As mentioned in section 6.1.1, the federal CMAQ programme was flexible in allowing funds to be spent on a broad range of activities. However, all local mobility 'projects' in receipt of federal funding are reviewed by the awarding MPO against federal AASHTO and MUTCD infrastructure standards.[107] This meant that NYC DOT had to fight to push through its experimental cycling infrastructure projects, which did not always align with these standards, among risk-averse NYMTC officials (NY20). NYC DOT staff used the quick-build approach, funded by DOT operational resources, in order to circumvent this design review requirement, i.e. purposedly *not* using federal funding for the implementation phase. The findings also revealed a significant role played by civil society throughout the trajectory, and how CSOs were interrelated with public contestation of cycle lanes and political leadership (inductive factors, section 7.5).

Table 6.11. Context factors enabling transformative impacts from NYC cycle lane experimentation.

Context factors	Phase of trajectory		
	Cycling policy development and testing elements	**Experiment establishing working configuration (Ninth Avenue protected cycle lane)**	**Expansion following experiment**
Municipal resources	Securing federal CMAQ funding; provided a stable resource base for capacity-building within DOT Bike and Pedestrian Projects group Municipal funding (Tillary Street experiment)	PlaNYC polital mandate, municipal operational budget allocation Low-cost, quick-build approach reliant on DOT operational funds; no external funding meant flexible implementation and exemption from NYMTC review	Federal CMAQ, STP funding; Municipal funding commitment (de Blasio/Vision Zero) Low-cost, quick-build approach Circumventing federal street design guidelines; pushing grants through NYMTC review Institutionalisation into Street Design Manual

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[107] The American Association for Highway Transportation Officials (AASHTO) *Green Book* (Policy on Geometric Design of Highways and Streets) and the FWHA *Manual on Uniform Traffic Control Devices* (MUTCD).

Governance institutions	Governing by provision, without partnership	Governing by provision, without partnership	Governing by provision, without partnership
Other/inductive factors	Civil society advocacy – policy development (NYC Bicycle Master Plan, lobbying Doctoroff)	Civil society advocacy – protected cycle lanes; community vision for Ninth Avenue redesign	Civil society advocacy – demonstrating public support for controversial infrastructure

6.2.5 Public space: reallocating street space to transform public life

Experimentation with public space in NYC resulted in city-wide spatial expansion of some novelties, and in the greatest transformation of policy and governance institutions.
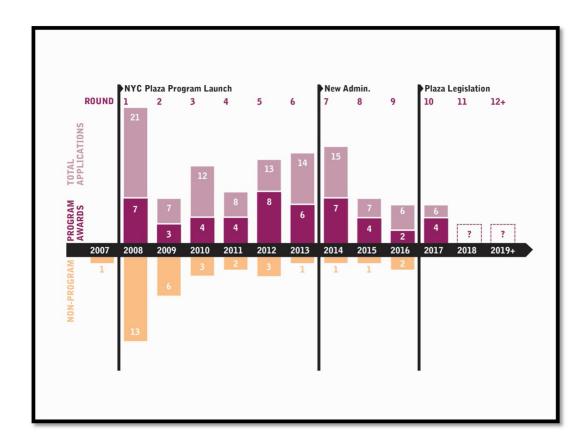
Temporary car-free streets: transformative impacts from long-running initiatives

Experiments with temporary car-free streets resulted in significant new DOT policy institutions: Summer Streets has been an annual multi-day occurrence closing Manhattan avenues to traffic since 2008, whereas multi-day and multi-block street closures as part of the Weekend Walks Program have been running since 2010. Weekend Walks events expanded city-wide to 56 locations across all five Boroughs in 2016 (and further since then), totalling 96 days of street closures. These trajectories were not studied in-depth, but as discussed in section 6.1.2, they were associated with DOT governing by co-provision, enabling and drawing on co-funding from non-state actors.

Public plazas: what explains transformative impacts?

The Public Plaza Program emerged as a new policy institution that signified the broadening of NYC DOT's remit to governing public space. By 2016, the Program encompassed 72 plazas city-wide, with the evolution over time shown in Figure 6.17. While this expansion constitutes a significant transformation of NYC streets, the findings point to the challenge in determining the impact of new public spaces on mobility flows, discussed further in chapter 9. Table 6.12 summarises the available evidence. There is evidence that larger-scale experiments like Green Light for Midtown (testing partial pedestrianisation of Times Square and Broadway) and Summer Streets resulted in

improved traffic safety, increased pedestrian volumes and physical activity. However, these impacts cannot be considered transformational because they are limited to specific spaces and/or months of the year. For most other public plazas, data is only available on footfall measured at specific times, and on retail sales, in line with NYC DOT's evaluation process focused on measuring impacts on local business (section 6.1.2).

Figure 6.17. Public plazas implemented by NYC DOT. Plazas initially implemented outside the DOT Plaza Program are marked as 'Non-Program', plazas within the Program are marked as 'Program Awards'. The 'New admin' milestone refers to the start of the de Blasio administration, 'Plaza legislation' to Local Law 53/2016. Image source: provided to the author by NYC DOT.

Table 6.12. Impact of NYC public space experiments.

Experiment	Evidenced impact
Pedestrianisation of Broadway and Times Square	Green Light for Midtown (one-year after): injuries to motorists reduced by 63%, pedestrian injuries reduced by 35%, 80% fewer pedestrians walking in the roadway, pedestrian volume along Broadway increased by 11% (NYCDOT 2010a).
Pearl Street Plaza	172% increase in retail sales at locally-based businesses, compared to 18% borough-wide (NYCDOT 2012c)
Summer Streets	2008 (first experimental year): 50,000 people participated, 24% of participating New Yorkers who did not routinely engage in physical activity did so at the event; majority of participants arrived by bicycle (Wolf et al. 2015)
Weekend Walks - Montague Street	2010: 76% of merchants saw increased foot traffic, 86% of the merchants surveyed reported an increase in sales during the event (NYCDOT 2011c)

Table 6.13 summarises the Context factors that enabled transformative impacts. The precursors and Willoughby Plaza as a 'template' configuration endorsed in PlaNYC have been discussed in section 6.1.1 and 6.1.2. In the expansion phase, several techniques of institutionalisation were used by DOT staff (section 6.2.1). The quick-build approach drawing on municipal operational funds continued to be used up until 2016: its importance in circumventing NYC city government's slow capital construction process and the need for municipal capital budget allocation is illustrated by the fact that many temporary plazas implemented prior to 2010 had not been reconstructed using permanent materials by 2019 (NY01).[108] DOT was also able to use CMAQ grants for some elements of plaza experiments – illustrating the flexibility of the CMAQ programme.[109] DOT's strategy of **co-provision** and **co-funding** with BIDs and other non-profit organisations that was crucial to expansion.[110] To help BIDs cover their maintenance costs, NYC city government introduced a 'concessions' model through which plaza partners can generate revenues through commercial sponsorship or allowing food vendors to operate in the space (NY01). This model, as well as other types of activities permitted in plazas, was codified in the 'Pedestrian Plaza Rules' (NYC DOT 2016d), as a new piece of local

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[108] Observed during fieldwork, e.g. at Pearl Street Plaza.

[109] While CMAQ makes explicit provision for pedestrian- and cyclist-focused interventions, the NYC DOT approach of using CMAQ grants to purchase plaza street furniture was more unorthodox (Gates Patrick 2008).

[110] When probed for a counterfactual of what the Plaza Program might have looked like without non-state co-funding, an interviewee commented it was difficult to imagine and suggested that the Program probably would have taken a less transformative form with smaller, more modest spaces (NY01).

legislation (significant new policy institution). The DOT Plaza Program thus reinforced and vastly expanded the mode of governing by co-provision with BIDs, that pre-existed in 1997. As hinted at in section 6.1.2, findings revealed that CSOs played an important role in enabling the plaza trajectory (section 7.5).

Table 6.13. Context factors enabling transformative impacts from NYC plaza experimentation.

Context factors	Phase of trajectory		
	Precursors – early experiments (Coenties Slip, etc.)	**Experiment establishing working configuration (Willoughby Plaza)**	**Expansion following experiment (Plaza Program)**
Municipal institutions and resources	Federal CMAQ funding for staffing/planning studies Low-cost, quick-build approach reliant on DOT operational funds	Low-cost, quick-build approach reliant on DOT operational funds Model of BIDs paying for maintenance costs particularly attractive in context of Great Recession	Institutionalisation into PlaNYC; application-based programme; Street Design Manual; plaza toolkit Concessions model to support BID partners PlaNYC capital funding commitment; flexibility of CMAQ funding Low-cost, quick-build approach reliant on DOT operational funds Philanthropic funding for Neighborhood Plaza Partnership, OneNYC Plaza Equity Fund allowed city-wide expansion
Governance institutions	Co-provision in partnership with BIDs	Co-provision in partnership with BIDs	Co-provision in partnership with BIDs, Conservancies and non-profit community organisations
Inductive factors		Civil society advocacy – NYC Streets Renaissance Campaign	Civil society advocacy – Friends of Diversity Plaza Individual leadership – Trottenberg for OneNYC Plaza Equity Fund

The challenge that NYC DOT faced was that the PlaNYC goal was to implement one public plaza city-wide in each of 59 'community districts', but the Plaza Program was predominately receiving applications from BIDs in wealthier neighbourhoods (NY01; Janoff 2018). Developing a funding model to allow non-profit organisations in lower-income neighbourhoods to participate was crucial to enabling city-wide expansion. DOT partnered with the Horticultural Society of New York, a philanthropically-funded 'park conservancy' common across NYC,[111] to develop such a model with the Neighborhood Plaza Partnership (NPP), which was tested at several locationd including Diversity Plaza in the Jackson Heights neighbourhoods of Queens (studied in-depth, Appendix B). Diversity Plaza was an existing space in a lower-income neighbourhood without local organisations that had the organisational and financial capacity to manage and co-fund maintenance, including liability insurance, operating concessions, cleaning crews, event permits, etc. During NPP's development, a resident-led community group called Friends of Diversity Plaza resisted the insistence of other partners for it to register as a formal non-profit organisation and take on some of these functions, and instead successfully lobbied NYC decision-makers, along with the NPP team and DOT Commissioner Trottenberg, to commit to funding plaza maintenance in low-income neighbourhoods from the municipal budget. This new model that NPP morphed into, the OneNYC Plaza Equity Program, was a significant new policy and governance institution that represented a break with the model of co-funding and co-provision with BIDs establishes since the 1980s. Thus, although public space experimentation in NYC reinforced the pre-existing mode of BID co-provision overall, the OneNYC Plaza Equity Program represents a tentative step towards an alternative politics of public service provision.

6.2.6 Automobility: transforming safety, limited reconfiguration of car use

NYC city government experimentation with improving traffic safety generated transformative impacts, but experiments with reconfigured car use generated the least transformative impact, among all types of experimentation. Notably, there was no

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[111] Park conservancies were established in the 1970s, in response to cuts to the municipal parks budget (Krinsky and Simonet 2017) - reflecting the same shift towards co-provision as BIDs (section 4.3.4).

significant reform of parking policy (Nessen 2019) – in 2018, 97% of on-street parking spaces in NYC remained free to use (Shoup 2018).

Traffic safety programmes: transformative impacts

Experimentation resulted in significant new policy institutions in the shape of DOT programmes: e.g. Safe Routes to School, running since 2004. Street engineering, speed limits and speed cameras installed as part of Safe Routes to School and Slow School Zones programmes expanded to improve safety at hundreds of locations city-wide; similarly, neighbourhood-scale traffic calming (Neighborhood Slow Zones Program) and street redesign focused on elderly citizens (Safe Streets for Seniors Program) expanded to dozens of neighbourhoods. An experiment with traffic calming at left-turn intersections launched by the 2014 Vision Zero Action Plan was scaled up to improve safety at hundreds of intersections city-wide. By 2016, and in some cases post-2016, all of these trajectories generated transformative change not only in terms of their spatial extent, but also in terms of mobility flows – if measured in metrics of people Killed and Seriously Injured (KSI) and unsafe vehicle speeds, as shown in Table 6.14.

Table 6.14. Impact of NYC traffic safety experiments on mobility flows.

Experiment	Evidenced change in mobility flows
Safe Routes to School Program	30 schools with interventions in the surrounding area: annual rate of school-age pedestrian injury decreased 44% between 2001-2010 (DiMaggio and Li 2013). Muennig et al. (2014) also find the SRTS Program has reduced the risk of pedestrian injuries.
School Speed Camera pilot program	21% decline in KSI from crashes within school speed zones with speed cameras; 63% decrease in speeding during school hours (NYCDOT 2018a).
Neighborhood Slow Zones	2012 data on four Slow Zones one year after implementation: 14% reduction in crashes with injuries and 31% reduction in vehicle injuries (NYCDOT 2014a). Road casualties fell by 8.7% from 2011 within over 20 Slow Zones, while they increased in control zones, data for 2011-2017 (Jiao et al. 2019).
Safe Streets for Seniors	Post-implementation data on 121 interventions within senior pedestrian safety focus areas: 15% decrease in pedestrian injuries, 9% decrease in total injuries (NYCDOT 2017f).

NYC city government was only involved in one experiment with EV charging infrastructure, which did not launch a transformative trajectory. This was initiated by the federal government's ChargePoint America programme (studied in-depth, Appendix B): primarily aimed at job creation after the Great Recession, but also seeking to create a national 'living laboratory' harvesting data from local EV charging demonstrations. The federal government awarded funding to Californian company Coloumb Technologies to install 5000 charging points across US city-regions, with the grants leaving local partners and charging locations to the discretion of Coloumb. In 2010, NYC city government had already adopted a strategy of **enabling** the private sector to provide EV charging infrastructure, instead of municipal **(co-)provision**.[112] Coloumb worked with privately-operated, publicly-accessible parking garages to install 200 charging points across the NYC city-region, with NYC OLTPS only doing light facilitation. Although the experiment did result in institutionalisation in new local legislation requiring private parking garages to have a minimum level of infrastructural *readiness* for EV charging points, this does not require actual *installation* of charging points (City of New York 2016a). Although the number of charging points installed by private providers grew gradually, the ChargePoint experiment did not launch a trajectory generating sufficient access to EV charging points across NYC, since EV consumer uptake was slow to grow: up until 2016, EV registrations in NYC fell considerably below NYC city government projections.[113]

The federal ChargePoint America programme can be critiqued for its unsophisticated design, in awarding millions of dollars in discretionary grants to private companies, without requiring partnerships with municipalities and exploration of context-specific needs. However, the key factor constraining transformative impacts was NYC city

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[112] OLTPS commissioned a market research study of EV consumer adoption in NYC (City of New York 2010a), which recommended that NYC city government should focus on the needs of early adopters. The research found early adopters would likely charge their vehicle at home or be willing to use private facilities, and did not recommend municipal investment in public EV charging infrastructure. Thus NYC city government decided to facilitate a market-led approach by informing private providers about EV consumer needs (City of New York 2011a).

[113] Between 2011-2015, 2230 plug-in EVs were registered in NYC (NYCDOT 2016c, p.11), while 1.9 million standard passenger vehicles were actively registered in NYC, in 2015 (NYSDMV 2021). In 2010, NYC city government projected that "by 2015, up to 14-16% of all new vehicles purchased by New Yorkers could be electric vehicles" (City of New York 2010a, p.5).

government's decision to take a passive approach to enabling market-driven provision of EV charging infrastructure, rather than proactive co-provision. For example, the market-driven approach resulted in most charging points being located in Manhattan, which posed challenges for achieving a city-wide network and equal access across the five Boroughs (NY14). In 2016, NYC city government concluded that "a lack of a robust *public* infrastructure network to support ZEVs is a major reason their uptake has lagged in New York City" (City of New York 2016a), announcing future municipal investments.[114] Only three years after the end of the ChargePoint America experiment, the NYC City Council reoriented the city's EV policy to focus on municipally-initiated public-private partnerships to test on-street charging infrastructure (Appendix B).

6.3 Summary: municipal capacity for transformative experimentation

With regard to RQ1.1, the vast majority of NYC experiments resulted in embedding of some kind, and many experiments also launched trajectories that generated transformative change in NYC's mobility system. Transformative experimentation thus occurred in NYC between 1996 and 2016.

Starting with RQ1.2, we can summarise the findings for *external mobility funding* as an *exogenous driver* shaping experimentation. NYC city government was chosen as a case because it enjoys a high degree of fiscal autonomy, and thus a low degree of reliance on external funding. My findings revealed that US federal government funding was important for mobility experimentation, as a specific type of NYC DOT activity, particularly during periods of austerity politics with downward pressure on municipal expenditures.

Federal funding programmes were an enabler of transformative impact, rather than a constraint. The CMAQ funding programme in particular, was very important for DOT capacity for transformative experimentation with velomobility, public space and even

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[114] Citing the fact that in 2014, the NYC city-region had the lowest per capita number of EV charging points, among 25 other US city-regions (Lutsey et al. 2015, p.21).

busmobility. Where there were constraints, NYC city government devised effective endogenous strategies to overcome them:

- With regard to the *scope of experimentation,* the CMAQ programme was highly flexible. Where use of federal funding required review of cycling infrastructure design against federal regulations, the interpretation of these was down to NY state government officials and city-state politics, and NYC DOT successfully pursued an endogenous strategy of using municipal operational funds for experimentation, to circumvent such review. Broadly, NYC DOT managed to push through its priorities for the size/length and scope of its grant applications within the NYMTC process for releasing federal funding. There is no evidence that competitive FTA grant programmes constrained the transformative impacts of Select Bus Service, even if these had stricter requirements.

- With regard to *organisational form*, federal grants were awarded by NYMTC in the form of projects. From 2007, NYC city government pursued an endogenous strategy of anchoring these within permanent organisations and institutionalising temporary interventions in programmes (semi-permanent organisations), which triggered a shift to a more systemic Type 4 approach to experimentation.

- With regard to *evaluation processes,* the influence of federal funding requirements was negligible (discussed further in the next chapter, section 7.1). Although endogenously-designed analysis of interventions was an important element of NYC DOT capacity generally, data-intensive or formalised evaluation results were not a key factor explaining transformative impacts in relation to the four trajectories I studied in-depth (Select Bus Service, protected cycle lanes, public plazas and EV charging).

Austerity politics was a more significant exogenous driver (RQ1.2) than external mobility funding, for the NYC case. Austerity cuts to municipal expenditures sought to to balance the municipal budget and/or economic downturns (9/11, Great Recession), determined by the politics of different NYC Mayors. Yet overall, austerity was also linked to a *discourse*

of scarcity, as municipal resources grew steadily over the study period. Endogenous strategies in response to austerity politics were central to NYC DOT capacity for transformative experimentation, including: use of the low-cost, quick-build approach to experimentation, and use of co-funding from non-state actors for public space experimentation, drawing on a pre-existing mode of governing by co-provision that emerged in response to austerity politics following the 1970s fiscal crisis.

Turning to RQ1.3 and the influence of governance institutions on NYC city government capacity, I found that:

- There were no significant exogenous drivers or multi-scalar politics influencing the governance modes that NYC city government chose to adopt.

- Expanded co-provision with NYCT in governing busmobility was effective in generating transformative impacts, and the NYC DOT-NYCT partnership managed to overcome city-state politics, at least up until 2016.

- Co-funding linked to governing by co-provision and enabling was central to enabling transformative impacts from experimentation with public plazas.

- Governing by enabling the private sector was unsuccessful in launching a transformative trajectory for EV charging infrastructure.

- To a significant extent, NYC city government continued to govern through provision and authority, without partnership, which was linked to many transformative trajectories (cycle lanes, traffic safety).

7 COMPARING MUNICIPAL CAPACITY

This section compares municipal capacity for transformative experimentation in Bristol and NYC, answering Primary RQ1: *How did multi-scalar governance cause municipal capacity for transformative experimentation to differ in Bristol and New York City, between 1996/7 and 2016?*

Section 7.1 compares the Outcomes of experimentation (RQ1.1 findings) in Bristol and NYC. Experimentation trajectories had transformative impacts in both contexts, but I conclude that experimentation was *more transformative* in NYC, compared to Bristol.

The remainder of the chapter then analyses what Context factors describe this difference in Outcomes, starting with the factors related to municipal institutions and resources (RQ1.2, section 7.2), followed by factors related to governance institutions (RQ1.3, section 7.3). Section 7.4 then draws together the comparative analysis by answering Primary RQ1 in full. Section 7.5 briefly presents inductive findings on the influence of 'local' politics on municipal capacity for transformative experimentation.

7.1 Comparing outcomes

This section compares case findings for RQ1.1: *To what extent and in what ways have experiments resulted in embedding and transformative impacts?* It reveals that broadly similar mobility experimentation has taken place in the case contexts, which supports my argument that experimentation in Bristol and NYC can be meaningfully compared, because it has been undertaken within a shared global context of purposive reconfigurations away from automobility and sustainability entrepreneurialism.

7.1.1 How transformative was experimentation?

Below, I compare and contrast the transformative impacts described in section 5.2 for the Bristol case (Table 5.6) and section 6.2 for the NYC case (Table 6.7).

In both Bristol and NYC, municipal governments launched experiments with a similar Bus with High Level of Service configuration (Showcase bus service/Greater Bristol Bus Network, Select Bus Service), launching a trajectory of experimentation that transformed busmobility. The trajectory expanded the municipalities' policy agenda for public transport, and transformed busmobility governance by asserting greater municipal leadership in improving the city's bus services – in Bristol, vis-à-vis private bus operators, and in NYC, vis-à-vis MTA NYCT. New types public-private (Quality Partnership Agreements) and public-public (NYC DOT-NYCT) partnerships emerged and were segmented through successful experiments proving the ability for collaboration. Ridership on the upgraded bus routes improved, in both cities. However, BHLS upgrades were limited to a smaller number of bus routes, with most innovative elements not expanded to improve bus services city-wide, in either context. In Bristol, however, BHLS expansion did contribute to a city-wide increase in bus ridership, whereas in NYC it did not.

Both municipal governments successfully introduced novelties through experimentation significantly increased cycling levels among residents. In Bristol, this was primarily achieved through behaviour change-oriented experiments to promote commuter cycling via employers; whereas in NYC, it was primarily achieved through expansion of the cycling infrastructure network, including protected cycle lanes. Experiments resulted in the institutionalisation of new, bespoke design standards for cycling infrastructure in NYC, with cycling becoming established as a major area of policy for NYC DOT. In Bristol, change manifested in governance institutions, as cycling experiments opened up a greater role for employers and the private sector in the governance of sustainable commuting in the city-region.

NYC city government pursued a much more ambitious public space agenda, compared to BCC. Experimentation trajectories resulted in city-wide expansion of new public plazas and temporary car-free streets. Reallocation of street space from vehicles to public life was much greater in NYC: between 2007 and 2013 alone, approximately 16 hectares or 29 football fields of road space was repurposed for plazas, public seating and other pedestrian space (NYCDOT 2013c). Car-free street events amounted to 96 days of street closures in neighbourhoods city-wide, i.e. a quarter of a year in total. BCC's limited number of public

space experiments mostly failed to have transformative impact. Circling back to chapter 1, the only public space innovation to really take off in Bristol was play streets, which expanded city-wide and became institutionalised, led by a civic initiative that BCC supported financially. BCC support also helped to support the growth of the Bristol Bike Project, as a long-standing cooperative that nurtures local cycling culture and mobility justice. Overall, however, BCC's endogenous strategy of enabling local civil society experimentation bore limited fruit.

NYC DOT's focus on improving the safety of NYC streets resulted in dramatic reductions in traffic fatalities and injuries; to which experiments with novel configurations targeting travel to school, neighbourhood-level traffic calming and elderly citizens contributed. BCC's safety agenda was limited to the city-wide expansion of 20mph speed limits: this trajectory did reduce traffic injuries, but still pales in comparison to the evidence on traffic safety improvements achieved in NYC.

In contrast, experimentation with reconfiguring car use was more transformative in Bristol. NYC city government's experiments with parking reform and low-emission vehicles did not amount to much by 2016. BCC's experimentation resulted in a mature local market for car-sharing, with several providers competing for members. BCC also successfully pushed through parking reform with the city-wide introduction of resident parking zones, following an initial probing experiment. Where NYC city government was hesitant to invest municipal resources in public EV charging infrastructure and opted for facilitating market-led provision, BCC secured resources from the private sector and national government to experiment with and expand a city-regional charging network – followed by a transition to a fully municipally-owned network after 2016.

Both BCC and NYC city government had successes in transforming respective mobility systems. However, I argue that experimentation was more transformative in NYC because of the greater *material* transformation linked to street space reallocation (public space, protected cycle lanes) away from cars and improvements to traffic safety.

In NYC, transformative impacts were also achieved in a more condensed time period, compared to Bristol. NYC city government's commitment to transitioning away from automobility and adoption of experimentation as a governing mechanism to achieve that only began in earnest from 2007. From 2007 to 2016, *for the first time*: sustainable urban mobility emerged as a policy area central to NYC politics; dozens of new DOT programmes and design codes were institutionalised; and new local legislation was made. Most of the transformative changes to mobility flows and the city-wide changes to streetscapes and infrastructures in NYC, by 2016, occurred as a result of experimentation that was undertaken after 2005. NYC city government also introduced configurations that were virtually unknown in the US (protected cycle lanes, quick-build plazas). I argue that this warrants describing the transformation of NYC's mobility system as *radical*.

The transformation of Bristol's mobility system was more *incremental*. In the late 1990s and early 2000s, many novelties were introduced in Bristol based on EU and UK policy trends, and BCC incrementally expanded these same novelties up until 2016. However, the Bristol findings point to a distinct sense of policy incrementalism and limited municipal government capacities that have characterised urban mobility systems across the UK since the mid-1990s (Docherty and Shaw 2011). Thus I conclude that the capacity of NYC city government for transformative experimentation has been greater, based on a qualitative distinction between radical versus incremental transformation of urban mobility systems.

7.1.2 Patterns of embedding

Findings reveal that most experiments resulted in some kind of embedding of novel configurations, with 87% of NYC experiments resulting in combinations of different embedding outcomes beyond *stabilisation* (the configuration being made permanent *in situ*, section 6.2.1), and the equivalent figure for Bristol experiments being 72% (section 5.2.1). This quantitative figure for Bristol and NYC cannot be compared outright, as there was no control to ensure the comparability of the two large-N samples of experiments. Here, I compare the qualitative patterns of embedding.

Sections 5.2.1 and section 6.2.1 show that embedding of experimental configurations is not simply a contingent event, but a result of municipal decisions: to draw on knowledge, or sometimes physical artifacts, produced by one experiment and redeploy this in another experiment (circulation); to create new policy or governance institutions or modify existing ones (institutionalisation); and to marshal municipal resources to extend a configuration spatially (scaling up). Certainly, other actors have influenced these processes, putting forward their own ideas and resources (see chapter 9), yet embedding has ultimately involved municipal decisions and deliberate *endogenous strategies*.

For many trajectories in Bristol and NYC, embedding of experiment configurations took on a similar sequential pattern of: testing and circulation of elements, assembly of these into working configurations, institutionalisation of this configuration, followed by scaling up (discussed further in chapter 9). Three differences in the embedding patterns in Bristol (Table 5.5) and NYC (Table 6.5) can be observed.

First, in NYC, this sequence of embedding unfolded much more *rapidly* for busmobility, velomobility and public space experimentation, especially when a working configuration was tested, this was then institutionalised and scaled up relatively immediately; whereas in Bristol, we can note a slower sequence with more time lags between the 'steps'. For example, it took from testing busmobility technologies in the late 1990s to 2011 for these to be *begin* being scaled up as part of an integrated service (Greater Bristol Bus Network), whereas in NYC, some elements were tested in 2005-2007 and by 2013 these had been scaled up to six Select Bus Service routes. The conclusion drawn regarding incremental versus radical transformation (previous section) reflects this.

Second, experiments in Bristol were more *tentative* than in NYC: there were several 'rounds' of experiments testing configurations that were *not* stabilised (i.e. not made permanent), and circulation of elements to further experiments (e.g. one experiment 'built on' a previous one, but with modifications) before a working configuration was found. NYC experiments also featured tentative testing of novel configurations, but the tentativeness of NYC experiments often centred around *how* a 'working' configuration that could achieve policy objectives would look, rather than *whether* pursuing a particular

type of policy innovation associated with that configuration was desirable. This type of tentative testing is difficult to distinguish from *demonstration* as an aim, e.g. the first Bx12 experiment with Select Bus Service was indeed called a 'demonstration route' that was hoped to demonstrate that BRT could 'work' in NYC.

Third, we can note greater overall heterogeneity of embedding patterns in Bristol, with less clear patterns of institutionalisation. Embedding in NYC exhibits clear and similar patterns for busmobility, velomobility and public space. The Bristol data was analysed first, and the *general* sequential pattern of circulation, working configuration, institutionalisation and scaling up was first noted on the basis of that data, and then later found to also characterise the NYC data. With the specific embedding patterns, this was done the other way around: the analysis was first conducted for the NYC data (to produce Table 6.5), and after specific strategies of institutionalisation employed by NYC city government were noted, I 'looked back' at the Bristol case and repeated this analysis (to produce Table 5.5). What became clear from the analysis of NYC data is that municipal government used systematic strategies to institutionalise configurations tested in experiments (design typologies and implementation approaches in the Street Design Manual, 'toolkits', local legislation). NYC policy strategies committed to introducing novelties with a particular timeline and budget allocation, with experiments and further actions then reported on in 'progress reports'. BCC employed no comparable systematic strategies. Institutionalisation in Bristol largely amounted to strategic policy documents 'adopting' an experimental configuration as part of a loosely-structured agenda (e.g. not with specific timeline or budget for expansion); specific instances of institutionalisation in new governance arrangements (Quality Partnership Agreements) or regulatory processes (Temporary Play Street Order) were exceptional.

The rest of this chapter explains why NYC city government had greater capacity for transformative experimentation, compared to BCC.

7.2 Comparing municipal institutions and resources

This section focuses on comparative analysis for RQ1.2: *How have the internal institutions and resources of municipal government influenced capacity for transformative experimentation?*

7.2.1 Approaches to experimentation and experiment funding

Figure 7.1 shows the evolution of experimentation approaches in Bristol and NYC. The scope of experimentation in NYC was determined by municipal visions rather than external priorities throughout the study period, however with a shift from a *piecemeal* Type 2 approach between 1997 and 2006, to a Type 4 *systemic* approach from 2007 to 2016.
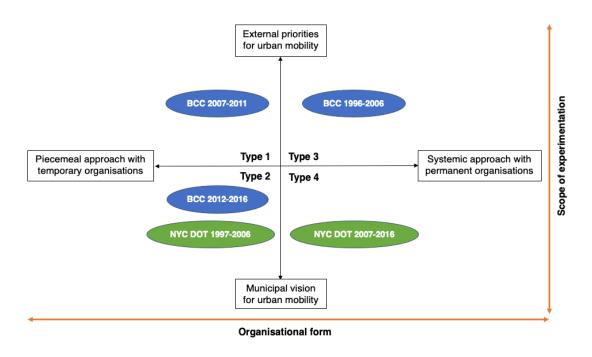
Figure 7.1. Comparing approaches to experimentation in Bristol and NYC.

In Bristol, the scope of experimentation was determined by external priorities throughout most of the study period, from 1996 to 2011. The first decade (1996-2006) was characterised by a Type 3 approach, with BCC pursuing EU and UK government priorities through a *systemic* approach; between 2007 and 2011, these priorities were pursued through a more *piecemeal* approach. Between 2012 and 2016, experimentation

remained piecemeal, but shifted to Type 2, as BCC asserted its own visions and priorities for urban mobility experimentation more strongly.

Existing research emphasised reliance on external mobility funding as the decisive factor inhibiting municipal capacity for transformative experimentation, and thus NYC city government was chosen as 'critical case' with a high degree of fiscal autonomy, in contrast with BCC's low degree of fiscal autonomy. Figure 7.2 compares how experiments were funded in Bristol and NYC.[115] It confirms that NYC city government was less reliant on external funding than BCC, and resourced a greater proportion of experiments using discretionary municipal resources. However, even in NYC, one-third of experiments have relied on intergovernmental grants, from the federal government and state government via the MTA. Combining intergovernmental grants and non-state contributions, just over half (55%) of NYC experiments relied on external funding, whereas for the Bristol case, the equivalent proportion is 77%.[116] Although NYC city government was much less reliant on intergovernmental grant transfers for urban mobility experimentation than BCC, it was more reliant on such transfers for urban mobility experimentation as a specific type of expenditure relative to total municipal expenditures, and it was more reliant on non-state contributions than BCC. We can also confirm that NYC city government enjoyed greater access to non-competitive funding than BCC, because of the importance of the federal formula-based CMAQ funding programme for experimentation in NYC.

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[115] These figures refer to the *primary* source of funding for the *implementation* of an experiment, excluding external funding at the *planning* stage; virtually all experiments involved municipal 'match' funding. NYC BID contributions towards public space maintenance are not counted.

[116] In Figure 7.1, the 'discretionary municipal resources' figure for Bristol includes experiments funded from BCC's Integrated Transport Block allocation from UK national government, whereas for NYC city government, the same figure represents municipal own-source funds only. Considering that only 12-16% of BCC's capital programme for mobility was funded from own-source revenues on average between 2001/2 and 2014/15 (see Table 5.3), the actual difference in the degree to which experiments were funded from external grants is thus likely even greater between Bristol and NYC, than shown in Figure 7.2.

Primary sources of experiment funding in Bristol and NYC (N=108)

	Intergovernmental grants	Non-state contributions*	Discretionary municipal funds
Bristol	64%	13%	23%
NYC	34%	21%	44%
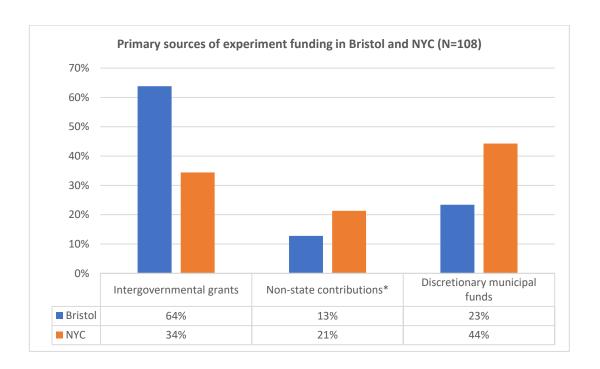
Figure 7.2. Comparing experiment funding in Bristol and NYC.

7.2.2   The influence of external mobility funding

In this section, I examine whether the capacity of NYC city government to pursue more endogenously-determined, policy-led and systemic experimentation was *by virtue of* its lower degree of reliance on external mobility funding, relative to BCC.

Municipal visions and the scope of experimentation

For both cases, my findings show that an overarching and holistic vision for urban mobility, that steers the scope of experimentation, is an important component of municipal capacity for transformative experimentation. Having such a vision in place was associated with a *systemic* approach to experimentation (Type 3/4).

NYC city government's approach to experimentation became systemic (Type 4) after 2007, with the launch of its first overarching visions for urban mobility. This shift is one factor that explains the difference in transformative impacts in Bristol and NYC. Experimentation between 2007-2016 was strongly led by municipal policy frameworks,

notably by PlaNYC initiatives, which had a political mandate of NYC's Mayoral team. Interviewees cited the importance of PlaNYC as a policy framework in relation to many trajectories (section 6.2). Considering NYC embedding patterns (section 7.1.2) from this perspective, it is less surprising that experiments with political backing would be made permanent, institutionalised and/or scaled up. Many NYC trajectories were arguably pre-envisioned (SBS, plazas, cycle lanes), driven by the need to deliver on long-term policy commitments. The policy-led nature of experimentation in NYC partly explains the high degree of institutionalisation observed: a lot of experiments flowed from, and fed back to, policy strategies. The Bloomberg administration's confidence in launching PlaNYC, and the fact that there was so much momentum behind it that initiatives were actually implemented, had nothing to do with the types of external mobility funding that could or could not be secured. This 'policy confidence' can instead be explained by the greater *general fiscal autonomy* of NYC city government, relative to BCC (discussed in section 7.2.3).

I only came to the conclusion that the scope of experimentation in Bristol had primarily been determined by external priorities, when I looked back at the Bristol case through the lens of NYC city government capacity. Initially, I concluded that BCC's approach had shifted from Type 4 to Type 2, i.e. always been primarily shaped by municipal priorities, because I found that BCC had employed endogenous strategies to pursue its own priorities within the framework of national and EU funding, and priorities had rarely been directly *imposed* by external funding programmes (section 5.3). In contrast to Hodson et al.'s (2018) finding that the scope of urban mobility experimentation in Manchester is strongly 'conditioned' by national economic growth agendas, I found that this focus did not actually filter down to experimentation on the ground in Bristol.[117]

However, upon comparing BCC's success in mediating national priorities, with NYC city government's policy-led experimentation, things looked different. Experimentation in NYC could not be characterised in any other way than Type 2/4: I had found that externally-imposed priorities were notably absent in NYC compared to Bristol. Thus, experimentation in Bristol could not be also be characterised as Type 2/4. During my

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[117] See discussion about LSTF in section 5.1.3.

analysis of the Bristol case, I examined the interplay of local and national mobility policies, in terms of their respective launch dates and the novelties that were emphasised. Re-examining this evidence from a fresh perspective - enabled by my comparison - I concluded that the scope experimentation in Bristol had primarily been shaped by external priorities (Type 1 and 3), with municipal priorities only successfully asserted from 2012 (Type 2). Experimentation in Bristol was always broadly in line with UK government transport policy (section 5.1). Indeed, BCC's strategy to attract external funding was to frame Bristol as a 'laboratory' for experimentation in relation to EU and national agendas.

Why did BCC consistently align experimentation with national policy priorities, despite the lack of direct imposition of such priorities? Since I arrived at this finding through comparative analysis, I did not ask Bristol interviewees. My analysis of UK mobility policy since 1996 shows that UK government enforced a strongly intentional policy agenda steering municipalities to introduce specific novelties (chapter 5). The most likely explanation for why BCC aligned its own visions with this is: 1) the intertwined mechanism of policy alignment and funding allocation by which UK DfT reviews Local Transport Plans and awards Integrated Transport Block funding according to the outcomes of this review (section 4.1.2), and 2) the generally pragmatic culture of UK local government within a centralised state (John 2014), where the focus of local policy-making is 'playing the game'[118] within the rules set by national government. In contrast, NYC city government was not subject to the same federal/state government review for policy alignment (section 4.1.2), and has a completely different culture of policy-making, where municipal priorities are asserted in defiance of national and state government (Berg 2007). My findings for the Bristol case is thus that *the scope of experimentation was not 'conditioned' or determined by external mobility funding programmes, but external priorities shaped the scope of experimentation at a 'deeper' level by influencing municipal visions.* The absence of *de facto* mechanisms for enforcing multi-scalar policy alignment in the US and New York state context enabled NYC city government to steer experimentation according to visions free from such 'deep conditioning'.

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[118] I.e. balancing national and local policy priorities, competing for national funding.
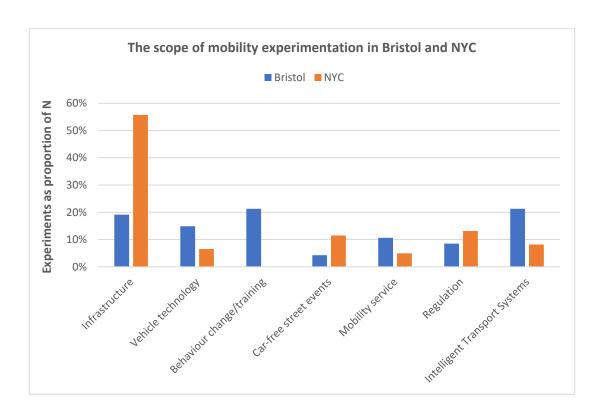
Figure 7.3. Comparing the scope of experimentation in Bristol and NYC.

Figure 7.3 compares the scope of experimentation. In Bristol, experimentation focused on behaviour change (including cycle training), and different types of vehicle and Intelligent Transport Systems (ITS) technologies. The stark contrast in the prevalence of infrastructural experimentation (Figure 7.2) is explained by the fact that:

1. In Bristol, experiments with public space accounted for a smaller proportion of all experiments (N=47), whereas they accounted for the largest proportion of experiments in NYC (see Table 3.2);

2. In Bristol, velomobility experiments focused on behaviour change rather than cycling infrastructure, whereas in NYC experiments focused only on the latter

BCC's focus on promoting cycling through behaviour change interventions reflects the UK 'Smarter Choices' policy agenda: my argument about the deeper influence of national priorities is bolstered by the fact that dozens of other UK municipalities have

experimented with similar 'Smarter Choices' mobility policies (Cairns et al. 2004, Hiblin et al. 2016). This trend reflects of the rise of the UK 'psychological state' (R. Jones et al. 2013), understanding social change as an outcome of 'Attitudes, Behaviour and Choice', to address sustainability challenges through individual pro-environmental behaviours (Shove 2010). Notably, the philosophy that cycling can be promoted through choices made by 'smart' individuals is much less confrontational than infrastructural change that risks disrupting automobility (Aldred et al. 2019).

In contrast, experimentation in NYC was strongly focused on physical infrastructure, reflecting DOT's focus on street space reconfiguration. This reflects NYC city government's capacity to determine its own mobility vision without external review (see above). Even so, to experiment with cycling infrastructure for instance, NYC DOT did have to circumvent review against federal street design guidelines, or deal with the politics of NYMTC funding allocation. This included experiments funded by the federal formula-based CMAQ programme, which in reality is 'quasi-competitive' (NY20, section 4.1.2) due to city-state politics. Thus, NYC DOT's ability to pursue infrastructural experimentation was not because it enjoyed greater access to this formula-based funding, than BCC. The scope of experimentation in *both* Bristol and NYC was neither entirely free from the influence of external mobility funding, nor entirely 'conditioned' by external funding. Both BCC and NYC city government pursued successful endogenous strategies to realise municipal priorities within the constraints of external funding programmes, however, in Bristol, national policy priorities had a deeper influence on the scope of experimentation *via* conditioning municipal visions.

The Bristol findings show that trajectories launched by experiments undertaken as part of systemic Type 3 experimentation between 1996 and 2011 did generate transformative impacts in the longer-term. Thus the findings for the Bristol case show that *externally-influenced experimentation, when systematically pursued, can be effective in generating transformative impacts*. This is discussed further in chapter 9.

Although whether the scope of experimentation is endogenously or exogenously determined does not necessarily matter for transformative impacts (as per above), my

finding is that the overall nature of mobility experimentation undertaken in a particular context does (Figure 7.2). My comparison shows that experimentation with many different types of configurations can reconfigure urban mobility systems away from automobility, i.e. there is not only one 'policy pathway'. However, I still argue that the greater degree of infrastructural experimentation in NYC explains why transformative impacts were greater in that context. The fact that NYC city government focused on infrastructural experimentation generated greater city-wide reallocation of street space away from cars, and consequent safety improvements, that fed into my assessment of NYC experimentation as more transformative (section 7.1.1). As streets and roads constitute the fundamental conduit for urban mobility, the lack of material change in this respect in Bristol led me to conclude that transformation of the mobility system was weaker. In that sense, the transformative extent of mobility experimentation in Bristol was constrained by the influence of the UK policy trend focused on 'Smarter Choices', as a feature of 'deep conditioning', rather than imposition by external funding programmes.

Organisational forms

In both Bristol and NYC, external mobility funding was awarded in the form of short-term and project-based grants; or at least the short time-frame during which grant funding had to be spent necessitated project organising. For neither case, was there evidence that project organising constrained embedding or transformative impacts. Rather, I found that both BCC and NYC city government employed – during specific periods – successful endogenous strategies to complement temporary organisations with permanent organisations.

Table 7.1 and 7.2 compare the way experimentation was organised within BCC and NYC city government (with reference to Figure 2.4). In NYC, embedding was linked to a systematic pattern of institutionalisation in *programmes*. Experimentation as a preferred mechanism was also institutionalised in several NYC DOT sub-units.[119] Organising experimentation in the form of semi-permanent and permanent organisations was central

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[119] Including in the DOT Pedestrian and Bike Projects Group, which undertook 'modular' experimentation within a long-running 'Bike Program' that was mentioned by interviewees (NY06).

to embedding patterns that generated transformative impacts in NYC. This shift towards a reliance on permanent organising took place in 2007 (Type 4 experimentation) – federally-funded experiments organised as projects (temporary organisations) provide a clear contrast, where experimentation was more piecemeal (Type 2, 1997-2005). This shift was not prevented by external funding constraints, and the result of endogenous strategies introduced by new NYC DOT leadership.

Table 7.1. Forms of organising experimentation in NYC.

Temporary organisations ◄————————————————————► Permanent organisations		
Projects	**Programmes**	**NYC DOT sub-units**
CMAQ-funded projects (1997-2005) ChargePoint America	Select Bus Service Program Bike Program Public Plaza Program Weekend Walks Program Safe Streets for Seniors Program; Neighborhood Slow Zones Program	NYC DOT Bike and Pedestrian Projects Group NYC DOT Office for Planning and Sustainability NYC DOT Public Space Unit (with portfolio of programmes)

Table 7.2. Forms of organising experimentation in Bristol.

Temporary organisations ◄————————————————————► Permanent organisations		
Projects	**Programmes**	**BCC sub-units**
All EU projects, Cycling City, LSTF projects Cycling City, LSTF and European Green Capital Grant Fund projects	LSTF, with nested projects	European Transport team (with portfolio of projects) Bristol Futures

In Bristol, most experiments were organised in the form of projects/temporary organisations, throughout the study period. However, the period between 1996 and 2006 in Bristol shows that experimentation reliant on external short-term funding can be systemic (Type 3), if temporary organisations are complemented by permanent organisations, which can ensure knowledge transfer between them (European Transport

Team, Bristol Futures). The shift from Type 3 experimentation to more piecemeal Type 1 piecemeal experimentation in 2007 took place as a result of organisational decisions made by BCC leadership. Both before and after 2006, external funding was awarded in the form of short-term grant awards structured as projects: before 2006, BCC chose to organise these projects under a permanent organisation, whereas in 2006 this approach was abandoned. As discussed in section 5.1.2, most likely the decision to disband the key permanent organisation between 1996 and 2016, the European Transport team, was associated with a shift in policy priorities from experimentation to city-regional infrastructure planning. Whatever the reason, this was a poor endogenous decision that weakened municipal capacity, rather than forced by changes to external funding. We can conclude that *organisational forms* in Bristol and NYC were neither entirely free from the influence of external funding, nor entirely 'conditioned' by external funding. Furthermore, I found no evidence of *projectification* as an increasing reliance on project organising over time (Godenhjelm et al. 2015); rather, the reliance on temporary versus permanent organisations oscillated over time, in both case contexts.

The Bristol findings show how projects need not be problematic for embedding *per se*. I found that projects can provide a 'protected space' to experiment beyond business-as-usual policy delivery, if managed effectively.[120] An interviewee who had worked in the European Transport Team (B23) commented that project organising was necessary for innovation activities, because this required a clear structure and different staff skills, to managing a process different from conventional policy implementation.

The NYC findings contradict the Bristol interviewee's argument about the necessity of project organising for innovation, however. NYC findings point to the strength of experimentation being institutionalised as a mechanism within permanent organisations, which allows for a more 'fluid' or 'modular' type of experimentation (e.g. institutionalised in 'toolkits'), relative to the more rigid type afforded by project organising. Indeed, beyond organisational forms in Table 7.1 and 7.2, the comparative analysis highlights that it was

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[120] Based on how many transformative trajectories can be traced back to VIVALDI, that project stands out as an example of this. This is in line with Cavoli's (2015) findings on the impact of the VIVALDI project in Bristol.

the overall endogenous strategy with respect to institutionalisation of experimental configurations, that was weaker within BCC than NYC city government. In NYC, the iterative relationship between experiments and institutionalisation in policy commitments was stronger (discussed above), and institutionalisation also occurred in design standards, policy toolkits and local legislation, which are not organisational forms. In Bristol, embedding patterns were associated with less systematic techniques of institutionalisation, compared to NYC (section 7.1.2): programmes were not as widely relied upon, and other types of institutionalisation found in NYC were absent.

Forms of organising also influenced how external funding requirements shaped experimentation in NYC. When interviewing people from NYC DOT, I noticed that they often did not recall exactly what external funding was used to resource an experiment or subsequent upscaling, and were vague on the details of what kind of requirements that external grant funding entailed. This was an extreme contrast to BCC interviewees, who could talk about nothing else. As the NYC research progressed, I developed a hypothesis that this was explained by the fact that external grants were managed by a separate Grants Management division within NYC DOT, rather than the planners implementing experiments, whom I was interviewing. A former DOT employee confirmed this, remarking that it was a question of having a division staffed with people skilled in 'using' federal money, as such grants are too complex to manage for other staff (NY21). This finding is significant because it aligns with a US National Association for Transportation Officials (NACTO 2018) report based on 200 interviews with transportation department staff in 16 US cities. NACTO proposes that in cities with successful mobility policy implementation, "consolidating grant management separately from project implementation… will enable staff to focus more on project delivery" (*ibid.*, p.5). NACTO essentially recommends the type of organising I observed in NYC, as best practice. This finding illustrates yet another endogenous strategy that NYC city government used to 'decouple' external grant funding and experimentation: taking project-based federal grant awards and divorcing these grants from their project characteristics, to the grant into resources for 'modular' experimentation that was institutionalised in the DOT Pedestrian and Bike Projects group.

My comparison suggests that it is endogenous strategies regarding how to complement projects with other forms of organising and techniques of institutionalisation that determined whether experimentation was piecemeal or systemic, to a greater extent than external funding mobility funding as an exogenous driver.

Evaluation processes

In the conceptual framework for RQ1.2, I also included *evaluation processes*, based on Hodson and Marvin's (2010, p.438) finding that strong capacity includes evaluation processes that go beyond "the often narrow metrics of external funders".

NYC city government met Hodson and Marvin's (2010) test of endogenously-designed processes for evaluating experiments, whereas BCC did not. In NYC, evaluation of experiments was undertaken in-house within municipal government; the evaluation process was only undertaken by non-municipal actors for civil society-led experiments. The influence of federal mobility funding on NYC DOT evaluation processes was negligible. Federal grants did require local beneficiaries to report different types of data (NY20), but this was never raised by NYC interviewees, even when prompted. US federal transportation policy is generally not performance-oriented, i.e. does not include systematic evaluation data collection against policy objectives across all funding programmes (Transportation for America 2015). The focus is on *ex-ante* evaluation of municipal projects applying for federal grants by MPOs, against the goals of different federal programmes.[121] In contrast, BCC's evaluation processes were determined by conditions tied to EU and UK funding, with limited evidence of endogenously-designed evaluation processes. This reflects the tradition of UK government to monitor local (transport) policy performance closely (Marsden and Bonsall 2006) and the emphasis on evidence-based policy-making (Sanderson 2002). To meet external quality requirements,

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[121] For example, in proposing projects for CMAQ funding within NYMTC, NYC DOT needs to submit information on estimated air quality emission benefits (NYSDOT 2016), because the CMAQ programme was established with a core objective to contribute to the 1990 Clean Air Act Amendment (FWHA 2008). There is little requirement of ex-post evaluation of local CMAQ projects (Farrell et al. 1998; FWHA 2009; TRB 2002).

experiment evaluation was typically outsourced to academic researchers at the UWE Centre for Transport & Society, Sustrans, or transport consultancies.

However, this difference in evaluation processes does not explain why NYC city government had greater capacity for transformative experimentation than BCC. As noted in section 5.3 and 6.3, formal evaluation results did not play a significant role within the majority of transformative trajectories, in neither Bristol nor NYC.

In NYC, the production of data demonstrating the benefits of cycle lanes and Select Bus Service likely helped in the *expansion phase* of trajectories, but evaluation data were not an important influence on decision-making for *experiments to be judged as 'working configurations'*, i.e. at the pivotal point where a trajectory was launched. NYC DOT interviewees cited a wide range of 'data points' that had shown a configuration 'worked', including 'popularity' of a bus service based on the number of people who could be observed riding it (NY10), or seeing a child cycle down the Ninth Avenue cycle lane, or seeing people using a public plaza immediately after it had been made into a car-free space (NY06). This points to more experiential types of knowledge, rather than formal evaluation data. Considering the political momentum behind experimentation with cycling, plaza, SBS configurations in NYC, the counterfactual that none of the associated transformative trajectories would have taken off, were it not for evaluation data from specific experiments, is unlikely. Embedding decisions were based on NYC DOT staff judgment that a configuration that had already been judged as appropriate (e.g. in PlaNYC), had indeed been demonstrated to work, by an experiment. For the NYC case, my findings thus contradict the established narrative of data-driven decision-making as a central element of NYC DOT capacity for transformative experimentation (section 4.4.2).[122]

BCC relied on evaluation data to a greater degree. BCC judgments about what configurations 'worked' were sometimes influenced by evidence regarding quantitative cause-and-effect relationships, but this was only the case for three configurations, however: the Showcase bus service (Table 5.7), personalised travel planning (Table 5.8)

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[122] When asked to comment on this narrative, some interviewees agreed (NY08), while others argued that decisions were based made on values and data was used to design and refine configurations, and build public support (NY03; NY18).

and 20mph zones (section 5.2.6). In relation to Cycling City interventions, external evaluation results were only published many years after experiments had ended (Cope et al. 2017). Despite greater emphasis on novelties having to be 'proven' to work, to a large extent, BCC tested configurations that had already been 'proven' to work elsewhere in the UK, and 'vetted' by their promotion in national government policy.

In summary, because evaluation processes did not have a significant influence on experimentation trajectories in neither Bristol nor NYC, the influence of external mobility funding on municipal capacity *via* evaluation processes was also negligible. The limited influence of evaluation processes is discussed further in chapter 9, where I suggest that decision-making about embedding experimental configurations can be better understood through the socio-material co-construction of knowledge.

Reflections: external mobility funding as an enabler

I have concluded that the degree of municipal reliance external mobility funding is not the most significant Context factor that explains the difference in BCC and NYC city government capacity. In many ways, evolving mobility funding landscapes were an enabler of municipal capacity for transformative experimentation, not a constraint. As discussed in section 4.1.2, funding landscapes as an element of multi-scalar structure evolved in a conducive direction, from a long-term perspective. In the US, the passage of the federal ISTEA act in 1992 vastly increased the volume and types of federal mobility funding available to NYC DOT, including the launch of the CMAQ programme (see also section 6.1.1). In the UK, DfT introduction of the Local Transport Plan process in 1999 improved the volumes and certainty of national funding flowing to BCC (see also section 5.1.1); and the EU's new urban mobility agenda also helped. Had these changes in multi-scalar context not taken place, it is likely that municipal capacity for transformative experimentation had been weaker.

7.2.3 The influence of general fiscal autonomy

Difference in the *general fiscal autonomy* of BCC and NYC city government was a significant factor explaining why NYC city government had greater capacity for transformative experimentation, more so than the nature of external mobility funding.

The difference in general fiscal autonomy was introduced in Table 3.1. NYC city government has a high degree of fiscal autonomy, relative to many other 'global' cities, whereas local governments in England have a relatively low degree of fiscal autonomy. This difference is reflected in the higher proportion of NYC experiments funded by municipal own-source revenues (Table 7.1).

The difference in general fiscal autonomy explains 'policy confidence': how NYC Mayoral administrations had the confidence to announce ambitious new visions and pursue policy-led experimentation (shift to Type 4 experimentation from 2007), as discussed in section 7.2.2. This confidence can be explained by NYC city government's greater access to own-source operational funding and capital borrowing (section 4.1.1). PlaNYC announced the introduction of mobility novelties, but crucially also committed significant municipal operational and capital expenditures to their implementation. *Even as* these funding commitments dissipated in the context of the Great Recession, and the Bloomberg administration's SMART proposal to generate additional resources failed, PlaNYC execution did not falter. NYC city government had the confidence to not *wait* for external funding to be secured prior to launching ambitious policy initiatives and could throw enough of its own money behind these initiatives to at least kickstart implementation. This was even more pronounced for de Blasio's OneNYC strategy, with significant NYC budget commitments for mobility.

This level of confidence in pushing ahead with municipal priorities feels unthinkable when considering the Bristol case. BCC's transport policy strategies read more 'wishlists' to national government, with a greater degree of tentativeness and explicit references to policy initiatives being 'subject to' external funding, as reflected in the difference in the speed of embedding between Bristol and NYC (section 7.1.2). Based on my comparison,

I argue that BCC's tentativeness was linked to a lower degree of *general own-source revenues*, as reflective of UK fiscal centralisation.

Most of the endogenous strategies central to municipal capacity in NYC were underpinned by greater access to own-source operational funding. Especially after 2012, many BCC staff were employed on contracts linked to a continuous series of short-term external grant funding, resulting in high staff turnover. BCC's mobility agenda suffered from a mismatch between capital and revenue funding, which constrained embedding of experiments ending in 2016. Capital-revenue mismatch was not an issue for NYC city government, since both types of funding were under municipal control and could be balanced. Staff positions at NYC DOT were secure and paid from NYC's core budget as a municipal agency, not by external grants. Interviewees commented that NYC DOT was able to hire highly-skilled staff by virtue of its competitive salaries (NY08; NY06). I would argue that this is linked to the resourcefulness of DOT's endogenous strategies. This is not to imply that BCC staff were *not* successful in their work, yet the difference in the ability of the municipalities to retain skilled staff is clear. Within NYC city government, establishing new permanent organisations and having a separate grants management division required operational funds. Crucially, *the use of the quick-build approach to experimentation relied on ready access to NYC DOT's operational budget* - a similar resource base would not be available to BCC staff, had they wanted to use this approach.

The contrast between policy-led experimentation in Bristol and NYC can also be attributed to differences in autonomy with respect to *capital borrowing*. The majority share of PlaNYC and OneNYC funding commitments for mobility initiatives were for capital rather than operational expenditure, raised through NYC city government bond issuance as part of its broader capital budget. Indeed, delivery of PlaNYC as a whole was enabled by large-scale capital borrowing by the Bloomberg administration (CBC 2013). BCC relied on the UK government's Integrated Transport Block allocation for its capital expenditures, which was cut severely from 2010 onwards. Like other UK municipalities, BCC did not have well-developed instruments for borrowing from the private market, in ways that would bypass national government. The role of capital borrowing for expanding

experimental configurations was not raised by or with Bristol interviewees, but the contrast with NYC points to this as a difference of some significance.

7.2.4   The influence of austerity politics

Another exogenous driver included in the conceptual framework for RQ1.2 is *austerity politics*, as linked to (neoliberal) state restructuring. Relative to the two other dimensions of municipal resources, austerity politics is not as significant in explaining the difference in BCC and NYC city government capacity. Austerity cuts to municipal budgets following the Great Recession from 2007-2008 did not limit the transformative impacts of experimentation undertaken between 1996/7 and 2016 to any significant extent, in Bristol nor NYC. (If the study period had extended beyond 2016, this finding would likely have been very different for the Bristol case).

Austerity politics was a more significant exogenous driver than external mobility funding, for the NYC case. The Bloomberg administration cuts to DOT budgets did not dent DOT expenditures in the long-term. There is no evidence that cuts prevented transformative impacts. However, even if objectively speaking municipal expenditures kept growing during the study period, the Bloomberg administration evoked a *discourse* of austerity that influenced NYC DOT adoption of quick-build experimentation as a low-cost approach, and an expanded co-funding model where non-state actors contributed to public space transformations. Notably, NYC city government had the capacity to devise endogenous strategies in response to austerity *because of its fiscal autonomy and access to own-source operational resources,* e.g. quick-build experimentation and more fundamentally, raising municipally-controlled tax rates.

From 2012, the impact of nationally-imposed austerity on BCC's discretionary operational resources was severe. Austerity did begin dismantling the municipal state in Bristol, at large. However, because BCC secured continuous national funding under the LSTF programme from 2011, austerity cuts only began to affect BCC mobility expenditures after 2016. The worsening capital-revenue mismatch did contribute to piecemeal experimentation between 2012 and 2016, but there was no evidence that austerity cuts

constrained transformative impacts. However, cuts did inhibit embedding from a few experiments ending in 2016 (section 5.2.4, 5.2.5). Findings related to these experiments suggest that as a result of austerity cuts, BCC's approach to experimentation shifted back to Type 1 after 2016. Austerity politics thus appears to have weakened BCC capacity for transformative experimentation, beyond 2016. Crucially, *because of BCC's lack of fiscal autonomy and own-source revenues to leverage, its capacity to devise endogenous strategies in response to austerity was limited.*

Peck (2012) has argued that in the US trend towards 'austerity urbanism', we can see austerity being imposed top-down on municipalities by higher levels of government through 'scalar dumping' of the Great Recession, but also that many municipalities have been 'complicit' with these austerity cuts. Aldag et al.'s (2019) counterargument has been that what can be observed across New York state has instead been 'pragmatic municipalism', where municipalities seek to balance imposed austerity cuts with attempts to protect public services. BCC also tried to limit service cuts. In both Bristol and NYC, we can thus characterise austerity cuts as 'pragmatic municipalism' rather than complicity to the degree described by Peck. However, a crucial distinction is that while BCC cuts were imposed top-down, austerity cuts in NYC were more self-imposed by the Bloomberg administration due to the high degree of fiscal autonomy.

7.2.5 Summary

Table 7.4 summarises what dimensions of municipal resources explain differences in BCC and NYC city government, via influence on municipal institutions. While both municipalities relied on external funding programmes to some degree and the specific nature of these programmes exerted a 'conditioning' influence on experimentation, both BCC and NYC city government demonstrated endogenous strategies that could overcome external constraints on both the scope of experimentation and organisational forms, thus limiting overall constraints on transformative impacts. The constraining influence of external funding was intermediated by decisions taken by BCC and NYC city government at various points in time, which explains the weakening and strengthening of municipal capacity (shifts in Type 1/2/3/4). Differences in the reliance on external

mobility funding thus do not explain the difference in municipal capacity between Bristol and NYC, if examined in relation to these outcomes of experimentation.

General fiscal autonomy was the most significant factor: constraining capacity for transformative experimentation in Bristol, and enabling capacity in NYC. This can be contextualised in relation to the wider context of the UK as a centralised state and US federalism, and the development of UK and US transport policy (chapter 9). I have shown that municipalities can tackle external funding constraints through practical bureaucratic strategies – crucially, claiming greater fiscal autonomy is an entirely different matter. General fiscal autonomy is interrelated with the potential impact of austerity politics.

Table 7.3. Influence of municipal resources on experimentation in Bristol and NYC.

Case	'Conditioning' by external mobility funding	General fiscal autonomy	Austerity politics
Bristol City Council	YES – present *Influence on experimentation:* Some constraints on transformative impacts; explained by shifting endogenous strategies over time	LOW *Influence on visions, scope of experimentation:* Tentativeness of visions and experiments *Influence on organisational forms:* Lack of staff continuity, capital-revenue mismatch	YES – deep cuts *Influence on municipal resources:* Severe, by 2016 *Influence on experimentation:* Did not constrain transformative impacts significantly, but prevented embedding in some cases
NYC city government	YES – present *Influence on experimentation:* No constraint on transformative impacts; explained by shifting endogenous strategies over time	HIGH *Influence on visions, scope of experimentation:* Policy confidence Capital borrowing enabling municipal funding commitments *Influence on organisational forms:* Continuity of staff, resourcefulness of endogenous strategies	YES – primarily discourse of scarcity *Influence on municipal resources:* Limited impact on NYC DOT *Influence on experimentation:* Did not prevent transformative impact, but led to adoption of low-cost approach to experimentation

Existing research on urban experimentation in the EU and UK suggests that municipal capacity for transformative experimentation is limited by the reliance on external, competitive, short-term and/or project-based funding, as a decisive factor. I operationalised this proposition by using the fiscal autonomy of municipal government as the basis for selecting BCC and NYC city government as contrasting cases (section 3.3.3). Initial research on Bristol confirmed the proposition, and thus BCC was chosen as a case where a low degree of fiscal autonomy inhibited municipal capacity – a representative case of the limited capacity of UK municipalities, more broadly. NYC city government was chosen as a 'critical' case, with a high degree of fiscal autonomy and purported strong municipal capacity, that would be 'least likely' to verify the proposition (section 3.3.4).

Based on my findings, the proposition is verified for *neither* the NYC nor Bristol case. Municipal capacity in Bristol *was* limited by reliance on external funding, however, while this was interpreted as the *decisive factor* limiting municipal capacity at the time of case study selection, my final findings show that reliance on external funding was *not* the decisive factor limiting BCC capacity. As expected, the NYC case did not verify the proposition. Municipal capacity in NYC *was not* limited by reliance on external funding for experimentation, even if there was evidence that dealing with external funding constraints did require endogenous strategies. Furthermore, the fact that NYC city government had greater capacity could not be explained by its greater access to non-competitive funding.

The emphasis on reliance on external funding in existing research is not misplaced: it may be too narrowly focused on the multi-scalar politics of *mobility* funding programmes, but valid in the broader sense. My findings suggest that reliance on specific types of mobility funding programmes is an important exogenous driver, but a 'lower-level' issue that ultimately can be managed through practical endogenous strategies, whereas general fiscal autonomy fundamentally underpins municipal capacity for transformative experimentation, and is more challenging to address through endogenous strategies.

7.3 Comparing governance institutions

This section presents comparative findings for RQ1.3. To build towards answering Primary RQ1, this section discusses to what extent differences in governance institutions explain why municipal capacity diverged in Bristol and NYC.

7.3.1 Overview of partnerships and governance institutions

Two hypotheses were identified for RQ1.3. First, that municipal government is a central actor with regard to urban mobility experimentation, by virtue of its control over urban mobility systems. Second, that the capacity of municipal government to form partnerships with non-state actors is a significant factor shaping municipal capacity for transformative experimentation. Figure 7.4 below compares the types of partnerships characterising experimentation in Bristol and NYC, including instances where BCC and NYC city government undertook experiments without partnership ('municipality alone') and where municipalities partnered with other actors (e.g. public-private).[123] The overall proportions of partnership types in Figure 7.4 show that the municipal governments undertook a significant proportion of experiments alone, and also pursued a range of external partnerships, confirming the hypotheses.

In Bristol, approximately one-fifth of experiments (21%) were undertaken by BCC alone, whereas approximately two-thirds (64%) were undertaken in partnership with non-state actors.[124] NYC city government undertook approximately one-third (31%) of experiments alone, and 69% of experiments with other actors (including public-public partnerships with NYCT). These trends demonstrate that BCC and NYC city government maintained the capacity to introduce mobility novelties independently of non-state actors, but equally point to how experimentation was characterised by a high degree of partnership. 80% of Bristol experiments and 83% of NYC experiments that involved partnership with other

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[123] 'Civic' stands for partnerships with civil society. All experiments featuring public-public partnership were between NYC DOT and NYCT.

[124] 13% of N=47 is accounted for by unknowns, i.e. 6 experiments for which partner involvement beyond BCC was likely but could not be verified. All of these experiments were undertaken in the late 1990s or early 2000s.

actors were *led* by municipal government, i.e. it was rare for non-municipal partners to take a leading role. 13% of Bristol experiments were led by civil society actors, whereas in NYC, 7% were led by civil society and 5% by private sector actors.
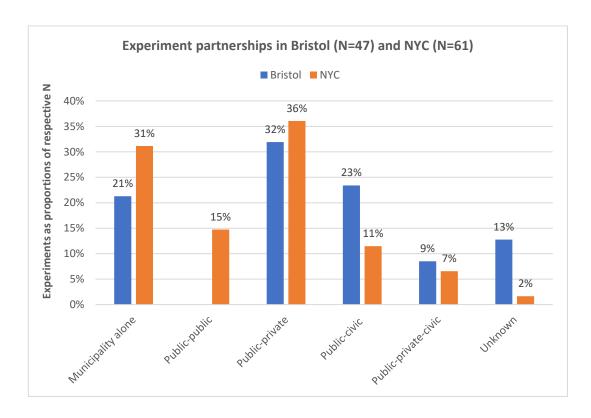
Figure 7.4. Prevalence of experiment partnerships in Bristol and NYC.

The overall proportions of different partnership types reflect distinct trajectories of experimentation with respect to busmobility, velomobility, public space and automobility – qualitative analysis is presented in the next section. Three aspects of the large-N proportions stand out as meaningful, which I refer back to below:

1. NYC city government pursued a greater proportion of experiments alone, whereas partnerships (with non-state actors) were more common in Bristol;
2. Partnerships with civil society were more common in Bristol, including experiments *led* by civil society organisations;

3. The proportion of experiments led by civil society or private sector organisations was small across both cities – suggesting that municipal government has sought to retain or assume control, where it has partnered with other actors.

The conceptual framework for RQ1.3 distinguishes between experiment partnerships as temporary organisations, and the institutions characterising actor relations within such partnerships. It examines governance institutions at two 'nested' levels (Figure 2.5): 1) at the level of experiments, where temporary partnerships feature specific relations, or *governance logics*, between partner organisations; and 2) at the level of mobilities (busmobility, velomobility, public space, automobility) where institutions exist 'between' experiment partnerships, and feature patterns of relations between municipal government and other actors, or *governance modes*.

Table 7.4 below gives a complete picture of the governance institutions that characterised experimentation in Bristol and NYC, including the governance modes and logics associated with most experiments in the large-N databases.[125] This is a more detailed version of Table 5.1 and Table 6.1, which provided an overview of changing governance modes between 1996/7 and 2016. In Table 7.4, the 'dominant' institution denotes the mode, logic and partnership constellations that were the most prevalent for a particular type of mobility, reflecting certain strands of experimentation with these constellations accounting for a greater proportion of experiments (e.g. cycle lane experiments accounted for 7 out of 10 velomobility experiments in NYC).

Table 7.4. Overview of governance institutions in Bristol and NYC.

Type of mobility	Governance modes and logics characterising experimentation	
	Bristol case (N=47)	**NYC case (N=61)**
Busmobility	*Dominant institution:* Governing by **expanded co-provision** through partnerships with **network** logics (BHLS, low-emission vehicles)	*Dominant institution:* Governing by **expanded co-provision** with NYCT through **network** partnership (SBS, Transit Signal Priority, real-time information)

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[125] Across the total sample of experiments (N=108), governance logics remained unknown for 16 experiments, as there was not sufficient documentation of the partnerships involved.

	Other institutions: Governing by **authority** through **hierarchical** logics (ANPR bus lane enforcement)	*Other institutions:* Governing by **provision,** without partnership through **hierarchical** logics (Sidewalk to Buses)
Velomobility	*Dominant institution:* Governing by **co-provision** through partnerships with **network** and **market** logics (cycle training, parking, individual mobility marketing, employer engagement) *Other institutions:* Governing by **enabling,** with **network** relations (Bristol Bike Project, All Abilities cycling, Cycling Resource Centre)	*Dominant institution:* Governing by **provision** of infrastructure, without partnership through **hierarchical** logics (cycle lanes) *Other institutions:* Governing by **co-provision** through public-private partnerships with **network** and **market** logics (cycle parking) Governing by **co-provision, network** partnership (Bike & Ride)
Public space	*Dominant institution:* Governing by **provision** through hierarchical logics, and **co-provision** through partnerships with **network** logics (home zones, Make Sunday Special) *Other institutions:* Governing by **enabling** civil society experimentation, through partnerships with **hierarchical** and **network** logics (Street Pockets, Playing Out)	*Dominant institution:* Governing by **expanded co-provision** through **network** partnerships (public plazas, Shared Streets); and **market** partnerships with commercial sponsors (Summer Streets) *Other institutions:* Governing by **enabling** experiments, through **network** partnerships (Weekend Walks, play streets, parklets) Governing by **authority,** without partnership through **hierarchical** logic (car-free parks)
Automobility	*Dominant institution:* Governing by **authority** with **hierarchical** logics (20mph, RPZ, road user charging) *Other institutions:* Governing by **co-provision,** public-private partnership with **hierarchical** and **network** logics (EV charging) Governing by **enabling** and **self-governing,** public-private partnerships with **network** logics (car-sharing)	*Dominant institution:* Governing by **authority** and **provision,** mostly without partnership through **hierarchical logic** (safety initiatives), in some instances **network** partnerships (traffic calming, PARK Smart) *Other institutions:* Governing by **enabling,** public-private partnership with **network** logics (EV) Governing by **provision** and **self-governing,** public-private partnerships based on **market** logics (parking payments, DOT car-pooling) Governing by **authority** through licensing and public-private partnerships with **market** and **network** logics (taxis)

Findings for both the Bristol and NYC case validated my adaptation of Bulkeley and Kern's (2006) typology, separating governing by *co-provision* and governing by *enabling*, to capture the distinction between public service delivery by non-state actors, and partnerships where municipal governments sought to empower civil society organisations.

Table 7.4 reveals that experimentation in Bristol and NYC has been associated with a complex mosaic of governance institutions. As expected, governance modes differed *between* the four types of mobility. However, there is also variation in the governance modes and logics characterising experimentation related to *each* type of mobility (e.g. within the automobility 'category'). This illustrates how BCC and NYC city government employed different modes of governing in relation to specific novelties, depending on decisions to provide or exert its authority alone, pragmatic necessity of certain types of partnership, or more normative desires to enable non-state actors.

The co-existence of different governance logics also reflects the absence of a neat correlation between the governance modes adapted from Bulkeley and Kern (2006), and the analysis of hierarchical, market and network governance logics as inspired by Lowndes and Skelcher (1998).[126] For example, in experimenting with traffic calming and 'smart' parking, NYC DOT governed by authority and provision, but specific experiment partnerships involved network logic of collaboration between actors. Based on the governance logics shown in Table 7.4, an assessment can be made regarding the extent to which mobility experimentation in Bristol and NYC was characterised by network governance: although experimentation frequently involved partnerships with network logics, this co-existed with market partnerships and hierarchical logics. It would thus be an oversimplification to claim that actors collaborating within experiment partnerships did so based primarily based on the trust, informal relations and shared goals characteristic of network relations. These points are discussed further in chapter 9. The remainder of this section focuses on comparative analysis of the Bristol and NYC findings.

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[126] The exception was where municipal governments undertook an experiment alone, in these instances acting through a hierarchical logic.

7.3.2 Diversification of governance modes

This section briefly compares and contrasts the governance modes characterising experimentation in Bristol and NYC.[127] It describes how the introduction of novelties into urban mobility systems (through experiments) and change in the institutions (needed to) govern those novelties is interrelated, serving as a basis for conceptual discussion in chapter 9.

In both Bristol and NYC, experimentation was associated with a diversification of governance modes. Table 5.1 and 6.1, at the beginning of chapters 5 and 6, show the governance modes characterising experimentation between 1996/7 and 2016 with the modes pre-existing in 1996/7. Comparing these, we can see that the modes associated with experimentation were more diverse, in the sense of multiple modes co-existing.

It was with the launch of new municipal visions that governance modes began to diversify and new types of partnerships began to emerge. This began earlier in Bristol, associated with BCC's (2000) Local Transport Plan, and only properly in NYC with the 2007 launch of PlaNYC. These policy agendas sought to introduce a plethora of novelties to the Bristol and NYC mobility system. Testing and expanding these novel configurations lied outside existing municipal expertise and budgets. My findings show how experimentation diversified governance modes, BCC and NYC city government needed to form partnerships to draw on other actors' resources and expertise.

The most notable change was that experimentation trajectories in both Bristol and NYC *expanded governing by co-provision*. New types of partnership with private bus operators in Bristol and MTA NYCT in NYC were necessary to experiment with improving bus services. In relation to velomobility and public space, BCC and NYC city government chose to align experimental configurations (cycling engagement, public plazas) with pre-existing governance modes of co-provision (with Sustrans, with BIDs). Subsequent trajectories substantially expanded the degree of co-provision and thus reinforced pre-existing modes of governance, but partnership arrangements also changed qualitatively.

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[127] *Self-governing* was very rare across both cases (Table 7.4), and thus is not discussed further here.

New actors (transport consultancy Steer Davies Gleave, park conservancy Horticultural Society of New York) and alternative norms (OneNYC Plaza Equity Program in NYC) became involved in co-provision, associated with different types of configurations tested as experimentation trajectories evolved.

Experimentation in both Bristol and NYC was associated with *new types of governing by enabling non-state actors*, although this was less common, as reflected in the low proportion of civic-led and private-led experiments in Figure 7.4. We can distinguish between two variants of *governing by enabling*: facilitating market-led governance, and normative efforts to enable civil society. *Market creation* was associated with a strategy of governing automobility through the market, rather than through municipal provision and authority. New policy agendas seeking to reconfigure private car use required new public-private partnerships to develop mobility services (BCC seed-funding for car-sharing experiments, NYC city government facilitating private sector-led expansion of EV charging infrastructure). *Enabling* civil society was driven by a normative desire to support experiments ideated and led by CSOs, in absence of a specific municipal agenda. This was more common in Bristol than in NYC, as reflected in the greater proportion of partnerships with civil society in Bristol (Figure 7.4). BCC's strategy of enabling through Grant Funds seed-funding civil society experiments reflects its genuine commitment to empowering CSOs to explore more socially inclusive mobility cultures. In Bristol, governing by enabling civil society thus involved state funding. NYC DOT also sought to enable civil society experiments, but this involved co-funding, i.e some municipal resources but also an expectation of substantial financial contributions from civic partners.

This contrast between state funding in Bristol versus co-funding in NYC, is one of the key findings for governance institutions. For public space experimentation involving both governing by co-provision and enabling, NYC DOT partnerships were (partly) motivated by the prospect of securing additional resources from non-state actors - whether from philanthropy, private companies, BIDs, or civic fundraising. In contrast, BCC did not systematically seek non-state funding to resource experiments or upscaling. This difference is partly reflected in the fact that 21% of NYC experiments were funded by non-state contributions, compared to 13% in Bristol (Figure 7.3).

I use the term *diversification* to describe the change in governance modes that was as associated with experimentation in Bristol and NYC, because it is not that traditional modes of provision and authority were *replaced*. There was no shift from 'government to governance', only a greater number of co-existing modes. BCC experimentation involved continued governing of automobility by authority (e.g. parking, speed limits), even as governing by authority and provision was more prevalent in NYC (e.g. traffic safety initiatives). Even as municipal government sought to introduce novelties, it often did so without partnership: 31% of experiments were undertaken by NYC city government alone, compared to 21% by BCC (Figure 7.4). Notably, NYC DOT continued to govern velomobility and expansion of cycling infrastructure by provision throughout 1997-2016.

7.3.3   Governance logics in experiment partnerships

Table 7.4 makes clear that experiment partnerships did not just feature network logics. This section discusses what role network logics within experiment partnerships ('network partnerships') played in enabling transformative impacts. The comparative analysis reveals greater similarities than differences, between the cases.

I discuss how the relations between partner organisations changed over the course of experimentation trajectories. The first section below considers the initial phases of testing elements and assembling working configurations: the two left-hand columns in the tables summarising factors explaining transformative impacts in section 5.2.3-5.2.6 and 6.2.3-6.2.6. The second section then considers the expansion phase of trajectories, i.e. post-experiment partnership arrangements.

Experiment partnerships: network collaboration, but not open innovation

In both Bristol and NYC, network partnerships were important in enabling partner organisations to test novel configurations in flexible ways and refine them to develop 'working' configurations.

A network partnership between BCC and First Bus within the VIVALDI project enabled experimentation with the Showcase bus service configuration, and the launch of the

transformative trajectory related to BHLS (Table 5.7).[128] Network collaboration between BCC and private company Charge Your Car, on the ICT4EVEU experiment that developed a software platform for the Source West EV charging network, allowed for technically complex R&D tinkering and adaptation of existing company products to suit the Bristol context (Table 5.9, Appendix B).

The experiment that first tested the novel Select Bus Service configuration on the Bx12 route illustrates the important role played by network-logic collaboration vividly (Appendix B). Together, NYC DOT and NYCT had to figure out how to design the many different elements of SBS and align them with the city's obdurate infrastructure, collaborating in a creative, flexible and informal manner (NY10, NY15). For example, SBS riders needed to be able to pay on-street, prior to boarding the bus, by both coins and Metrocard,[129] and while NYCT staff could easily reprogram the Metrocard machines used in subway stations, they did not have an existing machine that accepted coins and could be placed at bus stops. DOT staff had access to *parking* meters that accepted coins, and drove over a truck load to NYCT staff (NY10). NYCT staff then repurposed these meters to print 'proof of payment' receipts for SBS riders. This same story was told by two interviewees (NY10, NY15) because it illustrates how the network 'spirit' of collaboration between the two agencies was crucial to the success of the experiment, going beyond the pre-existing bureaucratic-hierarchical relations between the agencies.

The experiment at Diversity Plaza in NYC involved partners working together in an exploratory manner to solve a shared challenge: developing the Neighborhood Plaza Partnership as a model that could work in low-income neighbourhoods (Table 6.13). The flexibility with which The Horticultural Society of New York staff collaborated with NYC DOT and neighborhood partners like Friends of Diversity Plaza, including the informally negotiated nature of relations between them, was important to develop NPP as a configuration that 'worked' (Appendix B), and thus enabling transformative impacts.

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[128] A voluntary partnership agreement, that allowed for tentative exploration of the new type of bus service.

[129] NYCT bus services accept both cash payment and payment by the city's magnetic-stripe Metrocard.

The findings suggest that network logics are conducive to experimentation processes where novel configurations are developed to fit obdurate infrastructure and institutions, discussed further in chapter 9. However, several points of nuance must be added. As discussed in the previous section, many partnerships were driven by resource dependencies and pragmatic interest in collaboration, rather than shared normative commitments to advance sustainable mobility, in the loftier sense suggested in the sustainability transitions literature (section 2.2.2). Many experiment partnerships studied in-depth involved a mix of different logics. Even if network collaboration was the predominant logic, there were also market relations between actors, notably in relation to co-provision where municipalities contracted other actors to provide specific services: for example, with BCC tendering and procurement of First Bus involvement in the geo-fenced hybrid bus trial (section 5.2.3) and ChargeYouCar for the ICT4EVEU experiment (section 5.2.6).

Network collaboration was not a *precondition* for embedding and transformative impacts: there were network-logic experiment partnerships that *were not* associated with subsequent transformative impact. For example, in testing the new model of cycle parking for social housing tenants, BCC staff closely collaborated with social housing association staff on an informal basis, discussing their individual needs, designing bespoke infrastructure configurations, and building friendships in the process.[130] Yet this network collaboration did not result in any embedding beyond stabilisation – rather, BCC resource constraints in the contex to austerity was cited as the key reason for why the model was not explored further (section 5.2.4). Close, R&D-style collaboration between BCC and First Bus did allow tinkering with the complex 'geo-fenced' hybrid bus configuration to make it able to operate in the Bristol context, but this did not mean that the configuration was seen as financially viable for upscaling by First Bus (Table 5.2.3, Appendix B). These examples illustrate that the fact that actors are willing to experiment based on shared normative goals and developing a 'successful' collaboration does not necessarily translate into public or private resources being prioritised for the expansion of a configuration.

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[130] Working with Registered Landlords experiment – see section 5.2.4, Appendix B.

Finally, there were many transformative trajectories that did not feature network partnerships. For example, the experiment with a protected cycle lane along Manhattan's Ninth Avenue (Table 6.11, section 6.2.4) did not feature any partners - rather, NYC DOT followed a classic hierarchical logic of deciding a street needed to be redesigned.

Post-experiment trajectories: from network partnership to formalised partnership

I turn to the *expansion* phase of trajectories, as part of which transformative impacts were consolidated. The third column in the tables summarising factors explaining transformative trajectories (section 5.2.3-5.2.6 and 6.2.3-6.2.6) is the reference point here.

In section 2.3.5, I hypothesised that experiment partnerships can be understood as *temporary* governance constellations (Bradford and Bramwell 2014). My findings confirm this: governance logics characterising partnership working often shifted, after an experiment was over. Examining post-experiment partnership models revealed that network logics often gave way to more formalised governance arrangements. In both Bristol and NYC, after experimental configurations became institutionalised and scaled up, there was a tendency for relations between municipal government and other actors to become formalised, with a shift from network partnerships towards market partnerships or more hierarchical relations. The tendency of both BCC and NYC city government was to assume municipal leadership over experimental configurations once institutionalised, asserting their role in progressing a trajectory – even if experiments were initiated by non-state actors. This is reflected in the small number of civic-led and private-led experiments across the two cases (section 7.3.1).

After working configurations were developed, market partnerships were employed to regularise delivery of new services. To continue promoting cycling among large employers, BCC set up a market partnership whereby delivery of behaviour change interventions were outsourced to Steer Davies Gleave. After the experimental phase, BCC's partnership with Charge Your Car formalised into a more business-as-usual market-contractual arrangement where the company operated the Source West network's

'back office' on a running basis, and Charge Your Car was squeezed out, as it lost the BCC's re-tendering for its second-generation Revive network.

Network partnerships also co-existed with hierarchical relations during the post-experiment phase of trajectories. As described in section 5.2.3, post-experiment expansion of Showcase bus services in Bristol (Greater Bristol Bus Network) involved a shift to statutory Quality Partnership Agreements between First Bus and BCC: this was a shift from network partnership to hierarchical relations. These agreements only covered a limited set of routes, and relations with First Bus continued to feature different forms of voluntary network partnership, up until 2016 and beyond.[131] However, the (partial) shift towards more hierarchical relations with First Bus can only be understood as an action strengthening BCC capacity, since network partnerships with bus operators were imposed on UK municipalities as their only governance tool following national privatisation of the bus industry, and the introduction of Quality Partnership Schemes by national government was offered as a partial redress.

The partnership between NYC DOT and NYCT on SBS continued to be characterised by network collaboration after the initial Bx12 experiment (NY10). However, the SBS trajectory also illustrates the *fragile* nature of network logics. After city-state tensions and the MTA's financing crisis escalated from 2016 onwards, NYCT announced it was halting expansion of SBS in 2018 (Meyer 2018). A DOT interviewee remarked that the associated city-state tensions had begun to disrupt the carefully nurtured network collaboration between staff at the two agencies (NY10). A local expert on busmobility argued that despite the success of SBS and the DOT-NYCT partnership, NYCT remained a fundamentally bureaucratic organisation mired in unproductive control by the New York State Governor (NY17); another former NYCT employee agreed that the organisation remains highly politicised (NY15). Indeed, we can understand both NYC DOT and NYCT as bureaucracies that are prone to revert back to hierarchical relations with one

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[131] Alongside Quality Partnership Schemes, BCC maintained a voluntary partnership with First Bus, which traditionally took the form of a non-binding Memorandum of Understanding. This two-track partnership has continued beyond 2016, with Quality Partnership Schemes expanded as part of the Metrobus BRT system, and BCC forming a new non-binding 'Bus Deal' with First Bus.

another, pointing to how network logics associated with 'success stories' of specific experiments may pale in comparison to broader political struggles.

Municipal relations with civil society and non-profits also tended towards formalisation. In Bristol, experimental non-profit initiatives formalised as registered social enterprises a.k.a 'Community Interest Companies' (Playing Out and Bristol Bike Project) – likely to facilitate easier access to funding from BCC and other actors. As discussed in section 7.1.2, NYC city government institutionalised public space configurations in application-based programmes, which was a highly effective technique in terms of embedding. However, this also resulted in relations between NYC DOT and its partners becoming more hierarchical, characterised by legalistic bureaucratisation. Plaza Program partners are required to "sign an agreement that requires them to indemnify the City and insure the site, maintain it, and provide regular programming" (Urban Omnibus 2015). Responsibilities, costs and risk-sharing between municipal government and non-state actors were thus formalised. This bureaucratisation posed challenges for partner organisations in lower-income NYC neighbourhoods (section 6.2.5), both in relation to public plazas and resident-led play streets (Miller 2015b; Liff 2019; Aaron 2017). Notably, even as the Neighbourhood Plaza Partnership model was institutionalised, Friends of Diversity Plaza successfully reshaped governance institutions, in securing continued flexible support from DOT that is more characteristic of *network* rather than hierarchical relations.[132] Beyond issues of socio-spatial equity, this points to an interesting tension between how municipal bureaucracies operate, versus what kind of relations CSOs would like to see with municipal government.

I have shown that network logics were in many ways associated with experiments as temporary instances of innovative partnership working. We can summarise this section (7.3.3) by concluding that 1) network partnerships were important for experimenting with novel configurations, however, network collaboration was not a precondition for transformative impact, and 2) where network partnerships launched longer-term

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[132] In 2019, the DOT Public Space unit had one staff member focused specifically on lower-income neighbourhoods – who according to an interviewee spends most of their time coordinating with Diversity Plaza groups (NY02).

trajectories, there was a tendency for network logics to give way to more formalised partnerships featuring market logics and hierarchical relations.

7.3.4 The influence of governance institutions on municipal capacity

This section discusses how important 1) governance modes featuring partnerships with non-municipal actors and 2) network logics of collaboration within experiment partnerships were to transformative impacts.

Table 7.5 summarises the governance modes associated with transformative trajectories, in a stylised version building on the discussion above. I draw on this to consider RQ1.3 for each type of mobility, asking: was experimentation more transformative in NYC, and less transformative in Bristol, *because* of the governance institutions involved?

Table 7.5. Governance modes associated with transformative experimentation in Bristol and NYC.

Transformative trajectories related to...	Stylised version of governance modes	
	Bristol City Council	**NYC city government**
Busmobility	Co-provision: "Gradually rope in bus operators to assume more formal responsibility"	Co-provision: "Build informal relationships with bus operator"
Velomobility	Co-provision: "Pay the experts to promote behaviour change" Enabling: "Empower civil society through state funding"	Provision: "Build it and they will come"
Public space	Enabling: "Empower civil society through state funding"	Co-provision and enabling: "Engage non-state actors and co-fund"
Automobility	Authority: "Moderate car use" (parking, 20mph) Market creation: "Nurture the niche" (car-sharing) Co-provision: "Public procurement and management" (EV)	Authority/provision: "Government protecting street users" (safety) Market creation: "Facilitate private investment" (EV)

For velomobility and improving traffic safety, differences in governance institutions do not explain difference in the transformative extent of experimentation in Bristol and

NYC. To improve traffic safety (20mph speed limits in Bristol), NYC city government and BCC adopted the same approach of governing through authority, which was associated with transformative impacts in both cases. For velomobility, BCC's strategy of co-provision through contracting 'expert' organisations, and NYC city government's strategy of governing by provision, were both associated with transformative impacts.

The fact that experimentation with EV charging networks was transformative in Bristol and not in NYC can be explained by differences in governing strategies, however. BCC adopted a proactive approach to managing the development of the EV charging network, co-providing infrastructure through partnerships with private sector companies, whose expertise and services were procured by municipal government. In NYC, governance institutions had a *constraining* influence. NYC city government's more passive approach to governing through 'market creation', hoping to facilitate private providers to provide sufficient coverage of publicly-accessible charging points, did not support the development of a comparable charging network by 2016.

Diverging strategies of governing also explain differences in the transformative extent of civil society-led experimentation. BCC's strategy of enabling civil society through state funding succeeded in supporting some transformative grassroots initiatives focused on public space and cycling cultures, but did not prove sustainable for other initiatives. The findings highlight how civil society in Bristol has been reliant on continuous state support, beyond initial seed-funding. This finding aligns with other research: Jones et al. (2016) document the impact of austerity cuts on Bristol's 'voluntary sector' as mediated by cuts to BCC budgets, and Lacey-Barnacle and Bird (2018) note the dependence of Bristol's energy-focused intermediary organisations on public sector funding. In contrast, NYC DOT's strategy of drawing on co-funding from non-state actors, when co-providing and enabling experiment innovations, provided for more transformational change. This difference reflects different pre-existing governance modes in NYC, i.e. privatisation of public space governance from the mid-1970s. It is not too conceivable, nor perhaps desirable from the perspective of mobility justice, that BCC would have adopted a similar strategy of pursuing non-state funding. Indeed, the OneNYC Plaza Equity Program illustrates how access to public funds has risen to become a central locus of politics in

NYC public space governance. We can note that network collaboration was important for municipal capacity to pursue flexible experimentation in partnership with civil society (Bristol's Playing Out initiative and NYC's Neighborhood Plaza Partnership), but the difference in transformative impacts between Bristol and NYC can be explained by the governance institutions through which subsequent expansion of experimental configurations could be funded and sustained.

Experimentation with Bus with High Level of Service (BHLS) was pursued through governing by co-provision, and resulted in transformative impacts, in both Bristol and NYC. In both contexts, network partnerships with bus operators enabled experimentation, and thus it could hastily be inferred that voluntary collaboration is effective for busmobility innovation. However, the Bristol findings do not fully support Rye et al.'s (2018) argument that informal institutions between municipalities and bus operators are particularly important for effective busmobility governance, in the context of a privatised bus market like the UK. While voluntary network partnerships did enable BCC to undertake initial testing of BHLS elements and configurations, the Bristol findings add nuance to Rye et al.'s (2018) argument, in that it was the shift towards hierarchical statutory partnerships between BCC and First Bus that enabled transformative impacts of the Greater Bristol Bus Network. Limited transformative impacts from experimentation with smartcard ticketing in Bristol can be explained by the lack of effective governance tools available to BCC to get First Bus to collaborate.

In other words, informal relationships between NYC DOT and NYCT as a non-municipal but public bus operating agency is not transferable to the context of the UK's dysfunctional privatised bus market. Bristol interviewees often circled back to the theme of First Bus' risk-aversion to innovation being understandable considering that the company 'had to make a profit' as a commercial entity with 'very small profit margins' (B01, B15, B19). While financial information on First Bus West of England's subsidiary company could not be obtained, Taylor and Sloman (2016) show that the profits of

monopolistic bus companies in the UK are significant.[133] In response to a recent proposal for bus services to be transferred from the MTA to NYC city government control (NYC Council Speaker 2019), a NYC DOT interviewee argued that municipal control would not necessarily make a difference to the fundamental need for interorganisational partnerships to improve bus services, and that their colleagues in other US cities where bus services were privately operated suggested the same - in the end, the interviewee argued, it is the informal relations between staff that matter (NY10). On the contrary, the Bristol findings suggest that the 'strength of informal ties' depends the extent to which the public interest can be pursued within public-private partnerships. As discussed further in chapter 9, there are better functioning private bus markets in countries other than the UK, but nonetheless, the comparison of Bristol and NYC suggests that the 'publicness' of busmobility governance matters.

In conclusion, I found that the two governance institutions explaining difference in municipal capacity for transformative experimentation were:

1) Busmobility governance: how the difference in public transport privatisation as an exogenous driver meant that municipal co-provision with bus operators was an overall constraint on transformative impacts in Bristol, but not in NYC;

2) State funding versus co-funding: how in Bristol, experimentation systematically relied on state funding, including a reliance of civil society experimentation on municipal support; whereas in NYC, partnerships were motivated by access to co-funding from non-state actors, even where the desire was to enable civil society experiments.

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[133] Pressure on First Bus West of England as a subsidiary of parent company First Group PLC's shareholders were often cited, because subsidiary investments to improve local bus services had negatively affected parent profitability (B19; B15; B03). This is linked to how First Bus has transformed from Bristol's Badgerline bus company following privatisation in the 1980s, to a multinational corporation (FirstGroup) owned by a US hedge fund.

7.4   Conclusion: municipal capacity in a multi-scalar context

The comparative analysis presented in this chapter can be drawn together to answer Primary RQ1: *How did multi-scalar governance cause municipal capacity for transformative experimentation to differ in Bristol and New York City, between 1996/7 and 2016?*

Regarding Outcomes (RQ1.1), I found that experimentation had greater transformative impacts in NYC than in Bristol, due to greater material change and improved safety in relation to streetscapes. As the embedding of experimental configurations reflected the endogenous strategies of municipal governments, I concluded that NYC city government had greater capacity for transformative experimentation, compared to BCC (section 7.1).

To explain the differing extent of transformative impacts in Bristol and NYC, I examined differences in the Context within which experimentation was undertaken. At the level of the Primary RQ1, differences in Context were conceptualised under the overarching heading of 'multi-scalar governance', including state restructuring broadly speaking, but also UK and US funding landscapes and policy alignment specific to urban mobility (section 4.1). I have shown that municipal capacity for transformative experimentation must be understood as an interplay between such multi-scalar structure (exogenous drivers) and municipal agency (endogenous strategies) in seeking to enlarge capacity. I examined this interplay for two sets of Context factors: municipal institutions and resources (RQ1.2) and governance institutions (RQ1.3).

NYC city government had greater capacity for transformative experimentation because of more effective endogenous strategies, which were in themselves possible because of differences in multi-scalar governance. From 2007, there was a radical transformation of NYC's mobility system: experimentation was more systemic, policy-led, with greater reliance on permanent organisations and with a broader range of effective techniques for institutionalising experimental configurations. The 'tactical', quick-build approach to implementing experiments was a crucially important endogenous strategy, which allowed experimentation to continue during periods of resource scarcity/austerity politics. These strategies were enabled by greater fiscal autonomy, which supported policy confidence,

operational funding for the quick-build approach, and long-term stability of competent staff, and also gave NYC city government greater levers of how to respond to austerity politics 'from above'. Municipal visions and the scope of experimentation focused on infrastructure and street space reallocation, which resulted in greater material transformation of the urban mobility system. This was enabled by greater policy discretion, with an absence of *de facto* mechanisms through which federal and state government enforced their own mobility policy priorities. The transformation of NYC streets and public spaces was also enabled by co-funding from non-state actors, in governing by co-provision and enabling - as another endogenous strategy in response to resource scarcity. Finally, NYC DOT capacity was enabled by its ability to form effective partnerships with MTA NYCT as a *public* transport operating agency, i.e. the absence of public transport privatisation.

Bristol City Council was exceptionally good at playing the EU's and UK's competitive funding game to resource mobility experimentation, piecing together different grants to incrementally transform the Bristol mobility system. Yet the effectiveness of endogenous strategies varied over time: from 2007, experimentation was piecemeal, no longer as strongly linked to municipal visions and policy frameworks, and with a reliance on temporary organisations. This is partially explained by what appears to be poor endogenous decisions in dismantling permanent sub-units within BCC that were managing experimentation, and worsened from 2012 with the growing capital-revenue mismatch imposed by national austerity cuts. More fundamentally, the transformation of Bristol's mobility system was limited by the lack of infrastructural experimentation, due to municipal visions influenced by the UK's 'Smarter Choices' policy philosophy. The tentativeness of experimentation in Bristol compared to the momentum behind NYC policy initiatives can be explained by BCC's low degree of general fiscal autonomy, as inextricably linked with lack of policy discretion, pragmatic incrementalism and 'deep conditioning' of municipal policy-making in the context of the UK as a centralised state. BCC's lack of access to own-source municipal revenues weakened the organisational basis for experimentation and limited the possibility of effective endogenous strategies in relation to resource scarcity/austerity politics. Where BCC tried to enable experimentation

by civil society, the ultimate effectiveness of this strategy was constrained by the reliance of CSOs on continued (and limited) state funding. Finally, successful endogenous strategies to secure greater contributions from private operators towards bus service innovation met the structural limits of UK's dysfunctional bus market, i.e. public transport privatisation was a constraining factor of enduring importance.

Comparing BCC with NYC city government allowed me to look beyond the problematic of project-based/competitive grant funding, to reveal other factors that matter for municipal capacity. For my cases, I conclude that the decisive factors were: relative fiscal autonomy and policy discretion of municipal government, how experimentation was organised and institutionalised, and how experimentation was related to the 'publicness' of mobility governance and models for funding mobility infrastructures/services.

7.5 Inductive factors: 'local' politics

This final section presents inductive findings regarding factors influencing municipal capacity that were not included in the theoretical framework, i.e. factors beyond the framing of Primary RQ1 itself, namely 'local' political institutions that were not as shaped by multi-scalar drivers. These findings are summarised here, with a full account provided in Appendix H. I discuss these findings not only to provide a comprehensive empirical account of the Bristol and NYC cases, but because they point to possible refinements of my theoretical framework (chapter 9).

7.5.1 Civil society advocacy

NYC city government capacity for transformative experimentation cannot be explained without attention to state-civil society relations, including the role of civil society advocacy and individual municipal leaders. Civil society influence in NYC was not limited to CSOs partnering with municipal government to implement specific experiments or receiving municipal seed-funding, but extended to broader influence on municipal visions and

municipal/governance institutions.[134] Looking back at the Bristol case through the lens of the NYC findings, a similar influence of civil society and individual leadership was absent.

Traditions of civil society activism was one the path-dependencies discussed in section 4.3.4. Bristol had a strong tradition of cycling activism at the start of the study period, which had influenced BCC policy in the 1980s. By 1996, Sustrans had professionalised and morphed into an organisation focused on delivering publicly-funded cycling infrastructure rather than campaigning, and the cycling activism scene had quietened down (B02). As discussed in chapter 5, Sustrans was contracted by BCC to deliver different interventions (co-provision), and as discussed in Appendix H, Sustrans even took over some functions related to velomobility policy-making from BCC. However, I found no evidence that Sustrans nor other CSOs had significant influence on BCC policy between 1996 and 2016, e.g. by advocating for specific experiments. This was surprising considering Bristol's tradition of cycling activism but appeared even more interesting in light of the NYC findings.

My findings suggest that CSOs played a significant role in influencing the mobility content of all major NYC city government policy strategies between 1997 and 2016. In 1997, Transportation Alternatives (T.A.) remained a small group predominately focused on cycle campaigning and being vocally critical of municipal policy, whereas Project for Public Spaces (PPS) was a professionalised place-making consultancy (section 4.3.4). From 2005, T.A. and PPS joined forces on the NYC Streets Renaissance Campaign (NYSRC), funded by private philanthropist Mark Gorton. My findings suggest that NYSRC was successful in pushing experimentation with cycle lanes and plazas onto the agenda of Doctoroff and PlaNYC development, and Sadik-Khan and NYC DOT's policy strategies from 2007, contributing to transformative impacts (Table 6.11, 6.13). T.A. grew professionalised and later prefigured the Vision Zero Action Plan launched by the de Blasio administration, also helping Sadik-Khan shore up public support for controversial cycling infrastructure. As discussed in section 6.1.2, after Sadik-Khan hired Wiley-

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[134] My methodology was designed to include data collection on such broader influence, by conducting interviews with local CSOs, even if they had not partnered on experiments in either large-N sample ('Type 3' interviews, section 3.5.2).

Schwartz to join NYC DOT, PPS' ideas about quick-build experimentation (for which they had developed their own approach since the 1970s, see Appendix H) and BID partnerships came to form part of municipal institutions. My findings thus add nuance to the established narrative regarding NYC's municipally-led 'tactical urbanism' under Sadik-Khan, by making clear that the quick-build approach to experimentation had little to do with her (or Bloomberg) as individual leaders, and acknowledging the role of civil society (in line with Levels 2019).

Civil society influence may have been greater in Bristol than my research was able to reveal, yet the same research design applied to both cases revealed strong civil society influence in NYC. My data does not lend itself to comprehensive explanation of the differences between Bristol and NYC, in this regard. We can contrast the NYC style of civil society influence as one of political contestation, policy lobbying and informal professional networks, with the Bristol style as one of co-governing, and consensus-oriented and formal network organisations. Aldred (2012) has argued that contracting-out of cycling policy implementation to CSOs like Sustrans is symptomatic of a 'hollowing out' of the UK 'cycling state'. While I have shown that BCC co-provision with Sustrans was associated with transformative experimentation (section 7.3.4), i.e. was instrumentally effective, my comparison with NYC suggests that Aldred's (2012) broader critique of co-provision as a state-civil society dynamic with weak transformative potential may warrant further exploration. My findings have shown the relevance of traditions of civil society activism as a path-dependency shaping urban mobility systems (section 4.3.4), which might explain how and to what extent civil society supports municipal capacity for transformative experimentation. In this regard, differential CSO capacities for resource mobilisation will be worth exploring in the context of national state-civil society relations: for example, T.A. and NYCSRC received millions in funding from private philanthropy, whereas Bristol CSOs (beyond Sustrans) are run by volunteers.

7.5.2 Individual leadership

Existing narratives about urban mobility experimentation in Bristol and NYC emphasise the importance of leadership by individuals within municipal government (section 4.4.2).

Inductive findings suggest individual leadership was an important factor shaping municipal capacity for transformative experimentation: again, more so for NYC than Bristol.

Many NYC interviewees argued – unsolicited by the author – that the leadership of Mayor Bloomberg and Sadik-Khan was important in determining NYC city government capacity for transformative mobility experimentation, in line with the established case narrative. Interviewees pointed to the strong executive powers of the Mayor, within the political structure of NYC city government. The NYC findings point to the role of municipal leaders in *mediating between municipal action, civil society advocacy and public contestation*: 1) acting as a conduit for civil society influence (Doctoroff and Sadik-Khan, see above) and 2) their leadership approach to dealing with public contestation of experiments (Bloomberg, Sadik-Khan) and collaborating with CSOs to deal with such contestation (Sadik-Khan and T.A., see above). Third, Sadik-Khan's leadership was important for the adoption of quick-build implementation (again, by hiring civil society advocates) and the organisational forms and techniques of institutionalisation (DOT sub-units, Street Design Manual) - decisions made by Sadik-Khan personally were thus likely an enabling factor for institutions that were central to transformative experimentation. These findings align with a US think tank study (TransitCenter 2015) tracing the history of recent urban mobility innovation in 5 US cities including NYC, which found a common dynamic of change: interaction between civil society campaigning and new ideas, individual municipal leaders providing space for experimentation within bureaucracies, and institutionalisation in municipal processes. In contrast, Bristol interviewees only emphasised one leader, Mayor George Ferguson, in relation to public contestation: spearheading the city-wide expansion of Resident Parking Zones following protests, including an armoured tank being driven through Bristol streets (BBC 2014).

This differential role of individual leaders in Bristol and NYC could be interpreted by pointing to the weak tradition of executive leadership in UK local government, compared to US Mayors (Hambleton and Sweeting 2004). Along the lines of this argument, the fact that Ferguson was the only leader mentioned by BCC interviewees, signals the relevance of the introduction of the model of directly-elected Mayors in the UK (Hambleton and

Sweeting 2014). More broadly, it would be easy to argue that the NYC 'strong mayor' system explains the 'policy confidence' and 'top-down' political momentum driving experimentation based on PlaNYC initiatives (section 7.2.3). Along the lines of this argument, BCC would have had greater capacity for transformative experimentation, had there been stronger executive leadership. Although I did not find Ferguson had a significant impact on mobility experimentation in Bristol (section 5.1.3), this warrants exploration in future research. The crucial nuance is, however, that no political leader of BCC would have had greater municipal resources to play with, relative to NYC Mayors: their policy strategies had clout precisely because there was money attached to them. Indeed, Hambleton and Sweeting (Hambleton and Sweeting 2004, p.482) observe that "there is a truly massive difference in the policy environment shaping the leadership potential of English local leaders compared to their U.S. counterparts, and this concerns the extraordinary centralization of power within the British state. Local leaders are hamstrung because in the United Kingdom because they lack financial power". The argument about Mayoral leadership thus circles back to the conclusion I have drawn in section 7.2. The fiscal autonomy dimension adds nuance to the debate about political leadership as a driver of urban (mobility) transitions.

8   COMPARING MOBILITY TRANSITIONS

This chapter answers Primary RQ2: *To what extent has there been a transition away from automobility in Bristol and New York City, between 1996/7 and 2016?* Examining the extent of urban mobility transitions as distinct from transformative experimentation corresponds to the final element of the causal-analytical framework (Figure 3.1), that first interrelates Context, Mechanism and Outcomes, and then also considers to what extent Outcomes have contributed to Transitions, RQ2.1: *To what extent has transformative experimentation contributed to urban mobility transitions?* While experiments are understood to potentially contribute to the reconfiguration of urban mobility systems through material and institutional change, the extent to which this translates to affect transitions is a different question.

I defined urban mobility transitions as system shifts away from automobility, involving at the very least a shift in mode split away from private car use, but also encompassing the reconfiguration of private car use (e.g. towards sharing, low-emission vehicles) and mitigation of automobility externalities (safety, CO_2 emissions). In the first section below (8.1.1), I assess change in high-level indicators as 'proxies' for these dimensions of transitions (Primary RQ2), and discuss to what extent transformative experimentation contributed to change in these indicators (RQ2.1), for the Bristol and NYC case in turn. The second section (8.1.2) then summarises by answering Primary RQ2 and RQ2.1.

Experimentation as a change dynamic will not be the only thing shaping the extent of urban mobility transitions. Longer-term path-dependencies act at stabilising forces shaping urban mobility across city-regions, which have been discussed for the Bristol and NYC case in section 4.3. Looking beyond experimentation, the third section (8.1.3) answers RQ2.2: *How can difference in the extent of urban mobility transitions be diagnosed through the lens of path-dependencies?,* by comparing how path-dependencies evolved in Bristol and NYC during the study period.

8.1.1 Change in high-level indicators

I examine change in high-level indicators for three dimensions of urban mobility transitions: shift away from private car use, reconfiguration of private car use, and mitigation of automobility externalities.[135] I draw on the discussion of transformative change in mobility flows in section 5.2 and 6.2, to note the contribution of experimentation to changes in high-level indicators (RQ2.1).

The data presented below refer to the Bristol and NYC mobility systems as delimited by municipal boundaries. The discussion here does not consider public space transformation in Bristol and NYC, as the evidence on whether public space experiments resulted in transformative change in mobility flows was limited (see chapter 9).

The evolution of Bristol's mobility system

In 1996, Bristol's urban mobility system was dominated by automobility, with one of the highest levels of private car use and one of the lowest levels of bus commuting, among large UK cities (Mathers 1999). Bus ridership had been growing since privatisation of the bus industry in 1986, but from a very low baseline (BCC 2000). Cycle commuting had, however, been growing since the 1970s (Figure 8.2).
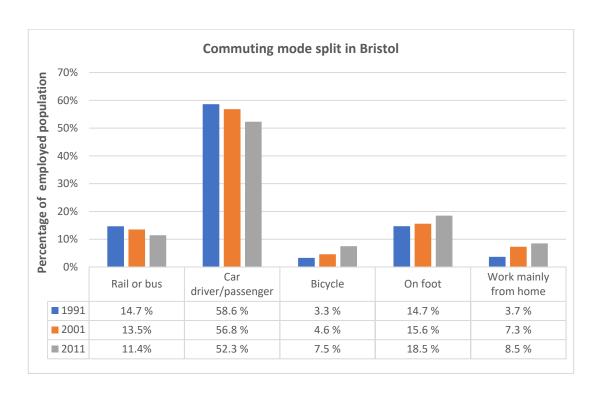
Was there a shift away from private car use, to other modes?

Figure 8.1 shows the evolution of the overall mode split for commuting in Bristol, over two decades from 1991 to 2011.[136] The mode share for car commuting decreased from 58.6% to 52.3% (6.3 percentage points, 10.8% decrease). Overall, Figure 8.1 suggests that there has been a mode shift from private car commuting to walking and cycling, and more people working from home and thus not commuting.

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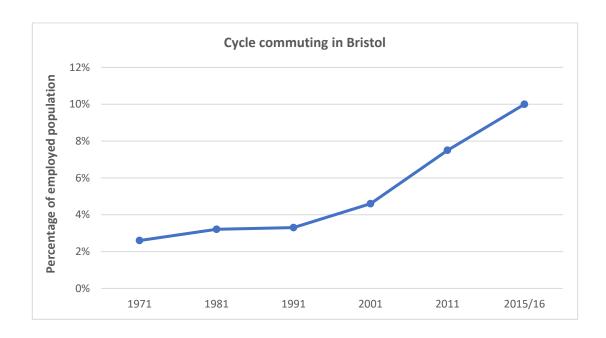
[135] A limitation is that this relies primarily on commuting data. This is in line with the focus on commuting flows in the discussion of city-regional mobility systems and path-dependencies (section 4.2.2 and 4.3.3), but it is acknowledged that commuting only represents a partial picture on urban mobility patterns.

[136] Working-age, employed Census population.

Commuting mode split in Bristol

	Rail or bus	Car driver/passenger	Bicycle	On foot	Work mainly from home
1991	14.7 %	58.6 %	3.3 %	14.7 %	3.7 %
2001	13.5%	56.8 %	4.6 %	15.6 %	7.3 %
2011	11.4%	52.3 %	7.5 %	18.5 %	8.5 %

Figure 8.1. Evolution of commuting mode split in Bristol. Data source: 1991 figures (BCC 2003a), 2001 figures (ONS 2001), 2011 figures (ONS 2013).

Figure 8.2. Cycle commuting mode share in Bristol. Data source: UK Census data compiled from different sources, 1971 figure (BCC 2014a), 1981 figure (Parkin 2004), 1991 figure (BCC 2003a), 2001 figure (ONS 2001), 2011 figure (BCC 2014a), 2015/16 figure is an estimate by Sustrans (2017, p.5) based on the 2011 Census figure plus data from local cycle counters.
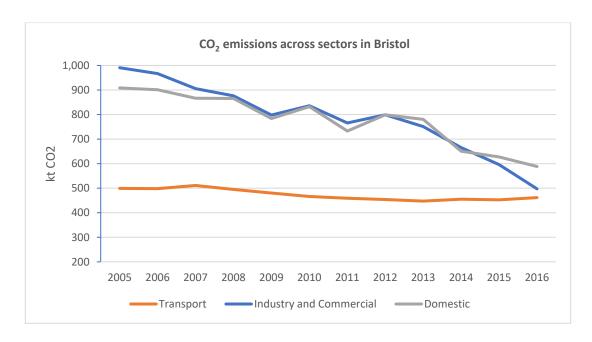
Although Bristol cycling levels remain low compared to UK cities with more established cycling cultures (Aldred and Jungnickel 2014), it is clear that Bristol's mobility system has gradually been reconfigured towards a 'cycling city'. As shown in Figure 8.2, cycle commuting in Bristol grew from 2.6% in 1971 to 3.3% in 1991. This trend continued during the study period: cycle commuting grew even faster, tripling between 1991 and 2015/16. In 2015/16, an estimated 10% of the Bristol population commuted by bicycle. The rate of growth in commuter cycling between 2001 and 2011 was the highest among all English 'Core Cities', outside London (BCC 2014a). I have shown in section 5.2.4 that the trajectory of experimentation with cycling promotion through major employers contributed to the increase in cycle commuting.

The Census data in Figure 8.1 indicate that public transport commuting declined: distinguishing between rail and bus, we can note that the mode share for bus commuting decreased from approximately 13% in 1991 (BCC 2000) to 9.4% in 2011 (ONS 2013). However, this does not capture the significant increase in bus ridership from 2012/13 to 2017/18 (Figure 5.9): we can thus assume that since the launch of the Greater Bristol Bus Network in 2012, there has also been a modest mode shift towards busmobility. I have shown that a transformative trajectory of experimentation to upgrade Bristol bus services contributed to this increase in bus ridership (section 5.2.3).

Was private car use reconfigured?

Private car use was not significantly reconfigured in Bristol between 1996 and 2016 (section 5.2.6). Even if a robust local car-sharing market existed by 2016, car club membership and parking bays grew slowly. Experimentation with EV charging infrastructure to facilitate consumer uptake only began in 2011. The total number of electric vehicles registered in Bristol, as a proportion of all registered cars, grew rapidly from close to 0 in 2011 to 0.16% in 2015 (Heidrich et al. 2017, p.20). This signals potential future growth in EV uptake, which indeed has taken off in the UK since 2016. However, the growth between 2011 and 2015 is too tentative, to suggest Bristol was on a path of reconfigured car use.

Were the externalities of automobility mitigated?

There was a 7.5% decrease in total annual CO_2 emissions from Bristol's mobility system between 2005 and 2016 (Figure 8.3). These emission figures are for types of road transport within BCC's scope of influence.[137] In line with the general trend for the UK, Figure 8.3 shows that transport emissions have not declined at nearly the same pace as in industrial, commercial and domestic sectors. Environmental externalities of automobility were thus only mitigated marginally. This is unsurprising considering the small reduction in private car use, and the limited proportion of low-emission cars. Streets in Bristol became somewhat safer. The total number of people Killed and Seriously Injured (KSI) was largely flat between 1994 and 2005 (West of England Partnership 2006b, p.44), but decreased by 31% from 2005 to 2016 (BCC 2018).[138] The experimentation trajectory resulting in city-wide expansion of 20mph speed limits (section 5.2.6) will not have contributed to this, as the expansion was completed in 2016.

Figure 8.3. Estimated total annual CO_2 emissions in the City of Bristol. Data source: UK Department of Business, Energy and Industrial Strategy (2018).

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[137] Emission estimates include Road Transport on A-roads and minor roads.

[138] Author's calculation based on average total KSI between 2005-2009, and total KSI in 2016.

Was there a transition: a system shift away from automobility?

There was a transition away from automobility in Bristol between 1996 and 2016, as there has been a shift away from private car use towards cycle commuting and bus use, partly as a result of transformative experimentation. The decrease in private car commuting is similar to other comparable urban areas in the UK,[139] whereas the growth in cycling and bus use was faster than in many other areas. Walking and cycling combined accounted for 26% of commuting mode share in 2016 (Figure 8.1). We could thus speculate that within municipal boundaries, Bristol is on a path of becoming an 'active mobility city'.

However, the shift away from the automobility path Bristol was on in 1996 can be described as highly tentative. As a medium-sized city, Bristol still lacks is an integrated public transport system that can compete with automobility. Bus ridership has continued to increase beyond 2016 and further BRT investments are planned (BCC 2019a), however evidence regarding increased bus user satisfaction (section 5.2.3) can be contrasted with recent media reports and opinion surveys, in which Bristolians cite poor bus services as one of the major constrains on their quality of life (BCC 2019b). Bristol's mobility system remains severely congested (ITS International 2013), which has undermined the efficacy of local investments in bus services as buses get stuck in traffic (Cork 2020b). Comparing the early 2000s with the situation post-2016, Bristol stands yet again at a 'fork' in its development path, as to whether it will remain dominated by automobility or evolve into a 'public transport city'. The latter path would likely require complementary rail services.

Automobility has proved resilient in Bristol. Private car use retained the largest mode share for commuting (Figure 8.1). Car ownership increased: in 2011, 71% of Bristol households owned a car, up from approximately 66% in 1991.[140] Bristol's future path may be complicated by resilient automobility within the city-region.

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[139] Change in journeys to work (Table 2) in 'Urban city with town' areas (DfT 2016a).

[140] UK Census data retrieved from Office of National Statistics, Nomis website. 2011 data from Table KS404UK, 2001 data from Table UV062, 1991 data from Local Base Statistics, Table L21.

The evolution of NYC's mobility system

NYC is a city built around its rail networks - a 'transit metropolis' (Cervero 2020). The NYC mobility system was arguably not been dominated by automobility during any period of the 20th century, despite the post-war increase in car use (section 4.3). At the start of the study period, NYC was once again on a path of shifting away from automobility. In 1997, subway and bus ridership was growing (section 4.3.1). Cycling was a marginal mobility practice, with 0.3% of the working population resident in NYC commuting by bicycle in 1990 (Pucher et al. 1999), but growing significantly by 1997 (Pucher et al. 2010).

Was there a shift away from private car use, to other modes?
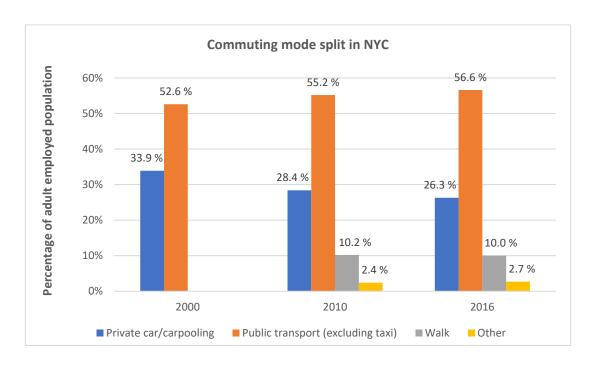
The US Census data shown in Figure 8.4 indicate a shift from private car commuting to public transport commuting from 2000 to 2016: the mode share of car commuting decreased from 33.9% to 26.3% (7.6 percentage points, 22.4% decrease), while the share of public transport commuting increased from 52.6% to 56.6% (4 percentage points, 7.6% increase).[141] NYC DOT's (2008d) analysis concludes that the public transport system absorbed the entire increase in mobility that resulted from NYC population growth between 2003 and 2007.

Figure 8.5 shows household travel survey data for total weekday travel by NYC residents (including all trip purposes, beyond commuting) *by primary mode of travel*, collected by NYMTC. This shows that the mode share for private car use is higher for all types of travel, compared to the mode share for commuting (Figure 8.4). The weekday mode share for car use reduced from approximately 37% in 1997/8 to 34% in 2010/11. Ride-sharing and taxi use increased. Interestingly, Figure 8.5 suggests that the rail mode share[142] remained largely stable, and bus mode share reduced by 1 percentage point. Figure 8.5 data thus are somewhat contradictory to subway ridership trends, which show a 27%

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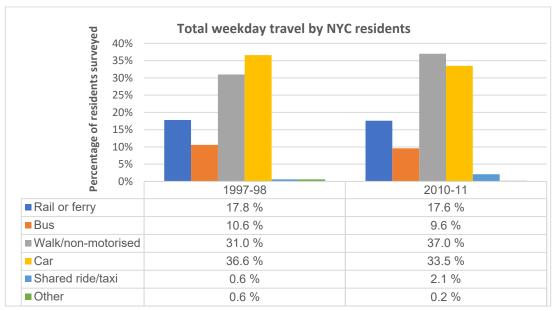
[141] By workers aged 16 years or over, who do not work at home.

[142] Referring to the 'rail or ferry' category: this includes ferry trips, but these account for a very small proportion of the overall share.

increase between 2000 and 2016 (NYCDOT 2018d)9, while they align with the fact that bus ridership declined between 2000 and 2016 (section 6.2.3).

Figure 8.4. Evolution of commuting mode split in NYC. Data source: 2000 figures (NYU Furman Center 2016), other figures from US Census Bureau American Community Survey, Table DP03, 2010 5-year estimate and 2015 5-year estimates, Geography: Place (New York City).

Total weekday travel by NYC residents

	1997-98	2010-11
■ Rail or ferry	17.8 %	17.6 %
■ Bus	10.6 %	9.6 %
■ Walk/non-motorised	31.0 %	37.0 %
■ Car	36.6 %	33.5 %
■ Shared ride/taxi	0.6 %	2.1 %
■ Other	0.6 %	0.2 %

Figure 8.5. Total weekday travel, by principal mode of travel, for NYC residents. Data source: 1997-98 figures (NYMTC 2000), 2010-11 figures (NYMTC 2014a).

The tentative conclusion that can be drawn is that there was a mode shift from private car use to rail,[143] but that this was greater for commuting, than for all types of weekday travel. This mode shift cannot be attributed to NYC experimentation (N=61), since rail mobility was not examined. There was no mode shift to busmobility and I have shown in section 6.2.3 that experimentation did not contribute to increasing bus ridership.

While I have already discussed that it is clear that cycling levels have grown quickly in NYC (section 6.2.4), neither the US Census nor NYMTC data provide a breakdown for cycling mode share. The 'walk/non-motorised' mode share category in Figure 8.5 includes cycling, so the increase in this share might partly reflect cycling growth. A 2017 DOT survey of NYC residents found that 3% reported cycling as their primary mode choice, for all types of trips (NYCDOT 2018d). The US Census Bureau's American Community Survey estimates that 1.3% of New Yorkers cycled to work in 2016 (NYU Furman Center 2017), up from approximately 0.5% in 2000 (NYU Furman Center 2016). We can conclude that cycling levels in NYC increased and transformative experimentation trajectories contributed to this (section 6.2.4): however, cycling remained a marginal mobility practice at the end of the study period, and it is inconclusive whether experimentation contributed to overall mode shift.

Was private car use reconfigured?

Private car use was reconfigured to a minimal extent between 1997 and 2016 (section 6.2.6). Experimentation with EV charging infrastructure did not support significant growth in plug-in EV registrations, by 2015 (section 6.2.6).

Were the externalities of automobility mitigated?

In NYC, total GHG emissions grew steadily from 1995 to 2005, with mobility accounting for 23% of 2005 emissions (City of New York 2007c, p.9). By 2016, citywide GHG emissions had reduced by approximately 15%, and CO_2 emissions from passenger cars

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[143] The fact that NYC DOT's (NYCDOT 2008d) analysis shows that city-wide vehicle traffic volumes (indexed to 1993) flatlined from 2000 onwards, appears to support this.

had reduced by 3.9% (City of New York 2017a). NYC city government analysis suggests that mobility emission reductions up until 2013 were produced primarily by changes in energy generation for public transport, as well as a small reduction in total Vehicle Miles Travelled (City of New York 2013c). It is unlikely that these emission reductions will be associated with NYC experimentation (N=61).[144]

The number of people Killed and Seriously Injured (KSI) declined by approximately 30% between 2001 and 2012.[145] The number of cyclists Killed or Seriously Injured declined by 73%, between 1996 and 2015.[146] Many different interventions will have contributed to this, including new cycling and pedestrian infrastructure, traffic calming and a range of safety policies. The scope of DOT safety interventions went much beyond the experimentation (N=61) examined (e.g. non-experimental street redesign), however, considering the quality of evidence showing that trajectories reduced KSI (section 6.2.6), we can conclude that experimentation likely contributed to improvements in traffic safety.

Was there a transition: a system shift away from automobility?

In 1997, NYC's mobility system was on a path of transitioning away from automobility, and by 2016 was further down that same path. A continued shift from private car use to public transport was complemented by an increasing number of New Yorkers cycling. The NYC case illustrates the extent to which urban mobility can be based around sustainable modes, within a 'transit metropolis' supported by everyday active mobility. In 2016, approximately 55% of New York households did not own a car.[147]

However, since 2016 NYC has arguably been suffering a public transport 'crisis', with both subway and bus ridership in decline (NYC Comptroller 2017; NYCDOT 2019c). How quickly these trends are reversed is largely an MTA governance issue related to city-state politics. The history of NYC indicates that whenever there has been substantive

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[144] Since experiments with low-emission vehicles had limited impact.

[145] Author's calculation based on data provided in NYC DOT (2013b).

[146] Average cyclist KSI per 100 million trips. Author's calculation based on data in NYC DOT (2017g).

[147] US Census Bureau American Community Survey, Table DP04, 2016 5-year estimate, Geography: Place (New York City).

investment in subway services, ridership has increased; and vice versa when investment and maintenance have dwindled (NYC Council Speaker 2019). Reducing car use and ownership further will likely require investment in new rail-based public transport services to fill coverage gaps and increase capacity, as emphasised in PlaNYC, but not yet achieved. Efforts to broaden the range of public transport options for New Yorkers bore limited fruit, as bus ridership flatlined from 2000 and began to decrease from 2010 (Figure 6.13).

Automobility has proven resilient *even* in NYC. Car ownership increased marginally, from 44% of NYC households owning a car in 2000, to 45% in 2016;[148] whereas per-capita car ownership had decreased between 1990 and 2000 (NYCDOT 2019c). A NYC DOT (2018d) travel survey found that 62% of resident trips were made by public transport, walking and cycling, but private car use had the highest individual share at 32%. Both car ownership and car use are highly spatially heterogeneous across the five NYC Boroughs, with the lowest in Manhattan and Brooklyn (NYCEDC 2018; TTC 2017) and much higher levels in Staten Island and outer Queens (NYC DOT 2018d), with the latter suburban areas having limited access to subway services (City of New York 2013c). To conclude, NYC's mobility system has shifted further away from automobility between 1997 and 2016, but automobility remains resilient in the city's suburban neighbourhoods.

8.1.2   The extent of mobility transitions in Bristol and NYC

Table 8.1 summarises the extent of urban mobility transitions in Bristol and NYC: the last row answers Primary RQ2, whereas the contribution of experimentation to transitions (RQ2.1) is indicated within the first three rows. In both case contexts, there was a transition away from automobility, as there was a shift away from private car commuting and mitigation of safety externalities, even if automobility remained resilient in both contexts (car ownership, subordination of other mobilities) and private car use was not significantly reconfigured. I argue that the transition away from automobility was greater in NYC than in Bristol, however, because the percentage change and rate of mode shift

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[148] Based on 2000 US Census figure reported in Salon (2009), and 2016 5-year estimate, US Census Bureau American Community Survey, Table DP04 Vehicles available per occupied housing unit, Geography: Place (New York City).

was greater in NYC, and because the deviation from an automobility path is highly tentative in Bristol.

This argument regarding the relative extent of transitions (Primary RQ2) does not align with the extent to which I found transformative experimentation had contributed to respective transitions (RQ2.1). I judge that Bristol's transition was lesser and more tentative than the one in NYC, but for the Bristol case, there is evidence that transformative experimentation contributed to mode shift (first row of Table 8.1). I judged that there was a greater transition in NYC, but there is no available evidence that would point to a clear contribution of transformative experimentation to mode shift away from private car use. However, this does not mean that NYC experimentation did not contribute to the transition. Indeed, I concluded that experimentation was more transformative in NYC than in Bristol, because there was greater institutional and material reconfiguration of NYC's urban mobility system (section 7.1). The NYC case highlights the limitation of mode shift as an indicator of transitions and the lack of indicators to capture how transforming street space contributes to a shift away from automobility.

Table 8.1. The extent of urban mobility transition in Bristol and NYC.

Dimension	Bristol mobility system	NYC mobility system
Mode shift in commuting, away from private car use	Yes, 6.3 percentage point decrease in car mode share (1991-2011) *Experimentation contributed?* Yes, velomobility and busmobility experimentation	Yes, 7.6 percentage point decrease in car mode share (2000-2016) *Experimentation contributed?* No, mode shift to subway
Mitigating externalities: KSI and GHG emissions	Yes 31% reduction in KSI (2005-16) 7.5% decrease in CO_2 emissions from road transport (2005-2016) *Experimentation contributed?* No	Yes 30% reduction in KSI (2001-15) 3.9% reduction in CO_2 emissions from private cars (2005-2016) *Experimentation contributed?* Yes, likely for KSI
Significant reconfiguration of car use	No, not significant *Experimentation contributed?* No	No *Experimentation contributed?* No
Transition away from automobility?	Yes, tentative shift to path away from automobility	Yes, remained on path away from automobility

My RQ2.1 finding for NYC also shows that whole-system reconfiguration and change in mode shift for NYC's mobility system cannot be explained without examining subway services (first row in Table 8.1): this is unsurprising, considering that the subway is the most dominant commuting mode. In Bristol, where there are no substantive rail services, growth in velomobility and busmobility as the primary competitors with automobility for commuters can translate into overall mode shift. The answer to RQ2.1 is that the contribution of transformative experimentation to a transition away from automobility is clear and significant for the Bristol case, whereas for the NYC case the contribution is less significant but also unclear. I have found that the transformative extent of experimentation *can be but will not necessarily be* reflected in mode shift, as an indicator of transitions.

Not only was the extent of transition greater in NYC's mobility system than Bristol's; I would also argue that *goal attainment* or the realisation of municipal visions for urban mobility reconfiguration was greater in NYC. From 1996-7, both the New Labour government and BCC adopted a policy agenda that explicitly sought to reduce private car use, but many of the most significant policies to achieve this like public transport investment and demand management, were never implemented. Bristol's mobility transition could potentially have been much greater and more decisive - instead, automobility still dominated in 2016. The NYC system was obviously 'further down' the path away from automobility and towards a post-car city than Bristol in 1997, but because of the realisation of new policy objectives set in the mid-2000s that generated extensive transformation of the mobility system, this was significantly reinforced by 2016. In the next section, I discuss what path-dependencies explain the resilience of automobility and tentative path-deviance in Bristol.

8.1.3   Diagnosing transitions through the lens of path-dependencies

To answer RQ2.2 and make sense of transition dynamics *beyond* experimentation, I return to the path-dependencies – public transport systems, city-regional governance, spatial structure and commuting flows, and civil society activism – existing at the start of the study period (1996/7), described in section 4.3. To diagnose why there was a greater

mobility transition in NYC than in Bristol, I examine how these path-dependencies evolved between 1996/7 and 2016. This focuses on the city-regional context, i.e. urban mobility systems as extending across municipal boundaries, and also includes rail services.

In Bristol, cycling-related **civil society activism** was already in a mode of professionalised co-governing by the mid-1990s, and this only grew stronger over time (section 7.5.1, Appendix H). In contrast, NYC's civil society activism was of an entirely different tradition, and evolved along a path conducive to transformative influence, as CSOs continued to focus on confrontational advocacy. While cycling activism in Bristol may potentially have kickstarted growth in cycle commuting from the 1970s (Ginger 2013; Figure 8.2), there is no evidence that activism contributed to transformative velomobility experimentation (section 7.5.1) and thus to Bristol's transition (first row in Table 8.1). Civil society activism clearly contributed to transformative experimentation in NYC (section 7.5.1), but experimentation did not contribute to transitions (first row in Table 8.1). Thus the difference in the extent of Bristol and NYC transitions cannot be diagnosed through the lens of this path-dependency.

The difference between Bristol and NYC transition-paths from 1996/7 to 2016 can be diagnosed by divergence in path-dependencies related to **public transport systems, city-regional governance, spatial structure and commuting flows.** The limited and tentative deviation from Bristol's automobility path is explained by the fact that none of these path-dependencies evolved in a conducive direction for a transition away from automobility.

The Bristol city-region had no high-capacity **public transport system**, including a very limited rail network (section 4.3.1). A historical reason for this was that the seeming 'chance event' that UK government did not establish a Passenger Transport Executive for the Bristol area in the 1960s, giving it an integrated **city-regional governance** structure for public transport comparable to other UK city-regions (section 4.3.2). BCC's (2000) first Local Transport Plan and a major planning study for the city-region, the Greater Bristol Transport Study (Atkins 2006), found that given projected population growth and the existing spatial structure, limiting further growth in car use would require a rapid transit

network combined with road user charging. BCC pushed for a city-regional light rail network ('Bristol Supertram') and managed to secure UK government financial backing in the early 2000s, but this was cancelled due to disagreements between BCC and neighbouring South Gloucestershire (BBC 2004a) and internal party politics within BCC (BBC 2004b).[149] As mentioned in section 5.1.1, road user charging failed to be introduced in Bristol, as it did in all other UK cities outside London - largely because of risk-averse local politicians and public contestation.[150] After 2004, no further proposals were put together for new rail-based infrastructure;[151] the focus on the Greater Bristol Bus Network and the Metrobus BRT system only emerged as substitutes for light rail (Atkins 2006).[152] Even if these bus investments have steadily improved ridership (BCC 2019a), the debate has continued about the need for complementary commuter rail and tram services (Moving Bristol Forward 2021; BCC 2019c). From 2017, under incumbent Mayor Marvin Rees, BCC has focused on an underground mass transit system for Bristol. This has been based on the argument that given existing congestion and the city's historical urban form, with narrow streets functioning as key mobility corridors, the potential to improve bus priority further is limited (BCC 2019c; B10). Interestingly, a 'Bristol metro' seems to resonate with Rees' social equity-focused politics, with the Mayor quoting (Rees 2018; Cork 2018) an article (Mahler 2018) on the centrality of the NYC subway to the city's opportunities for social mobility, to argue for the need for mass transit in Bristol. Civil

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[149] While most sources agree that it was local politics that ultimately doomed the Bristol Supertram, central government funding for the Bristol scheme was withdrawn at the same time as for similar proposed schemes in Leeds, Liverpool and Portsmouth (Comfort 2006). This reflects that the New Labour government backtracked on key pillars of its sustainable transport policy, as it was ultimately reluctant to commit to investment in public transport infrastructure, at least on a comparable scale to continental neighbouring countries (Docherty et al. 2009).

[150] The VIVALDI (2005) evaluation report suggests that the timescale for road pricing was 'amended' because the Labour Party lost overall control of BCC in the 2003 election. In 2004 national government launched the Transport Innovation Fund to provide greater financial incentive for municaplities to pursue road pricing (Butcher 2010b). The West of England Partnership (2006a) continued to pursue road charging and was awarded funding for feasibility studies from the Innovation Fund (West of England Partnership 2007), but never submitted a full proposal. Manchester was the only city-region to do so, but its congestion charging scheme was cancelled after defeat in a referendum. An interviewee cited the Manchester outcome and the fear of 'scaring away' investment as the key reasons that charging was never introduced in Bristol (B28).

[151] From 2010, the West of England Partnership did begin developing 'Metro West' plans for re-opening lines part of the city-region's *existing* rail network, where services had been terminated by the 1960s Beeching Cuts.

[152] Three 'Metrobus' BRT routes were launched in 2018-19. The West of England Partnership began planning these in 2006, following the Greater Bristol Strategic Transport Study.

society and politicians have thus recognised Bristol's weak public transport systems as an important path-dependency.

A lack of effective **city-regional governance** also persisted in Bristol, during the study period. From the 1970s to the 1990s, Avon County Council lacked capacities for strategic land use-transport planning, which resulted in a city-regional **spatial structure** characterised by sprawl and employment centres poorly accessible by public transport, which in turn led to growth in cross-boundary **commuting flows** by car (section 4.3.3). The abolishment of Avon County Council then left a complete city-regional governance vacuum. In 2008, the UK Government's amended Local Transport Act gave local authorities a new opportunity to form Integrated Transport Authorities (ITA), mimicking the governance structures established in city-regions with Passenger Transport Executives (section 4.3.2). The West of England authorities could have joined together to create what might have been the city-region's first-ever governance structure for integrated mobility planning, and debated it.[153] The authorities had already come together in the voluntary West of England Partnership, which undertook a formal review of the possibility of establishing more formal partnership working through an ITA (West of England Partnership 2008; 2009), yet decided against it. In this instance, BCC was internally unified, but the ITA was blocked by opposition from the other local authorities (Crump 2009; B13). It took until 2017, a central government-led devolution agenda, that the Bristol area got its first city-regional governance structure with ITA powers, the West of England Combined Authority.[154] Whatever exact politics caused both the Supertram and ITA proposal to fail, it is clear that persistently acrimonious relations between the different West of England authorities have played an important role (B10; B13). One interviewee argued that this city-regional politics was infused by power struggles between local

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[153] In addition to PTE public transport powers, ITAs may exercise additional planning powers, e.g. highways planning by local authorities must be transferred to this city-regional structure. An interviewee who had worked for a PTE elsewhere in England, commented that there is a considerable difference in capacity for public transport planning between a PTE and a governance structure fragmented across four West of England councils, e.g. ten times more staff working for a PTE (B13).

[154] Combined authorities are a recently-introduced local government unit in England (IfG 2021), designed to strengthen city-regional governance. The West of England Combined Authority comprises BCC, South Gloucestershire Council, and Bristol and Northeast Somerset Council.

politicians who had been happy to continue collaborating under a 'veneer' of partnership and joint funding bids, despite underlying conflict; which to some extent reflects 'red-blue' politics[155] between a left-leaning BCC and the surrounding suburban and rural areas dominated by car-driving electorates (B10). South Gloucestershire did partner with BCC on many key strands of experimentation from the mid-2000s, which enabled BCC to extend its efforts to promote cycle commuting beyond its own boundaries to target the North Fringe 'edge city' employment area. However, this was not enough to put Bristol's **spatial structure and commuting flows** on a sustainable path. By 2016, the North Fringe still did not have high-quality public transport connections, and traffic levels in the area grew, at least between 1994 and 2008 (West of England Partnership 2021). Research conducted in 2008 on the locational choice of SMEs found that only 15.7% of office buildings within Bristol, and 16.4% within the wider city-region, met public transport accessibility criteria outlined in spatial planning guidance (Dalton 2009b), and concluded that nearly half of SME 'office stock' in Bristol had poor, very poor or no accessibility to public transport (Dalton 2009a). Inward and outward commuting by car remains a major barrier to putting Bristol's mobility system on a sustainable path (BCC 2019c; B10). In essence, in 2016, BCC was still a municipal government constrained by the politics of the functional city-region and its associated path-dependencies and politics.

In contrast, in NYC, path-dependencies in public transport systems, spatial structure and commuting flows evolved in a direction *conducive* to the transition away from automobility. The city-regional context in NYC has similarities with Bristol (and many other cities): NYC city government boundaries are non-metropolitan (section 4.2.3), there has never been a **city-regional governance structure** for integrated land use- transport planning, and there are political tensions between the city government and the surrounding automobile-dominated suburban municipalities, which play out both in MTA public transport operations and NYMTC (section 4.3.2). Yet because of historical decisions like the public takeover of privately-operated NYC subway and bus services in the pre-war period and New York state government interest in establishing the MTA as a regional

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[155] BCC has traditionally been controlled by the Labour Party and Liberal Democrats, whereas the surrounding Councils have traditionally been controlled by the Conservative Party.

transport authority in the 1960s (section 4.3.1), the NYC city-region has an integrated rail-based **public transport system** that extends across the functional city-region and is governed by a single public authority. With an upswing in public transport service quality and ridership by 1997, public transport services saw further improvement during the study period. But more importantly, despite the lack of change in *de jure* city-regional governance, NYC already had *de facto* integrated planning of *commuter transport* across the city-region, through the MTA.

This public transport provision aligned with the conducive development of the city-region's pre-existing **spatial structure and commuting flows.** Despite the rise of automobility, and suburbanisation of housing and employment beyond NYC boundaries in the post-war decades, by the 1990s, NYC had retained its primacy as an employment centre to a greater extent than Bristol (section 4.3.3). This trend continued: the proportion of total office space in the NYC city-region that was located in the Manhattan Central Business District (CBD) remained virtually constant from 1999 (Lang and LeFurgy 2003) to 2005, with the emergence of Downtown Brooklyn as a secondary CBD (Lang et al. 2009). With improvements in MTA services, an increasing number of people commuting across the city-region were willing to do so by rail. From 2000, there was a sustained shift from private car use to public transport for both inward commuting to NYC and outward commuting from NYC (NYCDCP 2019; 2008a). By 2016, 58% of people working within NYC commuted by public transport, and approximately 8 million workers within the city-region lived in places where "the regional transit system provides services to Midtown Manhattan within approximately 90 minutes or less" (NYCDCP 2019, p.14).[156] As such, city-regional politics was not a constraint on NYC city government capacity nor NYC's mobility transition path between 1997 and 2016; thus unsurprisingly, the city-regional context was barely mentioned by NYC interviewees.

In conclusion, I argue that the difference in the extent of mobility transitions between Bristol and NYC can largely be explained by path-dependencies specific to the city-

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[156] In section 4.3.2, I define the NYC city-region in terms of US 'combined statistical area' geography. In the study cited here, NYC city government refers to a slightly larger 'Metro Region' geography.

regional context. As a case, BCC illustrates the challenges that many other non-metropolitan municipal governments face, in lacking effective capacity to shape mobility flows that extend across wider city-region, especially where public transport provision is poor for historical reasons. NYC city government, on the other hand, is arguably somewhat of an 'outlier' case in relation to city-regional dynamics: it does not face the same challenges as many other municipal governments, because it enjoys access to one the most extensive rail commuter systems of any city-region in the world, and has been able to retain its primacy as a global financial and service industry capital (Sassen 1991).

My analysis of the Bristol case has highlighted that the path-dependencies of automobility are not *irreversible* (cf. Urry 2004), but difficult to deviate from. By 2016, change in Bristol's mobility system had established a tentative transition path away from automobility, however, this shift might have been much more decisive and automobility might not have continued to dominate had there been earlier reform of city-regional governance and greater investment in public transport. However, such decisions go beyond the capacity of BCC alone, as they went beyond the powers and decisions of NYC city government for the NYC city-regional context, where the mobility system continued to evolve along the pre-existing path away from automobility that had been set in the early 1990s. We can conclude that municipal capacity for transformative experimentation is not sufficient to diagnose the extent of urban mobility transitions. The Primary RQ2 (incl. RQ2.1, RQ2.2) findings support the theoretical notion that longer-term path-dependencies constrain agency in relation to urban mobility transitions. However, I have shown that rather than understanding path-dependencies as set by historical 'chance events', we can understand them through multi-scalar politics (e.g. NY state government deciding to establish the MTA, to enlarge its own power; struggles between West of England authorities), that are not necessarily ideological (e.g. decision not to establish PTE in Bristol), but political nevertheless. The Bristol case points to the role of party politics at the local and city-regional scale in relation to path-dependencies: Bristol's limited transition cannot be 'blamed' entirely on national government.

Deep decarbonisation of urban mobility requires that shifts away from private car use are complemented by reconfiguration of private car use into more benign forms, like shared

mobility and low-emission vehicles. Neither Bristol's nor NYC's mobility system saw significant change by 2016 in relation to this third dimension of transitions (Table 8.1), but it will be crucial for future assessments of the cities' transition paths.

9 DISCUSSION

This chapter discusses the findings for each RQ in relation to existing literature, focusing on conceptual findings and theoretical contributions, and providing recommendations for future research. Reflections of the strengths and limitations of my research are interwoven throughout each sub-section.

Table 9.1 serves as a reference point for discussion of methodological strengths and limitations. Construct validity, reliability, internal validity and external validity are four concepts used to describe research designs across the social sciences. Corresponding to these four concepts, Yin (2009) has proposed four tests of rigour for case study research, against which my research design is assessed in Table 9.1.

Table 9.1. Strategies employed to ensure methodological rigour.

Tests of rigour	Definition (Yin 2009, p.40)	Strategies employed to ensure rigour	Stage of the research process
Construct validity	Identifying the correct operational measures for the concepts being studied	Defining experimentation clearly as a research object, with specific definition criteria (theoretical framework, constructing of large-N databases)	Research design
		Carefully considering whether interventions qualify as experiments (constructing large-N databases)	Data collection
Internal validity	If the investigator incorrectly concludes that there is a causal relationship between X and Y without knowing that some third factor Z may actually have caused Y, the research design has failed to deal with some threat to internal validity	Counterfactual thinking; Considering rival explanations; Combining deductive and inductive analysis	Data analysis
		Using multiple sources of evidence (including existing academic research); triangulation until evidence is convergent	Data collection Data analysis
		Informant and expert review of findings	Several points in time (Bristol)

External validity	Defining the domain to which a study's findings can be generalised	Initial exploration of theory (pilot study)	Research design
		Theoretical replication through multiple cases, for improved generalisability	
		Selection of Bristol as a representative case, NYC as a critical case	
Reliability	Demonstrating that the data collection and analysis process can be repeated, with the same results	Using case study protocols (incl. rules for adding and discarding experiments from the large-N databases; interview guides)	Data collection
		Structured process of thematic analysis, with primarily deductive codebook	Data analysis

9.1 Defining urban experiments

In the existing literature, definitions of experiments are wide-ranging (section 2.1), and thus it is important to reflect on mine. As discussed in this and the next section, my empirical findings reflect the construct validity of my research (Table 9.1). I defined an urban mobility experiment as *an intervention in an urban mobility system with the aim of testing a socio-material configuration that is novel in the context of that system* (section 2.5.1). To operationalise this definition empirically, the criteria for qualifying interventions as experiments were that (section 3.4.2): it was a *material* intervention in the urban mobility system, and that the aim was to test a configuration, ie. with some degree of *tentativeness*, that was *novel within the case study context*.

My definition emphasised that experimentation is about testing *configurations* of different *social and material elements*. This was inspired by socio-technical configurations relating to MLP niche-innovation (Geels 2002) but replaced the emphasis on technical elements with material elements. My findings point to the importance of emphasising the materiality of urban experiments. My findings suggest that decision-making regarding embedding of experimental configurations is about co-construction of knowledge in relation to context-

specific obduracy of the urban built environment, as discussed in section 9.2. Understanding such processes requires a different perspective than the co-evolution of social and technical elements, as rooted in sociology of technology. My comparison of transformative impacts in Bristol and NYC also points to infrastructural experimentation and material change as central to the reconfiguration of urban mobility systems. My findings illustrate the strength of defining experiments with *configurations* of different elements: this pays attention to whether the configuration *as a whole* is embedded, versus instances where *specific elements* of the configuration were institutionalised and circulated from one intervention to the next. I acknowledge the inspiration I drew from Williams (2016), in this regard. Without nuanced attention to *elements* within different configurations, my RQ1.1 findings would have been completely different.

My definition emphasised the novelty of configurations within a place-specific context. This was inspired by Bulkeley and Castán Broto (2013), in contrast to the MLP conceptualisation of experimentation with niche-innovations that are 'radical' in relation to regimes (Geels 2002; Schwanen 2015). My findings support the argument that urban experimentation should be understood as being about contextually-novel configurations. Mobility experiments in Bristol and NYC were not typically testing configurations that were 'radically' innovative in a national or global context, rather, most experiments were testing configurations that had already been experimented with elsewhere.

I defined experiments as aimed at *testing*, in the sense that there was some degree of *tentativeness*, reflecting the fact that there is often some degree of uncertainty about a configuration because it is novel. Tentativeness is related to how we can empirically identify experiments as objects of study, and proved challenging to operationalise as a criterion for qualifying interventions (section 3.4.2). The tentativeness of experiments is often explicitly indicated by labelling interventions as 'pilots', 'trials' or 'demonstrations': the use of such terms could typically be easily triangulated, to confirm tentativeness. However, I also identified interventions that were not referred to using these terms, but that qualified as experiments (section 3.4.2). In both Bristol and NYC, interviewees were hesitant to refer to interventions as 'pilots' or 'experiments'. From a realist perspective, interviewee perceptions as to whether an intervention qualifies as an experiment cannot

thus be relied upon; my theoretically-derived definition was crucial. The tentativeness of experiments was greater in Bristol than in NYC: the aims of experiments in both Bristol and NYC extended to *testing* and *demonstration* of configurations, although with more testing in Bristol, and more demonstration in NYC. I would argue that both testing and demonstration can be understood as tentative, but in different ways. I suggest a refined definition of an urban experiment as: *an intervention in an urban system with the aim of tentatively exploring a socio-material configuration that is novel in the context of that system, including testing and/ or demonstration.* The ambiguity about the tentativeness of experiments can be partly resolved by paying attention to different styles of experimentation, as discussed in section 9.3.1.

My definition was specific in that it identifies urban experiments as discrete interventions, in contrast to scholars who define urban experimentation in terms of broad process: an open-ended process of political negotiation (Frantzeskaki et al. 2017a), an 'open innovation' process in specific settings like urban laboratories (Evans et al. 2016a), or from an assemblage perspective (Hodson et al. 2017). I argue that conceptualisation of urban experimentation needs *dual* definition: 1) attention to the specific nature of experiments as discrete interventions and how they differ from other types of urban (policy) intervention, and 2) a processual understanding of experimentation as a mechanism of governing urban systems, which I discuss in section 9.4.1.

9.2 Understanding the outcomes of experimentation

A strength of my research is that it draws connections *and* distinguishes between short-term outcomes of single experiments, longer-term transformative impacts (RQ1.1), and the contribution of transformative experimentation to transitions (RQ2.1). This fills a gap in existing research, which has tended to focus on how the outcomes of a single experiment may hold 'seeds' for system change. I have observed trajectories and transformative impacts at an intermediate analytic level, i.e. how urban systems change through reconfiguration. My contribution is also in articulating embedding, transformative impacts and system path-dependencies with reference to *urban* contexts and the specific nature of urban mobility systems, by paying attention to the interrelation of

material/spatial change and institutional change. I have examined whole-system reconfiguration by studying four different types of mobility, and a large sample of experiments (N=108) relative to existing research.

9.2.1 Typologies and patterns of outcomes

My typology of embedding outcomes (Table 2.7) worked well for making sense of the empirical outcomes of experiments, and allowed me to uncover trajectories of experiments that were 'linked'. I would suggest that this typology, particularly how I have operationalised it, can inform future research.

My typology of transformative impacts (Table 2.8) was based on inductive observations regarding experimentation trajectories, including city-wide spatial expansion, significant change in policy and governance institutions, and change in mobility flows. 'Transformative change' is an increasingly popular term within policy and academic discourse. Often, it appears to refer to a break with the status quo of systems, which is more related to how I define an urban mobility transition. My three types of transformative impact are modest, reflecting incremental reconfiguration of Bristol and NYC mobility systems, that nonetheless amounted to significant system change over time. My inductive typology should be refined in future research.

Stabilisation of configurations

By separating out stabilisation as a category from Turnheim et al.'s (2018) typology, I was able to observe instances where an experimental configuration was 'made permanent' or retained up until 2016. The fact that more than half of all experiments resulted in stabilisation in both case contexts shows that experiments may leave traces in the urban fabric that persist for decades: for example, walking down a street in Bristol you might cross an experimental 'home zone' tested in the early 2000s, and while most people will have forgotten about the national policy trend of that time, the infrastructural 'relic' is still there. However, experiments resulting in no other embedding than stabilisation did not 'link' to other experiments and thus typically did not form trajectories nor generate transformative impacts.

Scaling up, city-wide expansion and change in mobility flows

In section 2.1, I argued that it makes more sense to understand scaling up in spatial-material terms, rather than as institutional 'scaling up' to a 'higher' level of regimes (van den Bosch and Rotmans 2008). Defining scaling up in terms of the spatial expansion of configurations allowed me to examine material change in mobility systems - e.g. the extent of cycle lanes - including potential city-wide expansion over time, as a transformative impact. Because I defined scaling up as expansion of a *configuration as a relatively intact whole* (cf. circulation, where configurations were modified), I traced the expansion of *specific* configurations. For example, in NYC, I distinguished between expansion of Class 1a (signalled intersections) and Class 1b (non-signalled intersection) protected cycle lanes; and similarly for different types of bus priority lanes. This allowed assessment of the *quality* of configurations that were expanded, and conclusions regarding the interrelation between material change and change in mobility flows. As noted for NYC's Select Bus Service trajectory, the potential of experiments is only as great as the configurations they test (section 6.2.3), i.e. based on the quality of the configuration for addressing context-specific mobility challenges.

Circulation of elements

Circulation was defined as instances where specific social or material elements 'moved' and were integrated into other configurations. My definition of experiments as configurations of elements (section 9.1), and my attention to circulation of these elements allowed me to capture instances where experiments had less direct impact, but nonetheless 'built' on each other. It is my detailed attention to circulating elements and evolving configurations that distinguishes my study of experimentation as *recombinant* innovation, e.g. 'modular' experimentation in NYC and technological tinkering in Bristol. This perspective has advantages to (transport) policy research, where a focus on innovation in 'policy measures' (e.g. Givoni et al. 2013) may not be able to capture subtle change in configurations. My findings on recombinant experimentation evoke the modular evolution of technology (Arthur 2009) as reflected in the MLP concept of niche-innovation 'linking different elements' into different socio-technical configurations (Geels

2002). I arrived at this similar finding for urban mobility experimentation inductively, which illustrates the empirical depth of my work and the strength of my definition of experiments and circulation.

Institutionalisation and significant new policy and governance institutions

Institutionalisation was included as a category of embedding based on Turnheim et al. (2018). In Transition Management literature, the institutional change that signals transitions is defined rather broadly as 'changes in thinking, doing and organising' (section 2.1). My approach was deductive, in examining institutionalisation in relation to specific municipal institutions (organisational forms, policy frameworks) and governance institutions (governance modes, partnership models). This allowed me to demonstrate how institutionalisation into different organisational forms relates to the problematic of project-based experimentation. Inductive findings also revealed how configurations were institutionalised in infrastructure design standards, local legislation and policy 'toolkits' as other types of institutions: this should be explored further in future research.

Institutionalisation was the most pivotal type of embedding for transformative trajectories, e.g. institutional techniques used by NYC city government versus BCC. It was most clear how institutionalisation involved concrete 'work' undertaken by municipal bureaucrats with specific skillsets, because of the difference between the case studies. This could be explored further by examining 'institutional work' (Lawrence et al. 2011; Fuenfschilling and Truffer 2014) perfomed by different actors, with a more nuanced approach distinguishing between generating new institutions, and maintaining, modifying and replacing existing institutions.

My typology of transformative impacts only considered significant new *policy* and *governance* institutions: inductive findings for the NYC case suggest that change in *political* institutions could also be included. Urban mobility became politicised in NYC: by 2016, it occupied a completely different 'rank' on local politicians' agendas, as illustrated by busmobility trajectories (see section 6.2.3). NYC interviews pointed to how the discourse and policy platforms of elected city government officials changed vis-à-vis mobility, including

Mayoral candidates and NYC City Councilmembers (NY11; NY06). My theroretical framework comprised no tools for rigorously assessing this type of institutional change, which could be explored in future research.

The finding that experimentation trajectories generated new policy and governance institutions is significant because it shows that experimentation and municipal capacity was not only *shaped by* governance institutions (RQ1.3), but that experimentation also *reshaped* governance institutions (discussed in section 9.3).

Patterns of embedding

An inductive finding was that across many trajectories of experimentation, there was an embedding pattern common to the Bristol and NYC case (section 5.2.1 and 6.2.1):

Circulation of elements → *Working configuration* → *Institutionalisation* → *Scaling up*

This pattern points to the role of configurations judged to 'work', which marked a pivotal point within trajectories, after which transformative impacts materialised. This finding was inductive, based on interviewee statements that 'seeing' and experiencing that a configuration 'worked' was important to decision-making regarding embedding, rather than the outputs of formal evaluation (see next section). Interestingly, this perspective on configurations aligns with Science and Technology Studies literature (Walker and Cass 2007). For example, in citing Hughes' (1986) notion of a 'seamless web' and Rip and Kemp's (1998) conceptualisation of technologies as 'configurations that work', Geels (2002) emphasises those authors' antecedent arguments that the social cannot be seen as separate from technology, because it is the ability of a socio-technical configuration to 'work' and serve a function that makes it a technology.

9.2.2 Recommendations for future research

My research shows that we can observe patterns of embedding and transformative change from experimentation, and understand the municipal and governance institutions that explain how such change was possible. This is quite powerful in itself. However, my

(critical) realist and institutionalist perspective, with a focus on the instrumental outcomes of experiments, also came with certain limitations. Future research on urban experimentation could explore complementary constructivist perspectives.

Embedding as a multi-actor process

Embedding should be analysed as a *process*, rather than a typology of outcomes. This should include attention to the agency of different actors involved in experiments. In my research, I 'speak back' to a theoretical framework focused on state capacity, and thus the embedding patterns I observe (section 5.2.1 and 6.2.1) are articulated as if municipal government took all the decisions involved in the embedding process.

In reality, other public and non-state actors will have had an influence on these decisions. Because of the reality of municipal control over many aspects of urban mobility systems, embedding *as decided on and organised by* municipal staff is critical. Yet, I have shown that experimental configurations were often led and ideated by CSOs: both through partnerships with municipal governments (section 7.3) or through prefiguring and advocating for configurations more broadly (section 7.5). Nuanced perspectives on how non-state actors shape embedding, in the context of asymmetric power relations where municipal bureaucrats in many ways might have 'the final say', are needed. This could attention to the roles of different actors during different phases of an experiment, including more attention to the 'pre-design' phase where a configuration is not yet specified, but ideas about what novelties should be introduced are circulating (e.g. to capture civil society influence, section 7.5).

My identification of experimentation trajectories was inductive, emerging out of in-depth study how experimental configurations became embedded, which revealed how *some* experiments became 'linked' to subsequent interventions, as 'things' transferred between them. This was visualised as 'arrows' between experiments in my visual diagrams (section 5.2.1 and 6.2.1). This 'link' between experiments does not signify linear causality, i.e. that one experiment caused a subsequent experiment to happen, but instead signifies a complex set of processes involved in embedding. Sustainability transitions research tends

to understand these processes as one of multi-actor 'learning' (section 2.2.2); I suggest a stronger theoretical grounding is needed in future research.

Capturing co-construction in the context of urban obduracy

My research approach could not fully explain exactly why and how municipal staff judged one configuration to 'work', and not another one. I found that understanding such decision-making through the lens of formal 'evaluation processes' as a municipal institution (RQ1.2) was insufficient, as evaluation data was not an important enabling factor for the majority of transformative trajectories (section 7.2.2).

Constructivist analysis is needed to understand the co-construction of the social and material in the embedding of experimental configurations, and the role of obduracy (Hommels 2016). I suggest that a Science and Technology Studies perspective would be the most enriching, to understand why actors judge that certain configurations 'work' (better than others). My interview data suggests that the judgments of municipal planners were co-constructed by their own experiences, how infrastructural/service elements operated in practice (e.g. did the new cyclist-specific traffic signal work, did the bus prototype run without breaking down), and the politics of public contestation - rather than formal evaluation processes (section 7.2.2). Smartcard ticketing and hybrid bus experiments in Bristol (section 5.2.3) pointed to the challenge of aligning novel technologies with obdurate infrastructure. For these trajectories, decisions about embedding were shaped by the limited capacities of municipal staff to develop configurations that were deemed to 'work' by bus operators, with claims constructed in relation to material elements like the need to retrofit bus depots or financial viability. For experiments that launched transformative trajectories, interviewees tended to 'black-box' decision-making regarding embedding as if the institutionalisation or upscaling of the configuration had been relatively inevitable, rather than acknowledging that there might have been a point at which 'it could have all failed'.

This points to the need for research focused on uncovering the co-construction of embodied/experiential aspects of knowledge production that is associated with:

experiments as material interventions, the formation of 'publics' (Marres 2016; Ryghaug et al. 2018), and how configurations need to be 'fit' to align with the obduracy of place-specific urban systems. Such a perspective would need to go beyond classic sociology of technology analysis (Pinch and Bijker 2012) that focus on locked-in 'dominant designs' (Geels 2002), to consider perspectives that engage with stabilisation of socio-material configurations in the urban built environment specifically, e.g. actor-network theory as articulated in relation to planning (Rydin 2013).

Public space transformation and change in mobility cultures

NYC findings highlighted the limited evidence available regarding whether/how street space reallocation and public space transformation affects mobility flows (section 6.2.5) and transitions (chapter 8). Most of the documentation on car-free spaces (parklets, plazas) introduced experimentally in NYC reported economic benefits, in terms of retail sales and increased consumption (Gehl Studio 2015, p.12), and anecdotal evidence suggests that Manhattan plazas increased real estate values (NY05). This aligns with the well-established fact that public space transformation can affect urban economies (Carmona et al. 2018).

Reallocation of street space from vehicles to public life can also reverse the privatisation of urban public space that is characteristic of automobility (Sheller and Urry 2000). However, our understanding of how public space transformation affects a potential transition away from automobility, both as gauged through short-term impacts of experiments (RQ1.1), quantitative high-level indicators (RQ2.1) and qualitative disruption to car culture, is relatively underdeveloped.

I would argue for future attention to transforming 'mobility cultures' (Sheller and Urry 2006; Cresswell 2010; Pooley et al. 2013; Aldred and Jungnickel 2014). This could help understand at what point large-scale introduction of car-free public space begins to change the social norms dominated by automobility. For example, an independent study of seven NYC plazas (Gehl Studio 2015) points to change in public culture, with an increase in the amount of time local people spent outdoors and social connections.

9.2.3 Can experiments affect system change?

We can turn to comparing my findings regarding embedding and transformative impacts (RQ1.1) and the contribution of transformative experimentation to transitions (RQ2.1) with the existing empirical literature.

The vast majority of experiments in Bristol (72%) and NYC (85%) resulted in combinations of embedding outcomes *beyond* stabilisation, i.e. including circulation, scaling up and/or institutionalisation; only a very small proportion resulted in no embedding at all (3-6%). Transformative impacts were rarer, and did not automatically follow embedding. However, the transformation generated by experimentation was not insignificant: comparing the material shape and institutional landscapes of Bristol and NYC mobility systems in 1996/7 and 2016, there was marked change. This can be understood as *system reconfiguration*. I found that transformative experimentation can contribute to transitions as *systems shifts* (RQ2.1) as assessed through change in mode split as a high-level indicator (Bristol case), but transformative experimentation may also contribute to transitions in ways that is not reflected in such indicators (NYC case).

Existing research on the impact of experiments (section 2.1.1, 2.1.2) suggests that they often remain 'isolated projects' that are disconnected from broader policy frameworks and governance processes, and have limited impact on system change (Hoogma et al. 2002; Kivimaa et al. 2017; Bertolini 2020). Overall, my findings differ from these previous findings that the 'potential' of experiments is limited, but because my definition of experiments and typologies of experiment outcomes differ from previous studies, comparing findings requires some unpacking.

Kivimaa et al. (2017) and Bertolini (2020) found that experiments generated diverse forms of institutional and material change, e.g. change in public policies and mobility patterns: these impacts can be equated with what I define as embedding and transformative change in mobility flows, so in this respect, my findings align with theirs. However, what other scholars (Hoogma et al. 2002; Kivimaa et al. 2017; Bertolini 2020) define as *system change*, equates to my definition of *transformative change in institutions*. Kivimaa et al. (2017) define system change as change in dominant institutions and disruption of an existing socio-

technical regime, Hoogma et al. (2002) as experiments contributing to a regime shift away from petrol-car automobility; both studies conclude that the contribution to system change was limited. I found that institutional change in systems did occur: dominant policy and governance institutions relating to different mobilities were transformed, including busmobility (Bristol and NYC), commuter cycling (Bristol) and public space (NYC); even if experimentation only incrementally reconfigured private car use. Bertolini (2020) defines system change resulting from experimentation as 'fundamental changes in line with defined visions'. I found that experimentation did generate institutional and material change in line with visions defined by BCC and NYC city government, e.g. policy objectives for increasing cycling levels, bus ridership and car-free public space. I defined transitions as *system shifts* and emphasised change in *mobility flows* (rather than institutions, as in previous research) as an indicator of these, and concluded that experimentation can contribute to such shifts: subject to considerable uncertainty regarding the appropriateness of proxy indicators and the real causal mechanisms at play (section 9.4).

My findings thus refute the claims of previous research cited above: I have shown that experimentation can both transform/reconfigure urban mobility systems and contribute to transitions. The points on which my findings agree with observations regarding the *limits* of experimentation is that (RQ2.1): 1) transformative experimentation does not decisively disrupt automobility in the sense of a large-scale regime shift away from it, indeed path-deviant change remained tentative in Bristol and automobility remained resilient in both Bristol and NYC; 2) experimentation as a mechanism of introducing novelties into systems is far from the only, or perhaps most significant, dynamic at play in transitions, e.g. in contrast to how longer-term path-dependencies evolve.

This discussion highlights that debates regarding the empirical outcomes of experimentation are first and foremost a matter of definitions. There are several reasons why my findings could be expected to differ from previous research. First, previous research examines a smaller set of case study experiments implemented in a wide range of geographical contexts, through primary research (Hoogma et al. 2002) or by reviewing cases reported in existing literature (Kivimaa et al. 2017; Bertolini 2020). I speculate that 'picking and choosing' disparate cases is generally more likely to find that experiments

have limited impact, since the 'average' experiment is more likely *not* to result in transformative impact. In contrast, I examined a larger number of experiments within particular places (N=47, N=61), which allowed me to uncover longer-term trajectories.

A methodological explanation for why I found experimentation to have transformative impact may be related to time frames: I study trajectories over 20 years, whereas Kivimaa et al. (2017) note for the studies they reviewed that analysis often occurred too soon after an experiment had finished, to provide definite results regarding outcomes.

Previous research focused on experiments with EVs or bike-sharing as nascent technologies (Hoogma et al. 2002) or street space experiments (Bertolini 2020), which can both be expected to face special challenges in relation to expansion. In contrast, I examined experiments with a broad range of configurations (e.g. new technologies, street infrastructure), with this diversity potentially increasing the likelihood that experiments produce embedding and transformative impacts.

Furthermore, I examined the contribution of transformative experimentation to change in high-level transition indicators in relation to four different mobilities (busmobility, velomobility, public space and automobility), which again possibly increases the likelihood of (identifying evidence of) such contribution. I argue that my research illustrates the strength of the perspective on urban transitions that Hodson et al. (2017) and Geels (2018) have called for: a whole-system reconfiguration approach examining a multiplicity of experiments within place-specific urban systems.

9.2.4 Methodological reflections: studying experimentation

My research combined large-N analysis of 108 experiments with small-n analysis of 8 experiments studied in-depth.

The large-N approach produced strong internal validity (Table 9.1): the extent to which a case study provides a "convincing account and explanation of what is observed" or "being true to life" (Curtis et al. 2000, p.1003). My large-N samples capture most urban mobility experiments actually undertaken in Bristol and NYC during the study period. Examining

only a small number of experiments would have resulted in different answers to the RQs. My case narratives align with that of experts on the respective local context: for the Bristol case, I had the opportunity to ask Bristol informants and local experts to review preliminary findings on several occasions,[157] which confirmed their validity; for both cases, different findings triangulate with secondary data from academic research.

The methodological limitation of my research relates to reliability (Table 9.1). To develop the greatest possible internal validity regarding experiments undertaken in Bristol and NYC, the large-N databases were subject to substantial iteration. Tracing experiment outcomes was complex, resembling 'detective work' rather than a linear sequence of steps that can be duplicated by another researcher. The fact that experimentation was such a 'fuzzy' object of study with divergent definitions in the existing literature, required this kind of iterative process, to develop a meaningful operationalisation of the construct.

More large-N, *primary* research on experimentation undertaken in specific places is needed. Purely desk-based large-N studies should be interpreted as highly indicative: I found that the attributes of an intervention as described in online sources did not align with the realities revealed by closer empirical study. Crucially, this extended to whether the intervention qualified as an experiment in the first place (section 9.2). Large-N analysis of experimentation should be complemented with small-n analysis. I found this strengthened the empirical rigour of my findings regarding how Context factors affected experiment Outcomes. I would recommend that a smaller number of experiments are only chosen for in-depth study once longer-term trajectories have been identified, to focus on experiments that tested 'working configurations' within trajectories.

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[157] Staff at Bristol City Council, researchers at the University of the West of England Centre for Transport Studies; findings were presented organised by the University of Bristol, with attendees across public, private and third sectors.

9.3 Municipal capacity for transformative experimentation

In this section, I discuss my findings for Primary RQ1, including how we should conceptualise and compare municipal capacity for transformative experimentation, and municipal institutions and resources (RQ1.2) and governance institutions (RQ1.3) as constituent parts of such capacity.

9.3.1 Experimentation as a governing mechanism

I conceptualised experimentation as governing mechanism through which novelties can be introduced, linked to the desire for purposive reconfiguration of an urban system (section 2.5.1). I adopted this rather general definition compared to existing literature, because I argued that urban mobility experimentation was not likely primarily motivated by climate change mitigation or adaptation (cf. Bulkeley and Castán Broto 2013), nor aimed at system change from the outset (cf. van den Bosch and Rotmans 2008; Sengers et al. 2019; Bertolini 2020). My findings for Bristol and NYC support this argument on both counts.

New urban politics driving the introduction of novelties

I have shown that experimentation was primarily associated with national and municipal *mobility* policy, which became a strategic priority for municipalities at a time when sustainability and merged with broader entrepreneurial policy agendas for advancing the competitiveness of Bristol and NYC. Promoting non-car mobility came to be seen as central to 'liveability' of respective cities. This political account of *sustainability entrepreneurialism* as a 'backdrop' to experimentation that was pursued contrasts with typical accounts of policy change in relation to sustainable transport, which emphasise shifts in the cognitive models of decision-makers regarding the unsustainability of the 'predict and provide' approach (Curtis and Low 2012; Melia 2019). In other words, my findings highlight new forms of urban politics as a *likely precursor* to the emergence of experimentation as a preferred governing mechanism.

Understanding why and when experimentation becomes more prominent

Experimentation is not the only approach to introducing novelties. My study of Bristol and NYC policy-making suggests that the importance of experimentation as a governing mechanism varied over time: for example, it was less predominant from 1997-2005 in NYC and from 2007-2011 in Bristol. My brief discussion of Bristol and NYC mobility systems from the 1950s (chapter 4) notes that mobility experiments were undertaken prior to the study period. Indeed, urban history suggests that different actors have always undertaken experiments to 'better' the city (Evans 2016). I thus do not argue that experimentation is a *new* governing mechanism unique to 21st century sustainability entrepreneurialism, but that it became adopted as a *more prominent* governing mechanism at various points during my study period.

Future research could examine experimentation from a longue-durée perspective informed by planning theory: considering for the second half of the 20th century during what time periods, in different cities or urban planning traditions, experimentation was adopted more prominently as a governance mechanism, and why. For example, we could ask whether the tentativeness inherent in experimentation as a mechanism of realising new policy agendas can be understood as 'post-modern', as a contrast with the imaginary of 'modernist planning' where novelties were implemented with less tentativeness and at large scale? This is a very relevant question for urban mobility transitions: since the post-war, state-supported rise to dominance of automobility in the Global North was one of the definitive projects of modernist planning, can urban mobility experimentation, in contrast, be understood as a more tentative mechanism of governing through incremental reconfiguration, and what are the implications of this for the potential contribution of experiments to transitions?

Exploring variation in Mechanism and styles of experimentation

Future research should explore variations in experimentation as a Mechanism. My causal-analytical framework for understanding municipal capacity for transformative experimentation (Primary RQ1) focused on how Context, Mechanism and Outcomes are

related. I focused on understanding Outcomes in relation to Context, with experimentation as Mechanism understood as a 'constant', i.e. examining the same basic causal mechanism operating in different Contexts and generating different Outcomes (section 3.1).

The causal-analytical framework served its purpose in providing a structured frame, but in holding the Mechanism aspect constant, my research characterised many features of experiments that were arguably part of the Mechanism (e.g. quick-build implementation process in NYC), instead as municipal institutions (endogenous strategy related to Context factors). Examining variations in Mechanism would allow for analysis of different 'styles' of experimentation. My conceptual experiment definition encompassed a wide range of experiments, from testing novel technologies in EU-funded R&D projects to civic-led demonstrations of play streets. These interventions have different aims, draw on different resources and competences, involve different types of actors and multi-scalar politics. In future research, it would make sense to systematically start categorising these different styles of experimentation as variations in Mechanism, related to a different set of Context factors for consideration, and approaches to evaluating Outcomes. This would include identifying experiments within 'living laboratory' settings and other types discussed in existing literature, as distinct styles.

One possible avenue for future research would be to draw on realist evaluation (Pawson and Tilley 1997; Heiskanen and Matschoss 2018). This approach begins with a formulation of a mini-theory theory of how a particular policy programme works and a set of Context-Mechanism-Outcome (CMO) hypotheses, which are then tested and findings developed in the form of different CMO configurations along the lines of 'what works for whom, in what context, through which mechanisms and with what outcomes' (Westhorp 2014). In line with this, future research could explore patterns of Context, Mechanism, Outcomes configurations from different styles of experimentation, and with subtle variations in Mechanism (e.g. organisational settings, implementation approaches, actor collaboration logics) between individual experiments.

Broadly, I suggest that greater attention to variation in Mechanisms would be productive for understanding the extent to which actors across different contexts have the capacity for different styles of experimentation. Following Bardach (2004, p.209), I defined experimentation as a basic causal mechanism. Bardach proposed this definition to solve the 'extrapolation problem', i.e. how policy-makers in one place can meaningfully draw lessons from the experiences of policies implemented in another place, by starting with identifying the 'basic mechanism' by which a policy 'works' or has causal power.

Table 9.2. Analysing NYC DOT quick-build experimentation as a mechanism.

Dimensions of policy extrapolation (Bardach 2004)	NYC DOT quick-build experimentation
Basic mechanism (effectiveness and cost-effectiveness)	Quick-build approach to implementing experiments, allowing for rapid implementation and at low-cost
Contingent features (Context factors)	
Implementing features (directly implement basic mechanism)	In-house construction/maintenance crews (asphalt, road markings) In-house materials for temporary use (paint, planters, granite blocks, etc.) Competent staff managing design, implementation
Optional features (no essential functional role, but beneficial)	Co-funding and partnerships for maintenance and programming (public space)
Supportive features (resources used to bring the implementing features into being, e.g. budget and institutional infrastructure)	Own-source municipal operational funding Organisational culture of creativity and risk-taking Organisational sub-units (permanent organisation) in which experimentation is institutionalised Ability to circumvent need for design review of interventions, that can slow down process

Bardach's full framework for policy analysis is illustrated in Table 9.2, with reference to NYC DOT's quick-build experimentation approach (or 'tactical urbanism') used for cycle lanes and public plazas. Not only does quick-build experimentation constitute an unorthodox mechanism of reconfiguring street space rapidly and at low-cost, but it draws on a set of Context factors that are specific to NYC city government. In Bristol, the exact same quick-build mechanism could not be used because: 1) BCC does not have the same access to own-source operational funding that can be deployed flexibly, as discussed in relation to fiscal autonomy (section 7.2.3), and 2) BCC does not have access to in-house

construction/maintenance crews and materials that underpin the rapid and low-cost nature of the mechanism. NYC city government has in-house crews for most street-related jobs, rather relying on contractors, as do 93% of 19 other US cities for road markings and 53% for concrete work (NACTO 2018). In the UK, the Thatcher government virtually eliminated comparable municipal 'direct works' departments by introducing compulsory competitive tendering (Higgins and Allmendinger 1999), which means that private sector contractors build and maintain streets. Furthermore, a survey of UK local authorities' cycling policy found that many respondents cited the value of "trial schemes using temporary materials" but noted that they involved "an element of risk" that "isn't within their nature" (Aldred et al. 2019, p.155) - this resonates with a BCC interviewee's direct reference to NYC quick-build experimentation (B03). This is not to say that BCC cannot pursue quick-build experimentation because of Context factors specific to the UK, but that pursuing that the approach would have to be different than in NYC. This example illustrates the value of examining variation in Mechanisms of experimentation, to understanding the geography of municipal capacity.

9.3.2 Experimentation beyond the projectification lens

My conceptual framework for RQ1.2 draws on Hodson and Marvin (2010), Hodson et al. (2013), Hodson et al. (2018), and extends this work by drawing on organisational studies literature to conceptualise their observations about piecemeal versus systemic experimentation. My central conceptual framework distinguishing between Type 1/2/3/4 experimentation (Figure 2.3) was adapted from Hodson et al.'s (2013) typology of four modes of urban energy intermediation (Figure 2.1), to focus on municipal government experimentation rather than 'activities' of intermediary organisations. I think my comparative analysis demonstrates the strong conceptual power and enduring relevance of Hodson et al.'s (2013) foundational framework, and how it is relevant for analysing municipal governments and experimentation, beyond intermediary organisations. Furthermore, I have improved Hodson et al.'s framework in five ways.

First, on the vertical axis (Figure 2.3), I focused on the tension between external priorities and *municipal visions* for urban mobility, in shaping the *scope of experimentation*. Focusing on 'municipal visions' rather than Hodson et al.'s (2013) 'context-specific priorities' focused on the evolution of policy strategies, and what novelties/experiments were mentioned in them, as a concrete empirical basis for understanding 'local' priorities. Distinguishing between *municipal visions* and the *scope of experimentation* allowed me to explain why experimentation was shaped by external priorities in Bristol, even in the absence of external funding programmes directly imposing a specific scope of experimentation, by explaining this with reference to policy discretion and 'deep conditioning' of experimentation at the more fundamental level of municipal visions.

Second, for the horizontal axis, I took Hodson et al.'s (2013) empirical distinction between piecemeal/project-based activities and systemic activities, and grounded this conceptually in organisational studies literature distinguishing between projects as temporary organisations and more permanent forms of organising (Lundin and Söderholm 1995; Godenhjelm et al. 2015): what is in fact a spectrum of permanence from projects, to programmes, and organisational sub-units (Figure 2.4.). Having this clear conceptualisation of different organisational forms was central to understanding

institutionalisation (e.g. of experiments into programmes) as a form of embedding and how the organisational structure of municipal governments was more or less conducive to strong municipal capacity with systemic approaches to experimentation (Type 3/4), as shown by section 7.2.2.

Third, I have demonstrated that my adaptation of Hodson et al.'s (2013) framework can be used to *explain* experimentation *outcomes*, i.e. it has explanatory power in relation to instrumental capacity (of municipal government) for transforming urban (mobility) systems. This is because BCC and NYC city government shifts between Type 1/2/3/4 experimentation underpinned transformative impacts, in being linked to the organisational forms and structures associated with municipal techniques of institutionalisation. Hodson et al. (2013) use their framework to compare the activities of intermediary organisations in London and Manchester in a descriptive sense, that hints at the *latent* capacities of intermediary organisations, but does not extend to explanatory claims about instrumental capacity. The descriptive style of research is widespread in existing research on urban experimentation (section 2.1.4). A contribution of my research is showing how Hodson et al.'s framework, and how experimentation is organised and institutionalised more broadly, matters for the actual transformation of urban mobility systems in terms of institutions, infrastructures and flows (RQ1.1); and how it matter(s) for the extent of transitions (RQ2.1).

Fourth, my findings show that experimentation in line with external priorities can be transformative and contribute to transitions. As shown for the Bristol case, Type 3 experimentation where EU and UK government priorities were systematically pursued was transformative. Hodson et al.'s (2013) research asks whether urban actors have the capacity to steer transitions in line with local priorities, and thus suggests that Type 4 experimentation based on local priorities is stronger than Type 3 experimentation based on external priorities. I ask a different question about the *outcomes* of experimentation in transforming systems and causing transitions, and find that municipal capacity for transformative experimentation can be strong, even if the scope of experimentation is shaped by external priorities. The Bristol case shows that municipalities can effectively realise national policy agendas: it is not that municipalities need to have complete policy

discretion, to experiment effectively. This is highly relevant for thinking about urban, suburban and rural areas beyond Bristol and NYC, where municipalities might not have equally ambitious visions, i.e. there might be no desire for purposive reconfiguration away from automobility. For such contexts, Type 3 experimentation where a national government 'push' for sustainable mobility policies translates into local implementation, will be highly relevant for urban mobility transitions.

Fifth, my research comprises modest methodological innovation, in showing how the rigour of research discussing municipal resources and multi-scalar funding can be improved by quantitative analysis of financial trends (internal validity, Table 9.1).

Revisiting the problematic of project-based experimentation

My research has unpacked the notion of experiments as 'projects', showing that experiments should not be equated with (pilot or demonstration) projects, as is the tendency in existing literature (section 2.3.2). My research has added nuance to the problematic of project-based experimentation as associated with more piecemeal experimentation and weaker municipal capacity (Hodson and Marvin 2010; Hodson et al. 2013; Hodson et al. 2018). My comparison has shown that (section 7.2.2):

- An approach to experimentation that involves experiments predominately organised as projects/temporary organisations can be *systemic* (BCC Type 3, 1996-2006), if this is complemented by permanent organisations (organisational sub-units) that effectively oversee and manage how these projects are linked to strategic policy and how embedding is managed. The prevalence and diversity of complementary permanent organisational forms was important for explaining municipal capacity.

- Experiments may or may not be organised as projects. Project organising can be conducive for creating 'space' for innovation within municipal bureaucracies (Bristol case), in line with existing literature (Table 2.6). Experiments can also be institutionalised as a mechanism within permanent organisations (organisational sub-units): the NYC case suggests that this allows for a flexible and 'modular' type

of experimentation, where teams draw on knowledge repositories (design manuals, 'toolkits' of elements) to test different configuration in a recombinant way. This finding can be explored for other cases in future research.

- How experimentation was organised within municipal bureaucracies related to both how experiments were *launched* and how configurations were *institutionalised* post-experiment: there is a recursive relationship between municipal institutions as organisational forms/structure, and institutionalisation as embedding.

- External mobility funding in both Bristol and NYC was typically awarded on a project basis (NYMTC, EU funding), or at least the short-term nature of external funding necessitated project organising (Bristol Cycling City). However, NYC findings show that experiments for which funding is awarded on a project basis *need not be organised within municipal bureaucracies in a project form*, e.g. through the separation of grant/project management and experimentation in different organisational units.

- Claims regarding *projectification*, i.e. increasing reliance on temporary organisations over time (Munck af Rosenschöld and Wolf 2017), need empirically nuanced investigation. I found that project organising was common in Bristol and NYC already in 1996/7, and there was no steadily increasing reliance, but rather oscillation, over time. To understand experimentation as related to projectification may thus require longer time frames of analysis, e.g. analysing change in municipal bureaucracies and planning practices from the 1970s.

I incorporated the concept of 'projectification' into the theoretical framework of this PhD research in 2017, after discovering Munck af Rosenschöld and Wolf's (2017) work.[158] Since then, other researchers have also engaged with the concept, e.g. Ehnert et al. (2018) cite previous research on this by Borgström et al. (2016) in noting the projectification of

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[158] Conference presentation of two full papers (Smeds 2018; 2019b), with the latter presented in a session I co-organised on 'Governing the city by projects'.

EU funding for local transition initiatives. Torrens and von Wirth (2020) have proposed 'strategies for redressing projectification in urban experimentation', such as organising 'portfolios' and thinking about 'project ecologies'. This work responds to what I agree is a real need for practical approaches to ensure knowledge transfer from projects to permanent organisations, to guard against piecemeal experimentation. However, I think a focus limited to practical tools risks replicating the tendency of sustainability transitions research to develop *'management'* approaches. In contrast, my research has taken a more critical institutionalist perspective, paying attention to the 'upstream' *drivers* of how experimentation is organised: not just external mobility funding programmes, but also fiscal autonomy and austerity politics.

9.3.3   Experimentation and governance: related how?

By incorporating analysis of governance institutions (RQ1.3), my research goes beyond the problematic of project-based experimentation and external funding landscapes, to contribute towards a more comprehensive theorisation of municipal capacity for transformative experimentation.

Modes of governing through experimentation

Prior to empirical analysis, I adapted Bulkeley and Kern's (2006) typology of governance modes (Table 2.9) by distinguishing between *governing by enabling* (modified definition) and *governing by co-provision* (added as a mode). My findings validated the relevance of this adaptation (section 7.3.1). Attention to *governing through co-provision* was central to capturing the politics of state restructuring, corresponding to the blurring of responsibilities for public service provision across public and private actors (Stoker 1998). My findings additionally pointed to two different types of *governing by enabling* (section 7.3.2): a mode seeking to realise municipal policy obejctives by enabling private sector experimentation through *market creation*, and a mode seeking to *enable* experiments ideated and led by civil society organisations, based on their own priorities. I propose that Bulkeley and Kern's (2006) typology is extended to include six modes: *self-governing, governing by authority, governing by provision, governing by co-provision, governing by enabling* and *governing by market creation.*

Governing by enabling is relevant to the emphasis on civic participation in contemporary urban governance and planning. My findings revealed instances where municipal government in Bristol and NYC was willing to cease some control and support CSOs to take the lead on experimentation. I have shown that CSOs can introduce diversity to the scope of experimentation, with new ideas and alternative values. In that sense, my findings support the emphasis in the sustainability transitions literature on civil society as 'agents of change' (section 2.2.2), while emphasising the relation of civil society and state action as crucial. My findings point to the financial sustainability of civil society experiments as a challenge linked to variable civil society dependence on state funding, versus CSO capacities for independent resource mobilisation (section 7.3, 7.5). Future research could unpack how productive different state-civil society dynamics are for transformative experimentation and transitions, including what the relative advantages are of different practical strategies municipalities can use to engage civil society: e.g. co-provision and seed-funding (Bristol) versus policy work and support in dealing with contestation (NYC).

Governing by market creation was relevant only to experimentation with car-sharing and EV charging, but became more important beyond 2016 in both cities, and is likely to become crucial to many municipalities responding to the rapid emergence of new markets in 'smart' mobility services and infrastructures (Docherty et al. 2018). My comparative findings tentatively suggest steering market-led provision of mobility services and infrastructure to deliver public value requires a proactive state approach, which is why I call it market creation (reflecting the general argument of Mazzucato 2016). The comparison between Bristol and NYC suggests that market creation supporting transformative experimentation may require a stronger state role compared to the Strategic Niche Management approach, where the public sector is seen more as a facilitator and manager of innovation networks (Schot and Geels 2008).

Bristol's car-sharing trajectory, where BCC seed-funded citizen groups and car clubs eventually 'scaled through the market', mirrors the trajectory of car club growth in Swiss and German cities (Truffer 2003). This trajectory is a classic case in the sustainability transitions literature, pointing to the role of the state as 'steering' rather than 'rowing' (*ibid.*). There is no argument that municipal capacity for transformative experimentation

must involve *governing by provision.*[159] However, the NYC EV charging trajectory illustrates how the SNM mode of 'network management' may not be sufficient, either. Bristol and NYC findings suggest that temporary network partnerships are conducive to EV charging experimentation, but are not a substitute for proactive shaping of urban EV markets by municipal governments, particularly as this is supported by other research (Thornhill and Grigordiadi 2020; Lutsey et al. 2015). The diverging BCC and NYC city government strategies for governing EV charging networks highlights the new capacities that municipalities need to develop to reconfigure automobility.

Bulkeley and Kern (2006) found that mobility governance in UK and German cities was associated with a shift to governing by enabling (and what I call co-provision), and weakening governing by provision and authority. Sustainability transitions research and many ideal-type governance models (Lupova-Henry and Dotti 2019) posit that the state cannot pursue sustainability innovation alone (section 2.2.2): for example, Swilling and Hajer's (2017, p.4) concept of a municipal 'entrepreneurial state' argues that urban transition "requires a form of radical learning that bureaucracies cannot deliver without partnering with… networks that include non-state actors". My findings show that neither argument was strictly true, for urban mobility experimentation in Bristol and NYC. Many transformative trajectories involved governing by provision and authority, without partnerships with non-state actors; indeed, these modes were associated with the *more* transformative experimentation observed in NYC. This is not to advocate for a state-centric perspective, rather, an argument for aligning debates around governance and urban experimentation with nuanced empirical realities, which will crucially depend on what type of systems are being examined (e.g. mobility vs energy).

Experiments as temporary partnerships

I have shown that examining experiments as temporary partnerships (Bradford and Bramwell 2014), and distinguishing between these partnership organisations and the

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[159] As an alternative strategy, BCC and NYC city government *self-governing* involved experiments with car-pooling for municipal staff, which can be understood in SNM terms as a proactive form of niche creation. Overall, *self-governing* was very rare in relation to experimentation: it is primarily relevant to municipal fleets, in the context of mobility systems.

governance logics involved (following Lowndes and Skelcher 1998), is a pertinent conceptual lens (section 7.3.3). I found that partnerships did not equal network collaboration, and network governance logics often shifted post-experiment, as related to broader governance modes to different types of mobility. My nested two-level conceptual framework (Figure 2.5) shows that understanding governing through experimentation cannot be limited to examining collaboration within specific experiment partnerships, but needs to incorporate a broader understanding of how mobility governance changes 'between' partnerships, as I have analysed with reference to governance modes for busmobility, automobility, velomobility and public space. My research thus contributes to the agenda proposed by Hodson et al. (2017) on experimentation in the context of pre-existing urban governance arrangements.

Experimentation as network governance?

My findings confirmed my hypothesis that urban mobility experimentation cannot be understood as a network governance phenomenon, per se (section 7.3.3). Because network collaboration within experiment partnerships was in some instances an enabling factor for transformative experimentation, my findings confirm existing theory that network logics provide a higher degree of flexibility and are conducive to innovation (Table 2.10). However, in neither Bristol nor NYC were the *majority* of experiment partnerships driven by a normative desire for collaboration based on trust and informal relations, rather, partnerships were driven by pragmatic necessity (and multi-scalar imposition, in the Bristol case) to access resources and expertise. My findings suggest that experiment partnerships are driven by both theoretical motivations discussed by Lowndes and Skelcher (1998): resource dependency between actors, and synergistic collaboration between independent actors.

The fact that network logics often gave way to more formalised, hierarchical or market relations as part of post-experiment trajectories in Bristol and NYC points to two theoretical issues, that can be explored further. Governance theory posits that hierarchical modes of governance are made efficient through the development of bureaucratic routines, which comes with a "reduction in flexibility and innovation because of a

tendency to formalization and routinization" (Lowndes and Skelcher 1998, p.318). First, my findings suggest that formalised relations may be an important feature of transformative impacts, in the current context of standardised state-controlled infrastructure, because establishing regularised hierarchical relations or routinised market relations (outsourcing) is important for the efficiency with which municipalities expand mobility configurations. In that sense, experiments may provide an 'exceptional space', that needs to be closed down and give way to standardisation. Second, this formalisation may be in tension with the capacity of municipal bureaucracies to engage with non-state actors in flexible and informal ways, as suggested by the challenges faced by community groups in NYC (section 7.3.3). This points to a broader question regarding state-civil society relations: if institutionalisation in municipal bureaucracies is a desirable outcome of experimentation, as it can lead to municipal investment in upscaling, then what *kind* of institutionalisation and desirable for *whom*?

Thus the im/permanence, exceptionality/standardisation and in/formality of relations with non-state actors may be important tensions, in relation to municipal capacity for transformative experimentation. It raises questions regarding the possibility of (sustained) flexible and informal 'open innovation' processes, which is how urban experimentation tends to be characterised in sustainability transitions literature (section 2.2.2). Urban experimentation may often involve contracts, legalistic dimensions and financial transactions, which may shape transformative impacts.

While I would not argue there is anything problematic with the concept or empirical manifestation of network governance *per se* (section 2.2.2), my findings for busmobility in Bristol illustrates that network partnerships can be *imposed* on municipalities by multi-scalar politics. The comparison of how network partnerships played for busmobility in Bristol and NYC highlights that contextualisation in relation to state restructuring is needed, to avoid obfuscating 'hollowing out'. In concluding that my comparison suggests 'publicness' of busmobility governance matters (section 7.3.4), I do not refer to the necessity of *governing by provision* or municipal government owning or operating public transport services. There is a vast range of organisational and contracting models for bus services, with difference in both the degree and nature of public sector involvement, that have been

proven effective in different cities (van De Velde 1999; van De Velde et al. 2008); it is beyond scope to comment on the comparative advantages of these. My broader point is that debates regarding public transport governance should take into account the extent to which public value can be effectively delivered: the 'publicness' of public transport as a public service, in the sense that the state can actually guarantee provision of equitable access to high-quality services (Paget-Seekins and Tironi 2016), in the context of network or market governance arrangements.

The role of experimentation in reshaping governance

What is specific about experimentation in relation to how urban governance changes? My findings suggest that because experimentation is a mechanism for the introduction of novelties into a system, experiments constitute moments in which municipalities make decisions how those novelties will be governed: sometimes drawing on pre-existing modes (e.g. co-provision with BIDs in NYC), and sometimes testing new modes (e.g. enabling car-sharing in Bristol), with the institutionalisation of these modes then depending on the 'forward trajectory', i.e. whether governance logics are institutionalised or shift after experiment partnerships.
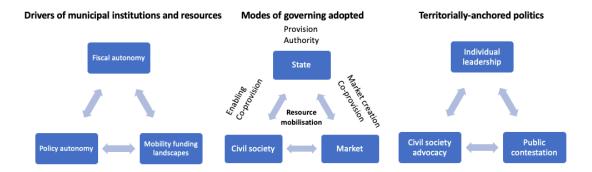
My inductive findings show how experimentation was not only *shaped by* pre-existing governance institutions, but also *reshaped* mobility governance in Bristol and NYC: I observed significant new governance institutions as one type of transformative impact (RQ1.1). I also noted how experimentation was associated with a diversification of mobility governance modes in Bristol and NYC (section 7.3.2), i.e. a greater mix of different modes between 1996/7-2016 relative to pre-existing modes in 1996/7; and how experiment partnerships sometimes involved multiple governance logics in relation to actor collaboration (section 7.3.3). These findings resonate with the literature on 'hybrid' urban governance, which explores the co-existence of multiple governance modes, e.g. hierarchy, market and network relations (Gross 2016; Skelcher et al. 2013). Inductive findings were analysed from the perspective of the hybrid governance literature, but cannot be accommodated within the thesis. My findings suggest that future research should explore whether experimentation drives hybridisation of governance relations,

whether temporarily or more permanently, as argued by Hodson et al.'s (2017) research agenda on urban transitions. Urban governance is not in reality characterised by ideal-types, and thus to go beyond critiques of network governance, research on how municipal government is embedded within local networks of *relations*, which reflects multiple modes. For example, Nochta and Skelcher (2020) provide an excellent comparative analysis of the centrality of different municipalities within energy governance networks, but I suggest we also need critical investigation on what the 'links' between different nodes actually mean: beyond relationships, what are the flows of resource mobilisation and division of responsibilities for public service provision?

9.3.4　An integrated perspective on municipal capacity

My theoretical framework for understanding municipal capacity for transformative experimentation (section 2.5) was rooted in 'new institutionalism' (Lowndes 2001). I would argue that my research illustrates the strengths of new institutionalism as a flexible theoretical perspective that encompasses the study of organisations (e.g. organisational forms within municipal bureaucracies, temporary experiment partnerships) and institutions (e.g. governance logics), and crucially, how they interrelate. My research has shown for both municipal institutions and governance institutions, how the permanence of institutions matters (Brady 2001): whether institutionalisation in permanent organisations, local legislation, infrastructural standards, or persistent partnership models. In doing so, my research sheds light on why the central anxiety of debates about experimentation has to do with its temporary nature: whether temporary projects, or temporary partnerships with uncertain futures.

I have commented on refinements to understanding Mechanism and Outcomes. Figure 9.1 provides a visual overview of the Context factors that I found were important in shaping municipal capacity; the arrows suggest the interplay of factors.

Figure 9.1. Context factors influencing municipal capacity for transformative experimentation.

My findings show how an understanding municipal capacity for transformative urban mobility experimentation needs a three-step analysis of:

1. *Multi-scalar mobility politics.* This involves analysing: how *de facto* autonomy of municipalities to determine their own mobility visions and scope of experimentation co-evolves with mobility funding landscapes (type of funding programmes, flows between scales); what specific novelties have been promoted by external funders and to what extent this has been reflected locally (e.g. 'Smarter Choices'); changes in national legislation opening or closing up space for specific configurations (e.g. street design guidelines); and how public transport has been regulated. As shown for Bristol and NYC (section 4.4.2), this is a complex undertaking: beyond historical analysis of national transport policy and local-national relations, it may need to include interactions between other scales (e.g. local-EU, city-state government).

2. *Dynamis of state restructuring.* It is crucial to understand multi-scalar mobility politics as interwoven with broader state restructuring, rather than analysing it in a silo, separate from other politics affecting urban policy-making. Research documenting a problematic of project-based experimentation with sustainable urban infrastructures, as linked to competitive funding programmes, is 'reinventing the wheel', if it ignores the extent to which such funding landscapes are manifestations of a broader shift towards competition states (section 2.2.4). The organisational basis and endogenous strategies that support municipal capacity for managing such

a competitive environment can only be understood with reference to the interrelation of fiscal autonomy and periodic austerity politics. Governance institutions exhibit long-term path-dependencies linked to critical junctures in state restructuring, e.g. 1980s public transport privatisation in the UK and privatised public space management dating to NYC's 1970s fiscal crisis.

3. *Local state-civil society relations, as mediated by individual municipal leaders.* Inductive findings highlighted that local politics and state-civil society relations, offer territorially-specific space for transforming urban mobility systems (section 7.5), which go beyond multi-scalar governance seen through the lens of intergovernmental relations.[160] The NYC case illustrates a type of 'urban autonomy' conceptualised by Bulkeley et al. (2016), which can be *made* in the relations between progressive municipalities and CSOs, beyond a 'verticalist' understanding of municipal autonomy as *conferred* by higher levels of government. The contributions of the research thus go beyond Primary RQ1, to conclude that the difference in municipal capacity for transformative experimentation (in Bristol and NYC) can only partly be explained through the lens of multi-scalar governance, as it was also determined by territorialised local politics. In mediating municipal-civil society relations, the styles of individual political and bureaucratic leaders feature as the most contingent type of factor shaping municipal capacity. There are many perspectives offered by theories of city leadership, that can be used to explore this further (Rapoport et al. 2019). However, individual leaders must also be analysed in the context of the fiscal powers they wield.

9.3.5   Generalising from Bristol and NYC cases

Existing research on urban experimentation in the EU and UK proposed that *municipal capacity for transformative experimentation is limited by reliance on external, competitive, short-term and/or project-based mobility funding, as a decisive factor.* As discussed in section 7.2.6, based on my final findings, the proposition was rejected for both the NYC and Bristol case. Of

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[160] Some would argue there is no such thing as local politics, given that the 'local' is a socially constructed scale and all urban politics is related to a multi-scalar flows (Massey 1991; Ward 2009). Yet urban scholars acknowledge that urban policy-making is simultaneously deeply territorial, in reflecting the historical-geographical conditions of specific places and relationships between public, private and civic actors (McCann and Ward 2010).

course, rejecting this proposition for BCC and NYC city government does not mean it can be rejected for all municipal governments. Here, I discuss other Global North cities to which the findings for Bristol and NYC cases can be generalised, addressing the external validity of my research (Table 9.1).

BCC was studied as a case representing the limited capacities of UK municipalities, based on existing literature pointing to the limited capacities of other UK municipalities like Brighton, Oxford (Schwanen 2015) and Manchester (Hodson et al. 2018). The logic of generalising from this case is that the findings for BCC apply to the 'typical' or 'average' local authority in England[161] (Yin 2009): in other words, the decisive factor limiting municipal capacity for transformative mobility experimentation in English local authorities is not reliance on external mobility funding programmes. Based on my arguments in section 7.2, I would argue that this can indeed be generalised for all English local authorities, because my comparison shows that the limited *general fiscal autonomy* of English local authorities is a *more* significant factor limiting municipal capacity. This should be an uncontroversial conclusion, given that the fiscal autonomy of UK local government is significantly below the OECD average (section 3.3.4).

At this stage, I can add some nuance as to *how representative* the BCC capacity from 1996-2016 was of the typical local authority in England during the same time period. First, BCC appears to have been extremely successful at 'winning' competitive EU and UK government mobility funding, relative to other comparable English local authorities, based on interviewee statements to the same effect (B03; B26) and my analysis of virtually all UK government mobility funding programmes since 1996. For English local authorities that were not as successful in applying for competitive funding, the very competitive nature of that funding might have been a more significant factor constraining capacity. Indeed, Schwanen (2015) has highlighted the differential success of local authorities in Brighton and Oxford in securing competitive mobility funding, for example. For other local authorities, austerity politics might have been a more significant factor

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[161] Elswhere I refer to 'UK' municipalities; the representativeness of BCC as a case should have been defined in relation to English local authorities, from the outset, because different multi-scalar governance arrangements are likely to apply the devolved nations of the UK (Shaw and MacKinnon 2011).

from 2011: the impact of UK government austerity cuts on BCC spending power was limited compared to other large cities in England (Meegan et al. 2014). Finally, as I have highlighted in chapter 5 and 7, BCC employed a range of endogenous strategies to circumvent the constraints of mobility funding programmes, and we can speculate that in English urban areas with weaker municipal tax bases or weaker two-tier governance structures (i.e. non-unitary authorities), the organisational basis might not have been sufficient to employ the same range of endogenous strategies.

Comparing BCC to NYC city government allowed me to look beyond mobility funding landscapes, however, and consider factors related to the differences in the broader multi-scalar context of the UK and US. Examining the Bristol case through this lens, I have shown how the fiscal and political centralisation of the UK state profoundly limits the fiscal autonomy, mobility policy discretion, and 'policy confidence' of all UK local authorities. Municipalities may be able to devise endogenous strategies to deal with external mobility funding, but there is no substitute for greater municipal autonomy in a broader sense, when it comes to capacity for transformative mobility experimentation.[162]

Furthermore, my Bristol findings regarding the 1) dependence of civil society on state funding and 2) the influence of a privatised and dysfunctional bus market, can likely be generalised to all UK local authorities. The interdependence of state and civil society in the UK is well established, including the tradition of municipalities co-providing services with and financially supporting CSOs (Jones et al. 2016; Aldred 2012). John (2014) notes how this has been used to explain the relatively mild civil society contestation of UK local authorities, relative to the 'community power' literature on US cities. The same constraints faced by BCC in relation to private bus operators have been documented for many other cities in England (chapter 2), and are likely to constrain municipal capacity for transformative experimentation of all municipalities in England, even if there is some variation.[163] The success of the bus franchising model operated by Transport for London

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[162] The growing 'policy confidence' of Transport for Greater Manchester since the 2014 decentralisation of powers and funding to the Greater Manchester city-region (Hodson et al. 2019) arguably illustrates this.

[163] For example, greater municipal control over bus companies in Nottingham and Reading, and the possibility that UK city-regions with Passenger Transport Executives will likely possess better capacities for negotiating with private bus

over the last two decades, as a result of differential powers granted by national government, provides a crucial counterfactual (CfBT 2018).

Geels (2018) has argued that the fundamental reason for why Great Britain's national-level mobility transition was limited between 1990 and 2016 is 'neoliberalism', as reflected in privatisation and austerity cuts undermining public transport systems, in particular. While I agree with the importance of privatisation, Geels' 'neoliberalism' label smooths over the ideological diversity during this period, i.e. the New Labour government. My Bristol findings rather support Docherty and Shaw's (2011) argument that mobility transition was limited in the UK under New Labour because of the reluctance of the government to meaningfully decentralise power and increase local autonomy (see also Corry and Stoker 2002). Centralism, albeit periodically peppered with neoliberalism, is a defining feature of UK multi-scalar relations in the second half of the 20th century, which has conditioned UK local authorities to be deeply pragmatic (John 2014).

The logic of generalising from NYC as a 'critical case' is: *If municipal capacity is limited by reliance on external funding (as a decisive factor) even in NYC, then municipal capacity is limited by this factor in most cities.* The NYC findings show that municipal capacity need not be decisively limited by external funding, in all cities. Studying NYC city government as a 'critical case' was enlightening for understanding the extent of transformative experimentation that is possible, if municipal capacity is underpinned by a high degree of fiscal autonomy, mobility policy discretion, and tradition of ambitious and 'confident' municipal policy-making. Crucially, this capacity was not automatically 'conferred' by greater municipal autonomy, but the result of endogenous strategies underpinned by such autonomy. My findings provide a new perspective on the much-cited case of NYC DOT mobility experimentation under Janette Sadik-Khan, pointing to how fiscal autonomy, rather than simply a low-cost approach of 'tactical urbanism' that any municipal government can employ (section 9.3.1) or a single individual 'visionary' leader (section 7.5), was central to capacity for transformative experimentation.

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operators, even if constrained by the same legislative framework (although BCC did pursue Quality Partnerships Schemes as the only statutory/most ambitious governance instrument available between 1996-2016).

US municipalities generally have greater fiscal autonomy than UK municipalities and the US federal transport policy machine generally is less oriented around enforcing specific priorities at a local level. However, the NYC findings are not generalisable to a significant subset of US municipalities,[164] due to variations in the 50 different US states in most of the Context factors discussed in this research, including: fiscal powers of municipalities (Ross and Levine 2012), privatisation of public transport, politics between municipalities, MPOs and state governments regarding the allocation of federal mobility funding (Rouwangould et al. 2018), etc. The point here is not that US federalism and national transport policy is more conducive to municipal capacity for transformative experimentation compared to UK centralism and national transport policy. If that was the point, I would highlight that within the US competition state, variation in municipal capacity is likely to be even greater than in the UK, because federal government largely leaves municipalities to 'fend for themselves' using whatever resources they can raise from highly variable local tax bases (Ross and Levine 2012). Instead, my comparison has teased out Context factors, as theoretical building blocks, that can be explored for other cases.

Propositions for future research

Based on my comparison of Bristol and NYC, some propositions can be made, for testing in future research:

1. *Municipal capacity for transformative experimentation is likely constrained by reliance on external funding, as related to sector-specific (e.g. mobility, energy) funding landscapes, in most cities, but rarely as the decisive factor.* This is because most municipalities will be able to adopt *some* endogenous strategies to deal with external funding constraints, to circumvent 'conditioning' of local experimentation. This proposition could be tested for municipal governments with even less fiscal autonomy than BCC, for which the ability to adopt endogenous strategies might be less likely, and mobility funding landscapes could be a more significant constraint.

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[164] Nor likely to other municipalities within New York state, because NYC city government has many special powers under New York state law (Berg 2007).

2. *Municipal capacity for transformative experimentation is strong in multi-scalar contexts where municipalities enjoy a high degree of fiscal autonomy and de facto mobility policy autonomy, irrespective of a competitive mobility funding landscape.* This proposition represents the NYC context. In such contexts, political cultures are conducive to greater 'policy confidence' and lower degrees of 'deep conditioning' of municipal visions, and less strong institutional isomorphism that results in incremental urban mobility configurations and transformations (as in the UK). The proposition could be verified for another US city, to verify NYC findings; or for municipalities in highly decentralised countries, e.g. for European cities to compare against Ehnert et al.'s (2018) finding that project-based/competitive funding remained a challenge for municipalities in countries like Sweden and Germany.

3. Both of the above propositions could be falsified by examining the capacity of municipal governments with a high degree of fiscal autonomy but comparatively low per capita tax revenues; in such contexts, external mobility funding landscapes might be the decisive factor shaping municipal capacity, because fiscal autonomy does not translate into a significant municipal resource base. I would suggest that this proposition could be tested for municipalities in Central and Eastern Europe, based on the findings of my pilot study on the Municipality of Ljubljana.[165]

I have shown how Bristol and NYC can be meaningfully compared, and found that the difference in population size did not matter for my analysis. Bristol is a smaller city with an ambitious Council, who has put the city in conversation with NYC Mayors and policies. Ultimately, NYC policy-makers face the same challenges in the face of resilient automobility. Population size is the signifier of comparability in the popular and even scholarly imagination of cities, yet it is up to researchers to show exactly how city size matters for municipal capacity for transformative experimentation. I would hypothesise that the difference that city size makes is that the economic dominance of large cities enables municipal governments in those cities to amass greater fiscal and policy autonomy

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[165] See section 3.3.2. Because municipal capacity was strongly shaped by EU funding programmes; however, fiscal decentralisation in Slovenia is comparatively low, so the Ljubljana case does not in itself disprove my propositions.

(e.g. London, Manchester), which proves my point regarding the importance of those factors. I think my research has illustrated the value of 'comparative urbanism' for theory-building (Robinson 2015): thinking 'back and forth' between the NYC and Bristol case allowed me to examine many different deductive and inductive factors, and step 'outside the box' of EU- and UK-centric literature. Building towards a theorisation of municipal capacity for transformative experimentation can continue by moving between such 'unexpected' comparisons of municipalities across strongly diverging multi-scalar contexts and types of cities to test and challenge existing conceptual frameworks, and comparisons between more similar cities and contexts, to further refine propositions.

9.4   Understanding urban mobility transitions

The analysis of mobility transitions in Bristol and NYC (chapter 8) suggests that the dynamics of transitions is the topic for which there is still the most limited scholarly understanding.

9.4.1   Can experimentation cause transitions, and how would we know?

Over two decades, transitions away from automobility did take place in both Bristol and NYC (Primary RQ2). However, the shift away from Bristol's automobility path was limited and tentative, and automobility remained resilient even in NYC. Because NYC has one of the world's most extensive public transport systems that allows most of its population to adopt low-car lifestyles, if they so choose, the findings raise questions as to whether automobility can be fundamentally disrupted through place-specific reconfiguration of mobility systems (cf. Geels 2018). Whole-system reconfiguration away from automobility only began in 2007 in NYC, but as a result of public investment mode shift to the subway continued steadily from the 1980s; yet by 2016 automobility was still resilient and public transport services in crisis. Perhaps transitions away from automobility require more than three decades of continuous whole-system reconfiguration (e.g. Amsterdam; Bertolini 2007). Yet the broader extent to which cities can actually become 'car-free' appears highly uncertain (Schwanen 2016).

My findings show that we do not necessarily know whether urban mobility transitions are occurring. As noted in section 2.5.3, the behaviour of mobility systems is complex and emergent. For the Bristol case, there was evidence to show that transformative experimentation can contribute to transitions away from automobility. However, even if experimentation was more transformative in NYC, there was no evidence for a contribution to NYC's mobility transition. It is not just a question of variable evidence on the two specific contexts. There are insufficient data and indicators to understand the connection between incremental reconfiguration/transformative experimentation and overall system shifts (RQ2.1): I have shown that mode split is a poor indicator, and that we do not understand how street space transformation affects mode split or other indicators (section 9.2.2).

From a critical realist perspective (section 3.1), my conclusion is unsurprising, as I studied experimentation as a basic mechanism operating in the *actual* domain and found based on observing outcomes in the *empirical* domain, that change in transitions as occurring the *real* domain could not be explained. Within critical realist philosophy, the real domain is never completely knowable, but researchers can try approximating generative mechanisms operating in that domain (Danemark et al. 2002). Transformative experimentation might have involved change in generative mechanisms within the real domain, but my study could not reveal this. A future study attempting to uncover generative mechanisms should likely conceptualise urban mobility systems in terms of Bertolini's (2017) land use-transport feedback cycle, focus on accessibility as an indicator, and in addition to experimentation and the introduction of novelties, incorporate 'phase-out' policies disrupting existing system structures (Rogge and Johnstone 2017), e.g. dismantling of existing road infrastructure (Khalaj et al. 2020).

9.4.2 Municipal capacity and mobility transitions

My comparison suggests that municipal governments cannot steer urban mobility transitions, alone. I would argue that city-regional politics poses a constraint on many non-metropolitan municipal governments, like BCC, in relation to urban mobility transitions. NYC is a somewhat exceptional case of city-regional primacy, where the lack of NYC city

government control over mobility outside municipal boundaries posed limited constraints.

My analysis of path-dependencies shaping transitions (RQ2.2) suggests that the city-region, as defined by a functional urban area (Dijkstra et al. 2019), is an appropriate scale at which to delimit the boundaries of urban mobility systems. This is because I found that the diverging extent of transitions in Bristol and NYC could be diagnosed with reference to actors at this scale making decisions about public transport systems, city-regional governance, and land use-transport planning affecting spatial structures; in response to multi-scalar politics (e.g. UK government, New York State decision-makers). In the concluding words of chapter 8, I highlighted how mobility transitions analysed at the city-regional scale also need nuanced attention to the interplay of endogenous strategies and exogenous drivers: good and bad decisions taken by city-regional actors, in response to exogenous pressures. Future research could explore the geographies of how automobility is reproduced further, particularly national decision-making.[166] Path-dependencies explaining why city-regions have different rail systems, are linked to variegated ideologies of public finance informing decisions about infrastructure investment over the 20th century (Pettifor 2019), as illustrated by diverging developments in Bristol and NYC.

We could raise an endless number of 'what if' questions regarding the Bristol and NYC cases: what if the UK had a more conducive mobility funding landscape between 1996 and 2016, would BCC experimentation have been more transformative? The answer is likely yes: more experiments would have been undertaken and with greater impact, than the experiments actually undertaken, which I have studied. What if NYC and Bristol had successfully implemented congestion charging, would this have transformed city-regional politics and allowed for greater rail investment? Yes, this is also likely. However, I think this chapter, in showing the limits to municipal agency in relation to experimentation and transitions, in many ways shows why such questions are not very productive to ask. There are many things that municipalities do not have the capacity to do, and that are of out their control, shaped by multi-scalar politics over the very long term. To understand

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[166] I did not consider the role of national governments in regulating car ownership, e.g. through taxation and subsidies.

municipal agency, we need to understand what municipalities *do* and *can* achieve. Recognising the transformative impacts and endogenous strategies successfully pursued by municipalities, in response to multi-scalar governance contexts, is the most effective research strategy to explain *variation* in the capacities of different municipalities - thus building towards an institutionalist geography of urban experimentation.

10 CONCLUSION

10.1.1 Place-specific embedding versus mobile configurations

This thesis has shown that place-specific mobility systems are difficult to change. Circling back to chapter 1, I found plenty of evidence of 'mobile policies', where experimental configurations tested in Bristol and NYC drew inspiration from policies elsewhere, or where configurations tested in Bristol and NYC inspired experiments in other cities. The former dynamic has been hinted at in the thesis, whereas the latter dynamic has not been discussed much. This is because of the argument made in chapter 1: that we need more research on how experiments scale up *within* specific urban mobility systems and cause those systems to change in the long run, beyond 'networked' experimentation where cities 'replicate' each other's policies to keep up with their neighbours. We can note that the overall type of mobility configurations experimented with in Bristol and NYC were remarkably similar (section 7.1), showing that municipal governments do indeed draw on the same globally-circulating pool of 'best practices'. Yet this thesis has underlined that what matters for transformative change in urban mobility, is how the same general configurations (e.g. play streets) that are novel in different contexts, are embedded within specific places. The most important question is not necessarily what configurations circulate or how, but the challenge of persistent, incremental *in situ* reconfiguration of urban institutions and infrastructures.

10.1.2 Contributions of the thesis

This thesis has made contributions to transport studies, urban studies, and sustainability transitions research. For transport studies, it offers a novel conceptual synthesis of how experimentation, systems and transitions interrelate for urban mobility specifically, as distinct from the multi-level perspective on socio-technical systems (cf. Geels:2012v; Bertolini 2017). It rehistoricises the failure of New Labour transport policy in fostering mobility transitions in UK urban areas (Docherty and Shaw 2011), particularly by conceptualising nebulous notions of local transport 'policy innovation' as

experimentation. It also contributes to the nascent literature on transport governance (Marsden and Reardon 2017), by showing how established governance theories can be applied to analyse relations between state and non-state actors in relation to mobility innovation.

The thesis has advanced the pioneering work of Mike Hodson, Harriet Bulkeley and Simon Marvin at the intersection of urban studies and sustainability transitions research. It has developed this work in a more explanatory direction, by linking theories to the instrumental outcomes of experimentation and change in urban systems. It has extended prominent conceptual frameworks (Hodson et al. 2013; Hodson and Marvin 2010) with conceptual innovations drawing on organisational studies literature, to unpack the problematic of project-based experimentation. It has gone beyond this problematic to show how municipal capacity for transformative experimentation must be understood also in relation to modes of urban governance and experiment partnerships, and revised established conceptual frameworks in this regard (Bulkeley and Kern 2006). More broadly, the thesis has shown the relevance of foundational debates in urban studies (state restructuring, austerity politics, entrepreneurialism) to analysing urban infrastructure, sustainability governance and urban transitions, hopefully laying the groundwork for closer future engagement by urban researchers with these topics (McCann 2017a).

The thesis has presented many critiques of sustainability transitions theories and literature. Ironically, the welcoming research community focusing on sustainability transitions has been the one I have been most closely engaged with.[167] I hope my critiques will be seen as constructive in furthering the research agenda on urban transitions and the geography of transitions. The thesis has shown further nuance is needed in debates on (network) governance, the role of the state, and the conceptualisation of experiments as innovation 'projects'. On the other hand, this thesis has been inspired by sustainability transitions research in thinking about how systems change over the long-term - whether incrementally or through more rapid shifts (Hodson et al. 2017; Geels 2018); and shown

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[167] Such as the Urban Transitions and Transformations thematic group under the international Sustainability Transitions Research Network (STRN), in which I have actively been involved.

the enduring relevance of conceptualising innovation as a recombinant process of combining elements into 'configurations that work' (Geels 2002). In sum, completing this doctoral research has been a fascinating interdisciplinary journey.

10.1.3 Policy implications

Policy recommendations that can be derived from this research include:

- How a strategic and systemic approach to experimentation may be developed, potentially by designing experiments with a longer-term 'roadmap' in mind for an envisioned trajectory of institutionalisation and scaling up.

- How experimentation can be effectively organised within municipal government, including how projects, programmes, portfolios and organisational sub-units can be related; inspiration regarding other techniques of institutionalising experimental configurations (e.g. street design manuals, public-private partnership agreements); considerations for whether and how to organise outsourcing of innovation activities.

- How 'tactical urbanism' or quick-build experimentation worked as a mechanism in NYC, and what implementing and supportive features were crucial to its (cost-)effectiveness, for other municipalities seeking to draw inspiration from this approach. This includes attention drawn to the potential socio-spatial equity implications of the co-funding, public-private partnerships model that enabled public space transformation in NYC.

- For organisations that award funding to municipalities for mobility experimentation, the findings suggest that the following changes would be conducive to supporting municipal capacity for transformative experimentation: providing a greater degree of non-competitive funding, improving funding certainty from the perspective of municipalities by limiting year-on-year change to funding programmes, providing greater flexibility regarding timeframes within which grant awards need to be spent, and providing a mix of capital and

operational funding. Mobility funding programmes could also provide greater flexibility regarding the scope of experimentation eligible for expenditure; for example, the US federal government CMAQ programme illustrates how such flexibility is conducive to innovation. However, this would need to be weighed against the need to ensure national policy objectives for transitions away from automobility and decarbonisation are translated into local experimentation, for municipalities more reluctant to embrace such objectives.

This thesis has demonstrated that there is no easy substitute for fiscal and political decentralisation if the objective is to strengthen instrumental municipal capacity for reconfiguring urban mobility systems. Recommendations such as these also do not capture the fact that municipalities have different capacities as a result of ideologically-influenced state restructuring, austerity politics and the tendency to treat urban areas as 'growth machines', that are to be either controlled through centralised state power (UK context) or left to their own devices in competing for tax revenues (US federalism). To conclude the thesis, below I offer two reflections on the politics at stake.

10.1.4 Just transitions and sustainability entrepreneurialism

This thesis has not systematically engaged with questions of mobility justice (Sheller 2018), even if I share a scholarly commitment to this issue (Smeds et al. 2020; McArthur et al. 2019). It remains conceptually challenging to combine attention mobility justice with a focus on instrumental capacity for transformative experimentation with mobility configurations considered to be 'sustainable', even if such configurations can expand access to non-polluting mobility services/infrastructures, and the economic, social and well-being opportunities this brings.

Castán Broto and Bulkeley (2018) critique calls for the 'need to achieve scale' within policy and research on sustainability-oriented experimentation, equating this notion with an "emerging nostalgic impulse to plan in what are thought to be more traditional ways, putting the state at the centre of a process of authority building": a reaction to communicative planning (e.g. Innes and Booher 2010) and fallback on 'modernist'

planning perspectives. Castán Broto and Bulkeley (2018) instead emphasise the emancipatory potential of experimentation as an open-ended political process. I agree that achieving just transitions involves greater deliberative justice (Smeds et al. 2020). However, distributive justice remains relevant, and I disagree with the characterisation of (my) concern with spatial scaling up as a state-centric and modernist. It is beyond doubt that the spatial distribution of socio-material configurations matters for just mobility transitions: for example, whether an individual can safely walk to a bus stop, to get them to work on time.

Of course, a relevant question is expanded access to services and infrastructure for *whom*. I assessed whether the expansion of configurations qualified as 'city-wide', which does not capture this. Future research should establish a more nuanced understanding of how experiments and configurations are distributed and spatially expanded, with attention to socio-spatial unevenness (see Håkansson 2019). This is important because the transformation of Bristol's and NYC's mobility system by no means benefited all citizens equally. For example, in both contexts, white, higher-income males continue to be overrepresented among those cycling frequently (BCC 2014a; Sustrans 2017; Pucher et al. 2010).

My research has not discussed the speculative and financialised entrepreneurial practices of BCC and NYC city government, which have been argued to worsen social inequality in respective contexts (DiGaetano 1997; Slater 2006; Angotti 2008; Brash 2011; Checker 2011). It was beyond the scope of this research to assess the mobility justice implications of all experimentation trajectories in Bristol and NYC, so my arguments here remain tentative. But I would argue that overall, experimentation undertaken by BCC and NYC city government can mostly be understood as a socially and environmentally 'progressive' entrepreneurial practice: not only in Phelps and Miao's (2019) narrower sense of a competent 'intrapreneurial' state delivering public service innovation, but also in pursuing 'pragmatic municipalism' in limiting the impact of 'scalar dumping' on austerity cuts (Kim and Warner 2016), and partnering with civil society to empower lower-income communities and alternative mobility cultures (Bulkeley et al. 2016). BCC and NYC city government invested in improving local bus services, of which the majority of users are

lower-income, non-white populations, in both contexts. Thus my findings support Lauermann's (2018) notion that contemporary municipal entrepreneurialism can involve co-existing speculative and growth-oriented, and progressive and non-growth oriented practices. Urban governance is not monolithic: at any point in time, *mobility* experimentation may be a more progressive practice, whereas other urban policy domains might reflect different, potentially speculative modes of experimentation (Blanco 2015).

10.1.5 Experimentation by and beyond the state

My argument regarding the possibility of progressive municipal entrepreneurialism can be tempered by pointing to the longer-term oscillations in austerity politics (Hood and Himaz 2016; Pettifor 2019), that have periodically undermined equal access to universal basic services, of which mobility should be considered one (IGP 2017). Municipal control over urban mobility systems in the Global North is the current reality with which research needs to engage with clear eyes, and in this reality, public investment and standardisation of infrastructure are key dynamics of system change. A state capable of providing access to basic infrastructures and services is important across the Global North and Global South (Palmer et al. 2017). Having said this, it is important to go beyond a state-centric perspective to foreground state-civil society relations: as attested by the global policy mobilities related to Sadik-Khan, the stories we tell about the dynamics behind urban transitions matter. There is potential to consider the possibilities of more decentralised control over infrastructure and service provision by citizens, in the future (Swilling 2020). This would likely require new forms of social organisation, and crucially, new forms of resource mobilisation for such organisation to be sustainable, going much beyond the state-civil society dynamics I have observed in Bristol and NYC. Yet it is clear that we need to think about experimentation by and beyond the state, across the Global North and South (Simone and Pieterse 2017).

APPENDIX A: EXPERIMENT SAMPLE

Table A.1 and A.2 below contain the full details and chain of evidence for every experiment in the large-N databases for Bristol (N=47) and NYC (N=61).

Information on funding and partnerships was obtained from the sources indicated in the Outcomes column.

Abbreviations for funding sources: Bristol case

BCC = resourced solely by Bristol City Council, with no external funding

DETR = UK Department for Environment, Transport and the Regions

DECC = UK Department for Energy and Climate Change

DfT = UK Department for Transport

EC FP4 = European Commission Fourth Framework Programme for Research and Technological Development

EC CIVITAS = European Commission CIVITAS Initiative[168]

EC THERMIE = European Commission Framework Programme 4, specific programme for research and technological development

NHS = UK National Health Service

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[168] In Phase I of CIVITAS (2006), beneficiaries were free to implement sustainable mobility interventions across eight categories (clean fuels, integrated pricing strategies, new forms of vehicle use, transport management, access restriction, collective transport, goods transport, soft measures). The BCC-led VIVALDI project as part of CIVITAS Phase I included £9 million in total BCC expenditure, with European Commission funding accounting for approximately 35% (BCC 2003a) and the rest covered by BCC's Local Transport Plan funding settlement from national government and other small contributions from non-state actors (Sustrans 2004).

Table A.1. Sample of 47 experiments undertaken in Bristol.

	Experiment	Start year	Funding	Partnership	Outcomes
Busmobility	Selective Vehicle Detection (ELGAR)	1996	EC FP4 DETR	Unknown	Selective Vehicle Detection (SVD) is a technology used for giving buses priority over other vehicles at traffic lights. SVD was first tested in 1998 at several junctions, as part of the ELGAR project (D'Arcy and Davis 2004). **Stabilisation** – BCC's (2000) first Local Transport Plan mentions bus priority facilities installed within the ELGAR project as one element of its traffic control elements currently in place. **Institutionalisation** – bus priority facilities implemented within ELGAR described as 'successful'; investigation of the feasibility of city-wide expansion of SVD is discussed as a key element of the bus strategy in BCC's (2000) first Local Transport Plan. **Scaling up** – SVD was scaled up along a new bus route within the VIVALDI project, as an integrated part of the Showcase bus experiment (VIVALDI 2005).
Busmobility	Variable Messaging Signs encouraging use of Park & Ride (ELGAR)	1996	EC FP4 DETR	Unknown	Variable Messaging Signs (VMS) are digital LED boards displaying information for drivers passing by. VMS were first tested in 1996 within the ELGAR project (D'Arcy and Davis 2004), displaying information for car drivers to try to encourage them switching to Park & Ride service. **Stabilisation** – VMS signs were maintained/operated at least until 2002 (D'Arcy and Davis 2004, p.266). **Scaling up** and **institutionalisation** – BCC's (2000) first Local Transport Plan prominently features VMS as part of its urban traffic control strategy and discusses how the technology has been extended to other locations, which is confirmed by LTP Progress Reports (BCC 2001a; 2002; 2003a; 2005).
Busmobility	Park & Ride real-time information (ELGAR)	1997	EC FP4 DETR	Unknown	On-street displays at bus stops providing GPS-based real-time information regarding bus arrivals were first tested in 1997 as part of the ELGAR project, on Bristol's Park & Ride bus service (D'Arcy and Davis 2004). **Stabilisation** – real-time information displays were maintained at least up until 2003 (D'Arcy and Davis 2004). **Circulation –** ICT system developed within ELGAR project acted as a common platform for real-time information tested in a different

Busmobility					configuration in the concurrent CENTAUR project (D'Arcy and Davis 2004).
					Institutionalisation – real-time information displays have been used ever since within Bristol bus system. Expansion of 'bus tracking' tested within the ELGAR project mentioned as a key item of future bus improvements within BCC's first Local Transport Plan (BCC 2000, p.100, p.199).
Busmobility	City centre real-time information (CENTAUR)	1996	EC THERMIE	BCC-private, in partnership with bus operator	On-street real-time information displays were tested within the CENTAUR project, for city centre bus stops, in a configuration involving co-management of the system with a local bus operator (D'Arcy and Davis 2004).
					Stabilisation – real-time information displays were maintained at least up until 2003 (D'Arcy and Davis 2004)
					Scaling up – on-street real-time information was scaled up along a new bus route within the VIVALDI project, more than doubling provision within the city, as an integrated part of the Showcase bus experiment (VIVALDI 2005; D'Arcy and Davis 2004).
Busmobility	CNG bus trial (CENTAUR)	1996	EC THERMIE	Unknown	BCC was involved in trialling three types of alternatively fuelled buses within the CENTAUR project (D'Arcy and Davis 2004).
					The CENTAUR project focused on environmentally friendly public transport vehicles, in line with the EC THERMIE's funding programme on energy-related R&D.
Busmobility	LPG bus trial (CENTAUR)	1996	EC THERMIE	Unknown	**Unknown outcomes** – no evidence available, not mentioned in any policy documents, e.g. first Local Transport Plan (BCC 2000).
Busmobility	Electric bus trial (CENTAUR)	1996	EC THERMIE	Unknown	
Busmobility	Online bus journey planner (INTERCEPT)	1998	EC FP4	BCC-private, in partnership with bus operator	A web-based journey planning tool for bus passengers, was first tested in Bristol in 2000 as part of the INTERCEPT project (D'Arcy and Davis 2004; BCC 2000; INTERCEPT 2001).
					Circulation – the bus journey planning tool was adapted and developed into an intermodal planner (covering all modes) tested within the VIVALDI project, described as "an enhancement of the prototype bus journey planner developed through the INTERCEPT project" (D'Arcy and Davis 2004, p.264).
Busmobility	Hybrid electric bus trial (VIVALDI)	2002	EC CIVITAS; UK Energy Savings Trust	BCC-private, in partnership with bus operator Buglers	No embedding (VIVALDI 2006).

Busmobility	Camera ANPR bus priority lane enforcement (VIVALDI)	2002	EC CIVITAS	BCC only	Camera-based enforcement of bus priority lanes using Automatic Number Plate Recognition (ANPR) technology was trialled as an integrated element within the VIVALDI Showcase bus experiment (VIVALDI 2005). **Circulation –** Building on lessons from the VIVALDI trial, ANPR technology was included within the Showcase bus route configuration rolled-out as part of the Greater Bristol Bus Network (VIVALDI 2005, p.181; Travelwest 2014a). The specific ANPR technology tested in VIVALDI did not perform well, however, and the evaluation indicates that further development of the technological specifications would be necessary (VIVALDI 2005). Thus it can be assumed that the ANPR technology scaled up later was of an adapted configuration.
Busmobility	Smartcard ticketing for Park & Ride (VIVALDI)	2002	EC CIVITAS	BCC only	A specification for a smartcard to be issued for users of BCC's Park & Ride bus service was developed for testing within the VIVALDI project (VIVALDI 2005; DfT 2004), however due to technological issues it was never launched publicly (VIVALDI 2006; Travelwest 2009). **Circulation –** back-office equipment procured for the VIVALDI smartcard experiment was later used as part of a smartcard trial led by BCC with operator Wessex Connect (Travelwest 2009).
Busmobility	Intermodal Trip Planner (VIVALDI)	2002	EC CIVITAS	BCC only	The web-based bus journey planner developed as part of the INTERCEPT project was developed into an intermodal planner and tested as a new configuration within VIVALDI project, also integrating real-time information regarding bus arrivals, coupled with the scaling up of this infrastructure within the Showcase bus experiment (VIVALDI 2005, D'Arcy and Davis 2004). A new website was set up at the URL: www.travelbristol.org. **Stabilisation** – the original website and planning tool was operational until 2012. **Circulation –** as part of the LSTF programme, the journey planning tool was redeveloped and relaunched on the Travelwest website in 2012, as the shared user-facing brand for travel information across the West of England authorities. The journey planner exists at https://journeyplanner.travelwest.info (www.travelbristol.org migrates to this website after 2012).
Busmobility	Showcase bus route (VIVALDI)	2002	EC CIVITAS	BCC-private, in partnership with First Bus	An experiment with a novel 'Showcase' bus service on the A38 road corridor was undertaken, to test the impact of a significant package of bus service improvements on route ridership. This integrated elements of real-time information, ANPR camera-based enforcement and Selective Vehicle Detection into a new configuration, tested for two bus routes (VIVALDI 2005). The experiment also tested a

| | | | | new type of partnership agreement between First Bus and BCC.

The VIVALDI (2005) evaluation report states that the Showcase experiment was perceived as a success by both BCC and First Bus due to increased ridership of up to 12% on Showcase routes.

Stabilisation – the Showcase service continued to operate on the A38 corridor after the VIVALDI project was over (West of England Partnership 2006a).

Scaling up – the Showcase configuration, including real-time information and Selective Vehicle Detection systems, was scaled up to 10 additional routes within the Greater Bristol Bus Network (direct attribution in VIVALDI 2005, p.575).

Institutionalisation – the Showcase bus experiment is discussed at length as a 'good practice' example in the first Joint Local Transport Plan, including the evaluation results (West of England Partnership 2006c). BCC provision of real-time information, camera-based enforcement and Selective Vehicle Detection were all included as formalised items within the Quality Partnership Scheme agreements made with First Bus for the Greater Bristol Bus Network.[169] |
|---|---|---|---|---|
| **Busmobility** | Smartcard trial with Wessex Connect | 2009 /10 | BCC | BCC-private-civic, in partnership with Wessex Connect and UWE | BCC worked with UWE and Wessex Connect to undertake a small trial of smartcards on Wessex Connect bus services (BBC 2010a; B13).

Circulation – this specification was eventually developed further into the Travelwest Travel Card, with grant funding from DfT (Travelwest 2013b) |
| **Busmobility** | Geo-fenced hybrid bus | 2015 | DfT | BCC-private, in partnership with First Bus | See Appendix B.

Stabilisation. |
| **Velomobility** | Adult cycle training pilot | 2000 | BCC | BCC-civic, in partnership with Cycle West | BCC's (2000) first Local Transport Plan mentions the implementation of a six-month pilot of cycle training for adults, delivered by non-profit organisation Cycle West (later renamed Life Cycle UK).

Scaling up and **institutionalisation** – adult cycle training delivered by Cycle West was continued in 2001-2 (BCC 2002) and has since been delivered as an integrated part of BCC's 'smarter |

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[169] Quality Partnership Schemes for Greater Bristol Bus Network Corridors 3, 6, 8, 9, 4 and 7. Bristol City Council in partnership with Bath and Northeast Somerset Council, North Somerset Council and South Gloucestershire Council, respectively. Available online at: http://www.buspartnership.com/index.php?fuseaction=statutory.greater-bristol [Accessed 28 July 2020]. These QPS agreements include mentions of real-time information, traffic signal priority and camera-based bus lane enforcement.

					choices' policy to encourage cycling; scaled up through subsequent funding programmes (e.g. Cycling City, LSTF engagement activities). Training has continued to be delivered by Life Cycle UK.
Velomobility	Cycling Resource Centre (VIVALDI)	2002	EC CIVITAS	BCC-private, in partnership with Mud Dock Café	BCC partnered with local bike shop and café Mud Dock, to test a new annex facility offering secure cycle parking, locker and shower facilities for paying cycle commuters, enabling an idea by the shop owner (BCC 2003b; VIVALDI 2005). The experiment was undertaken as part of the VIVALDI project. **Stabilisation** – the 'Bike Shed' still exists today at the Mud Dock (2021) in central Bristol. No further embedding - the VIVALDI (2006) evaluation report discusses how further public investment into the facility was not perceived as viable, due to limited demand.
Velomobility	TravelSmart resident PTP	2002	EC CIVITAS, DfT	BCC-private-civic, in partnership with Sustrans Socialdata	The TravelSmart approach to personalised travel planning (PTP) delivered in partnership between Sustrans and private company Socialdata (Parker et al. 2007; Sustrans 2004) was tested in Bristol as part of the VIVALDI project (VIVALDI 2006; Anable et al. 2004). One of the phases of the experiments in the Bishopston neighbourhood was launched after BCC secured additional pump-priming funds from DfT, but involved the same TravelSmart approach to PTP and the same partners (Anable et al. 2004). The official evaluation reported significant increases in walking, cycling (up to 42% in one area) and public transport trips, and 9-12% decreases in car trips (VIVALDI 2006), with Sustrans separately reporting synergies between TravelSmart and the VIVALDI Showcase bus route resulting in 27% increases in cycling (PTEG and Sustrans 2011). **Institutionalisation** – the First Joint Local Transport Plan features a case study discussing TravelSmart as a success story (West of England Partnership 2006a). and adopts PTP as a new cornerstone of its Smarter Choices strategy (*ibid.*, see Smarter Choices supplement). **No further embedding** - the TravelSmart configuration was not expanded further in Bristol (Parker et al. 2007), as another PTP approach became favoured (see below).
Velomobility	Steer Davies Gleave resident PTP	2006	BCC	BCC-private, in partnership with Steer Davies Gleave	An approach to personalised travel planning (PTP) developed by transport consultancy Steer Davies Gleave (SDG) was first tested in Bristol in 2006; there is no evidence of external funding (Parker et al. 2007). **Scaling up** – Steer Davies Gleave's approach to PTP was scaled up to a further three residential areas as part of the Cycling City project (BCC 2011b).

Velomobility				**Circulation** – Steer Davies Gleave delivered PTP adapted to target employees at major workplaces as part of the Cycling City project (BCC 2011b; Geelan 2019), and to target major employers and new residential developments within the LSTF programme (Geelan 2019; Travelwest 2011c).
Velomobility	Workplace Cycling Champions (Cycling City)	2008	Cycling England	BCC-private, in partnership with Steer Davies Gleave	The established approach to workplace travel planning was developed into a new configuration – a larger, flexible menu of support measures available to employers, beyond a focus on travel plans produced through planning process – as a 'pilot' within Cycling City, including new elements such as recruitment of individual employees to act as Workplace Cycling Champions, match-funded grants for cycle parking and shower facilities, bike maintenance training and with PTP services for employees also integrated as an element (BCC 2011b; 2008). 62 employers or an estimated 26% of the Greater Bristol workforce were engaged with between 2008-11, with 10 large employers targeted – many of which were situated in the Aztec West and Northern Fringe areas (BCC 2011b). **Scaling up** - the employer engagement package deployed within Cycling City including recruitment of workplace cycling champions was scaled up as part of the LSTF programme (Travelwest 2011c; Bartle et al. 2016). **Institutionalisation** – following Steer Davies Gleave delivery within Cycling City, a partnership approach between BCC and Steer was institutionalised, whereby Steer's Sustainable Travel Field team has been managing both resident and business engagement up until 2019 and beyond (Steer n.d.; Geelan 2019). Employer engagement also became a major component of the West of England authorities' 'smarter choices' policy (West of England Partnership 2011).
Velomobility	Hourbike bike-sharing	2008	BCC, UWE and First Great Western	BCC-civic-private, in partnership with UWE and First Great Western	From 2008 onwards, a PhD researcher at UWE studying bike-rail integration forged a partnership between private bike-sharing company Hourbike, UWE, Bristol City Council and rail company First Great Western to undertake a small experiment of 10 dockable shared bikes across UWE campuses and Bristol Parkway station (UWE Bristol 2008). This 'pilot' was delivered simultaneously with the Cycling City project, but with BCC providing a small amount of funding to Hourbike from a separate budget (BCC 2012b) to scale up the system through a further four hubs installed in Bristol city centre (Sherwin 2010). **No embedding** – the bike-sharing hubs were eventually removed and Hourbike withdrew from the Bristol market in 2010 (BBC 2010b). This experiment was not studied in-depth, so only indicate evidence is available. BCC cited a

				lack of a feasible business model as the key reason for the lack of success (BCC 2012b), in particular that the model was perceived as too reliant on Council resources in the context of emerging austerity cuts (B05). Hourbike cited the limited willingness of the public sector to invest as a barrier to upscaling (Peace 2009a). Bike-sharing schemes are challenging to test at small-scale as sufficiently large-scale deployment is often necessary to provide a financially viable and functional network for users. Both the scale of the scheme and funding issues were key challenges discussed during the process of designing Bristol's Hourbike scheme (Sherwin 2010).
Velomobility	Bikeability 3 (Cycling City)	2008	Cycling England	BCC-civic, delivered by Sustrans	'Pilot' testing the Bikeability Level 3 cycle training standard recently launched by Sustrans, for schoolchildren, including special Bikeability painted tracks in Eastville Park, offering a safe and dedicated off-road training facility (BCC 2011b; 2008). Bikebility Level 3 is the most advanced level of cycle training available for children. During the Cycling City project, 10% of all schoolchildren in Bristol received cycle training (BCC 2011b). **Scaling up** – Bikeability level 3 training was expanded to a larger number of schools city-wide as part of the LSTF programme (Chatterjee et al. 2016; Bartle et al. 2016). **Institutionalisation** – Bikeability level 3 training has been delivered by BCC ever since then – provision is mentioned on Travelwest (2021b) website.
Velomobility	Bristol Bike Project (Cycling City)	2008	Cycling England	BCC-civic, led by Bristol Bike Project	BCC seed-funded this civil society initiative through the BCC-run Cycling City Community Grant Fund (BCC 2011b). BCC support included £2500 towards equipping 400 bikes with locks and lights (BCC 2012b).Bristol Bike Project was featured as a case study in the Cycling City evaluation report, as by 2011 the initiative had been established as a Community Interest Company and won the Observer Magazine's Ethical Award for best grassroots organisation nationally (BCC 2011b). **Stabilisation** – Bristol Bike Project has been operating in Bristol ever since, https://bristolbikeproject.org. It received another £25,000 in seed-funding from BCC's LSTF Active Neighbourhoods Grant Fund (BCC 2015a). **Transformative impact - significant new governance institution.** In 2018, the Project celebrated a decade of work as a cooperative with 170 members, 100 volunteers and a public maintenance workshop; having worked with over 2000 people under 'earn-a-bike' and delivering special programmes for schools, young people, women (BBP 2018).

Velomobility	All Abilities cycling pilot	2008	Cycling England; Aiming High for the Disabled	BCC-civic, in partnership with Aiming High for the Disabled and Cycling Projects	Experiment with providing cycle training targeted at disabled children and their teachers, drawing on specialist bikes and staff, as part of the Cycling City project (BCC 2011b). **Circulation** – following BCC seed-funding of £40,000 through the LSTF Active Neighbourhoods Grant Fund (BCC 2015a), the All Abilities initiative was developed into a permanent Family Cycling Centre with a focus on disabled and disadvantaged young people, with DfT Sustainable Travel Transition year funding (DfT 2016b; McCretton 2016). Activities delivered by Bristol Bike Project and Life Cycle UK. **Unclear transformative impact** - the Family Cycling Centre was established in 2016 and was still operating in 2019, but it has not been possible to determine whether this has generated transformative impacts.
Velomobility	PTP for new residential developments	2011	DfT LSTF	BCC-private, delivered through Steer Davies Gleave	Pilot of an 'info pack' (personalised travel planning) for households in newly-built residential developments around the Bristol city-region (Travelwest 2011c), delivered by Steer (n.d.) Davies Gleave. **Stabilisation** – the West of England authorities continue to provide PTP for the residential developments targeted during the experiment phase, e.g. Cheswick Village and Charlton Hayes (Travelwest 2020; Geelan 2019). The majority of these are in South Gloucestershire. **Scaling up** – the PTP approach has been expanded to further developments, some of which are located in Bristol (Travelwest 2020). **Institutionalisation** – new developments were integrated as a new element of the PTP programme managed by Steer Davies Gleave's Sustainable Travel Field Team on behalf of BCC and the other West of England authorities, currently programmed until the end of 2021 (Steer n.d.; Geelan 2019).
Velomobility	Working with Registered Social Landlords	2015	DfT LSTF	BCC-civic, in partnership with social housing providers	See Appendix B. **Stabilisation.**
Velomobility	On-street residential bike hangars	2015	DfT LSTF	BCC-civic, led by local residents	BCC provided a seed-funding grant for local residents (on their initiative) to install and test Bristol's first Bike Hangar (Booth 2015), a type of secure cycle parking infrastructure manufactured by company Cyclehoop, from the LSTF Active Neighbourhoods Grant Fund (BCC 2015a).

Public space					**Stabilisation –** the first Bike Hangar is still in place, at the location where it was tested (Google Streetview) **Scaling up –** expansion of Bike Hangars to 17 locations city-wide (BCC 2016c), with part funding from the DfT Cycle Ambition programme. **No transformative impact** - expansion was halted due to austerity cuts (B20) by 2019. In 2021, BCC still did not have any funding available for further grant applications (Travelwest 2021a).
Public space	Horfield Home Zone	2001	BCC	BCC-private, in partnership with private developer	BCC launched a policy agenda on home zone development within the first Local Transport Plan, a dedicated Home Zone team within BCC, and a pilot programme funded through the Council's own resources that tested home zones in Horfield and Henbury neighbourhoods (BCC 2000; 2003a). For the Horfield experiment, BCC partnered with private developers on designing a layout for a new-build residential development (Biddulph 2000). **Stabilisation** – home zone was made permanent and studied by Biddulph (2012) in the 2010s.
Public space	Henbury Home Zone	2001	BCC	BCC only	A shared surface/space home zone was piloted at Trevelyan Walk (BCC 2002; 2000), a residential street in the Henbury neighbourhood. This was funded by BCC as part of its pilot programme (see above). **Stabilisation** – home zone still exists (Google Streetview, July 2019).
Public space	The Dings Home Zone	2002	EC CIVITAS; UK New Deal for Communities	BCC-civic-private, in partnership with Sustrans and Barratt Homes	An experiment with retrofitting street space in an existing residential neighbourhood called 'the Dings', in central Bristol, as part of the VIVALDI project (B21; VIVALDI 2006). Sustrans delivered the community engagement aspect and evaluation of the home zone; the experiment included national funding under the New Deal for Communities regeneration programme administered by a local NGO called Community at Heart; as well as financial contributions with a private developer constructing new housing adjacent to the home zone (Sustrans 2004). **Stabilisation** – the home zone still exists today (B21; Google Streetview) No evidence of further embedding (e.g. including in study by Biddulph 2010).
Public space	Southville Home Zone	2002	DfT Home Zone Challenge Fund	BCC only	This experiment tested a home zone configuration by retrofitting existing residential streets in Bristol's Southbille neighbourhood, funded by DfT Home Zone Challenge competitive funding programme; delivered by BCC but evaluated by UWE Centre for Transport and Society (Sherwin et al. 2006b). The

				experiment involved extensive community engagement and practical delivery challenges that resulted in high costs compared to similar interventions in other UK cities (Biddulph 2010). **Stabilisation** – the home zone was made permanent (Sherwin et al. 2006a) and still existed in 2019 (Google Streetview) **Institutionalisation** – lessons drawn from the experiment regarding the high cost of retrofit home zones caused a policy shift away from retrofits and to focus exclusively on new development (Sherwin et al. 2006a; B14). The 2006 West of England Joint Delivery Report, as a background document to the first Joint Local Transport Plan, states that "the high cost of these retrofit schemes [in Southville and the Dings] means that the strategy being taken forward in the JLTP focuses on new-build Home Zones implemented with development" (West of England Partnership 2006b, p.26). Home zone design principles are mentioned in the third Joint Local Transport Plan (West of England Partnership 2011) and Policy DM28 Public Realm of the Bristol 2014 Local Plan (BCC 2014b) also encourages home zones in 'appropriate locations'. **Unclear transformative impact** - it is unclear whether BCC planning policy advising home zone designs for new residential development was a significant institution or caused spatial change. Design guidance is negotiable between local authorities and developers as part of the planning process, and although one interviewee stated that "now every new development coming through in Bristol… generally are shared space, home zone" (B21), it has not been possible to triangulate this to establish to what extent planning guidance has resulted in city-wide prevalence of residential street design that prioritises pedestrians.
Public space	Playing Out 2010 trial	2010	BCC (Active Bristol)	BCC-civic, led by Playing Out	Following a first trial in 2009 of a play street organised entirely by volunteer parents, BCC seed-funded this larger civic-led experiment including five residential streets around Bristol, which stabilised the configuration and led to the establishment of Playing Out as a local non-profit company (Playing Out CIC 2010; BCC 2015b). BCC also supported the experiment in terms of practical implementation, which points to network collaboration (ibid). **Circulation** – the experiment was repeated in a modified form in 2012, when BCC led an experiment to test a Temporary Play Street Order as a new municipal regulatory process that could institutionalise the Playing Out configuration (see below).

Public space	Playing Out TPSO trial	2012	BCC	BCC-civic, in partnership with Playing Out CIC, NHS, Streets Alive	BCC led an experiment testing a Temporary Play Street Order (TPSO) as a modification of its existing permit application process for street parties, through which residents could apply for play street closure (Playing Out CIC 2012). **Institutionalisation –** TPSO was institutionalised as a new permit process within BCC and made available through an annual application process (Playing Out CIC 2012; Ferguson 2019; University of Bristol 2020). **Scaling up** – Playing Out was scaled up city-wide through funding from the European Green Capital Strategic Grant Fund (BCC 2014d). **Transformative impact -** the number of TPSO issued by BCC has grown over the years, with 49 locations city-wide in 2017-18 (BCC 2020a). Beyond seed-funding for the experiment in 2010 (BCC 2015b), BCC support for Playing Out has included £10,500 in Neighbourhood Partnerships funding, £56,000 from the LSTF Active Neighbourhoods Fund (BCC 2015a).
Public space	Make Sunday Special	2013	BCC	BCC only formal partner	Make Sunday Special was launched as an experiment and Mayoral initiative by George Ferguson in 2013. It involved a series of temporary closures of Bristol's Old City streets for one Sunday a month between June and October, with Ferguson envisioning this as an experiment that would serve as a precursor to getting the core of the city centre "completely free of cars" (B27). £195,000 was budgeted by BCC to cover the costs of all five days (BBC 2013b). A formal evaluation and public consultation was undertaken of the 2013 pilot, finding that 83% of respondents thought Make Sunday Special should continue, and that there had been increased footfall and local business sales in the pilot area (McKibbin 2014). A key concern raised by respondents to the consultation was the public cost of the initiative (BCC 2014e). **Initial stabilisation** and **scaling up** – Make Sunday Special was made an annual occurrence up until 2016 (BCC 2016d). During the 2015 Green Capital Year, Make Sunday Special was extended beyond the city centre through grant funding for local neighbourhood groups (Bristol 2015 Ltd 2016a). **Lack of transformative impact** - Although Mayor Marvin Rees extended Make Sunday Special for the summer of 2016, it was terminated the following year. This experiment was not studied in-depth so only indicative evidence is available. Likely the termination was motivated by austerity-related municipal budget cuts in 2017: Make Sunday Special is not mentioned as a specific item in the recommended savings proposals within the BCC Corporate Strategy

					2017-22 development process, however, the termination of programme is suggested several times by stakeholders and residents as a source of savings within the final report on the Corporate Strategy consultation process (BCC 2017a).
Public space	Street Pockets (Green Capital)	2015	DECC; Green Capital Strategic Grant Fund	BCC-civic, led by Sustrans	See Appendix B. **Stabilisation** and **circulation.**
Automobility	Road user charging trial (ELGAR)	1996	EC FP4, DETR	Unknown	A road user charging trial "whereby a selection of volunteers where charged virtual tolls (which increased during pollution episodes) for travel into the city" was implemented as part of the ELGAR project (D'Arcy and Davis 2004, p.260). **Circulation** – lessons from the ELGAR experiment were drawn on to repeat a slightly modified experiment within the INTERCEPT project (INTERCEPT 2001).
Automobility	Road user charging trial (INTERCEPT)	1998	EC FP4	BCC, South Gloucestershi re Council	An experiment with reward-based road user charging involving 200 volunteers to examine whether road pricing could generate mode shift in drivers to switch to ride-sharing or Park & Ride (D'Arcy and Davis 2004, INTERCEPT 2001). **No embedding** – lessons of trial not discussed in the next road user charging trial undertaken as part of the PROGRESS project (see below) nor in the West of England Partnership's (2006a) first Joint Local Transport Plan.
Automobility	Road user charging technology trial (PROGRESS)	2000	EC FP5; DfT DIRECTS	BCC-private-civic, in partnership with universities, consultancies	A road user charging experiment focusing on testing relevant technologies such as MPS (Mobile Positioning System) and ANPR (Automatic Number Plate Recognition) (D'Arcy and Davis 2004; PROGRESS 2004). The experiment evolved into a joint technology demonstration with UK government through (part-funding) from the DIRECTS project (Lumb and Tindall 2006). **Circulation** – the technical equipment tested within PROGRESS was repurposed within an experiment with Automatic Number Plate Recognition-based enforcement of bus lanes within the VIVALDI project: "the trial used equipment previously purchased to examine road user charging in the PROGRESS project" (VIVALDI 2005, p.174) **No further embedding** – although the PROGRESS project is briefly mentioned in the West of England Partnership's (2006b) Joint Delivery Report and the West of England Partnership's (2006a) first Joint Local Transport Plan, lessons from the experiment are not discussed in relation to planned future road user charging schemes.

Automobility	20mph school zone pilot programme	2001	BCC	BCC only	Experiment with 20mph speed limit zones surrounding schools mentioned in first Local Transport Plan (BCC 2000). **Stabilisation** and **scaling up** – between 2001 and 20015 more than a dozen zones had been implemented (BCC 2005). The majority of these zones featured advisory rather than statutory speed limits, which are considered less effective in reducing vehicle speeds.
Automobility	Taxi Sharing (VIVALDI)	2002	EC CIVITAS	BCC-private, in partnership with local taxi operator	The VIVALDI project included an experiment with taxi-sharing, where residents in neighbourhoods with poor public transport accessibility and low levels of car ownership were offered a free bookable taxi service to public transport stops, testing whether this would be cheaper for the Council compared to subsidising non-profitable commercial bus services to these areas (VIVALDI 2005). BCC staff had long wanted to test this kind of configuration (*ibid.*). **Stabilisation** – the taxi-sharing service continued to operate beyond the end of the VIVALDI project (VIVALDI 2006) and was discussed in the first Joint Local Transport Plan Taxi Strategy as subject to expansion following wider evaluation (West of England Partnership 2006a). **No further embedding** – taxi-sharing not mentioned within the first Joint Local Transport Plan 2006/7-2010/11 Five Year Progress review (Travelwest 2011a).
Automobility	BEST car club	1999	BCC	Civic-led, by Bristol Community Car Club Association, in partnership with BCC	BCC piloted Bristol's first car club (Bristol Environmentally Sustainable Transport) in partnership with the resident-led Bristol Community Car Clubs Association, providing seed-funding to the non-profit organisation (BCC 2002; Anable et al. 2004; D'Arcy and Davis 2004). The feasibility study preceding the experiment was funded by BCC through the European Commissioned-funded INTERCEPT project (BCC 2000; D'Arcy and Davis 2004), however the implementation of the experiment was funded entirely through BCC's internal resources. **Institutionalisation** – experiment prominently discussed in the first Local Transport Plan, with the promotion of car clubs discussed as a strategic policy agenda (BCC 2000). **Circulation** – the BEST car club was relaunched as Bristol City Car Club within the VIVALDI project, as a configuration involving old and new elements, see below (VIVALDI 2006; Anable et al. 2004).

Automobility	Bristol City Car Club (VIVALDI)	2002	BCC; EC CIVITAS	BCC-private, in partnership with Smart Moves Ltd.	The BEST car club (see above) was relaunched in 2002 as part of the VIVALDI project, with an experiment testing a new configuration, where private operator Smart Moves were awarded four years of seed-funding by BCC, based on a goal of scaling up to 1000 members and becoming financially independent (VIVALDI 2006; Anable et al. 2004). By 2006, Bristol City Car Club was far from this target at 220 members (VIVALDI 2006), yet had scaled up to eight city neighbourhoods and was one of the largest car clubs in the UK at the time (Cairns et al. 2004). **Stabilisation** – Bristol City Car Club continued to operate. **Scaling up** – the car club continued to expand, in terms of the spatial distribution of parking bays and users (VIVALDI 2006; B21; B22). **Institutionalisation** – experiment tested and codified new regulatory process where BCC could designate parking bays for the sole use of car club vehicle, creating a new legal order that did not exist in the UK at the time (VIVALDI 2005, 2006; Anable et al. 2004). **Transformative impact** - The long-term impact of the car club experiment launched during VIVALDI was cited by interviewees as a significant instance of larger-scale change (B21; B22). Smart Moves Ltd, the car club operator that launched in Bristol as one of its first locations, continued to expand nationally (Ball 2002) – at some point renaming the company City Car Club – until 2015, when it was acquired by one of the world's largest vehicle rental companies, Enterprise Rent-A-Car (B21; PR Newswire 2015). There is no evidence that car-sharing had a transformative impact on mobility flows, however. The number of local car club users increased from 220 in 2006 to 3730 in 2015 (CoMoUK 2018), at a compound annual growth rate of 37%. Although ComoUK presents estimates for how much this reduced car ownership among Bristol users, this has not been verifiable. There were 94 vehicles available to Bristol members in 2015, equivalent to approximately 40 vehicles per member.
Automobility	GoLow car pool	2009	NHS	Civic-led by Avon & Wiltshire Partnership Mental Health Trust, in partnership with BCC	This experiment led by a local NHS trust tested a car-pooling service for staff, but involved staff from BCC Social Services, and is thus an example of *self-governing* by BCC. BCC's subsequent strategy of pump-priming GoLow through LSTF is in line with governing through *enabling*, however. **Stabilisation** – the car pool scheme was made permanent after its launch in 2009 (Melia 2012) and was still operational within the Trust in 2015 (LGA 2015).

					Institutionalisation – GoLow was set up as an independent social enterprise following LSTF funding (Melia 2012; Travelwest 2011b) and was later acquired by Co-Wheels (Melia et al. 2016). **Scaling up** – GoLow scaled up its service within the Trust and to other public sector employers (Melia 2012). **Transformative impact** - contributed to establishment of mature local car-sharing market, via Co-Wheels focus on public sector employers and fleet for staff.
Automobility	20mph residential zones pilot (Cycling City)	2010	BCC	BCC only	Pilot of 20mph speed limit zones in two residential neighbourhoods of inner Bristol, covering some 30,000 households and 500 roads on which speed limits were indicated through 20mph signage only, accompanied by a communications campaign (BCC 2013a). This experiment originated with Dr Adrian Davis, an expert on public health and mobility who from 2008 was embedded part-time within BCC's Healthy Urban Team, set up to provide evidence-based approaches to considering public health in the transport and spatial planning processes (Pilkington et al. 2016; BCC 2008). The Cycling City team requested Davis to translate peer-reviewed evidence on the effectiveness of interventions to increase cycling, of which 20mph zones was one recommended measure (*ibid*). The 20mph experiment also drew on public health funding linked to the Active Bristol Strategy, a five-year programme to encourage active travel developed by BCC and local NHS institutions (B25). A monitoring and evaluation exercise demonstrated reductions in vehicle speeds, increases in active travel and a high level of public support (BCC 2012a). **Stabilisation** – 20mph speed limit in the two residential areas subject to initial experiment were made permanent (B25; BCC 2012a). **Institutionalisation** – the experiment influenced policy as reflected in the BCC's vote to expand 20mph speed limits city-wide (BCC 2013a). **Scaling up** – 20mph speed limits were expanded city-wide, with the exception of major roads (Pilkington et al. 2016). **Transformative impact** - UWE evaluation of the 20mph roll-out found reductions in average traffic speeds and traffic injuries (Pilkington et al. 2018). The study also found an increase in walking and cycling levels across Bristol during the roll-out, but these cannot be causally attributed to 20mph speed limits.

Automobility	Kingsdown Resident Parking Zone pilot	2011	BCC	BCC only	Experiment with Resident Parking Zones, where car parking is restricted using residential parking permits, motivated by the desire to reduce easy access to free parking for commuters into Bristol; tested in the Kingsdown neighbourhood as the first RPZ in the city (BCC 2012c). Resident Parking Zones were expanded in Bath from the early 2000s and the first Joint Local Transport Plan mentions strategy of introducing these in Bristol (West of England Partnership 2006a). By 2010, BCC had produced draft design proposals for two pilot RPZ in Kingsdown and Cliftonwood neighbourhoods (BCC 2010), referencing the JLTP. The Kingsdown pilot was then implemented in 2011. **Stabilisation** and **institutionalisation** – after a six-month review/evaluation, the Kingsdown zone was found to be a success and a decision was made to make it permanent, and to adopt expansion of RPZ as a policy item (BCC 2012c). The Kingsdown pilot served as the basis for expanding RPZ, as explicitly mentioned in BCC (2013c). **Circulation -** the operating principles of the RPZ were modified from the Kingsdown pilot to the configuration that was expanded to other areas (BCC 2013c). **Transformative impact -** by 2016, a total of 16 RPZ had been implemented city-wide in Bristol (BBC 2016a).
Automobility	Public car park charging	2011	Private developers (Section 106)	BCC-private, in partnership with private developers	The first 36 public EV charging points in Bristol were tested in public car parks in 2011-12 under the brand 'Source Bristol', drawing on funding from private developers as part of Section 106 agreements (Barnes et al. 2015; BCC 2011a; Next Green Car 2012). Although not explicitly discussed as a tentative intervention, small-scale deployment and an entirely novel configuration qualifies this intervention as an experiment. The 'Source' brand originated with Transport for London's Source London EV charging network, and was then made available through licensing for other areas (B09). Charge point manufacturer: Chargemaster. **Stabilisation** – unknown, no evidence whether these first charging points were retained or later decommissioned, although several charging units are operational in the same location (BCC 2017b). **Circulation** – since these charging points were first launched under the Source Bristol brand and since pre-existing Chargemaster units were mentioned by interviewees in relation to ICT4EVEU (B09), it can be assumed these charging points were incorporated into the

					Source West Network, which also used Chargemaster as a manufacturer.
Automobility	ICT4EVEU software	2012	EC ICT Policy Support Programme	BCC-private, in partnership with Charge Your Car Ltd.	See Appendix B. **Stabilisation**, **institutionalisation** and **scaling up.**

For the NYC sample (Table A.2), funding information was also retrieved from the federal databases and NYMTC documents mentioned in section 3.5.3. Funding sources are noted for the implementation, rather than pre-experiment planning or post-experiment stabilisation. Contributions by non-state actors to maintenance is not included.

Abbreviations for funding sources: NYC case

NYC = resourced solely by Bristol City Council, with no external funding

CMAQ = Congestion and Air Quality Mitigation Program (US Federal Highway Administration)

FTA = US Federal Transit Administration

FTA 5310 = FTA Section 5310 program for Enhanced Mobility of Seniors and Individuals with Disabilities

FTA Bus Livability = FTA Bus and Bus Facilities Livability Initiative

MTA = Metropolitan Transportation Authority

	Experiment	Starting year	Funding	Partnership	Embedding outcomes
Busmobility	Red-painted bus lanes (trial)	2007	NYC	NYC DOT-NYCT	The first-ever painted bus lanes in NYC (and the US) were tested for a trial period from August 2007, with official approval from the Federal Highway Administration under the MUTCD and involving NYCT (Chan 2007a; NYCDOT 2007c). The test was conducted on existing bus lanes along 57th Street between Manhattan's 2nd and 5th Avenue, and on Fordham Road between University Avenue to the Grand Concourse (the Bronx). **Stabilisation:** No/unclear (Google Streetview). Red-painted lanes were no longer in place along 57th Street in 2011, and while they were present along Fordham Road in the same year, this might have been repainted as part of the Bx12 SBS route. **Circulation:** this element was incorporated into the Bx12 SBS experiment configuration, launched the following year (Barr et al. 2010). **Scaling up** and **institutionalisation:** red-painted bus lanes have been applied on many bus routes (Carry et al. 2012) and institutionalised in the DOT Street Design Manual (NYCDOT 2009e; subsequent editions).
Busmobility	Bus bulb experiment	2007	NYC	NYC DOT – but NYCT involvement unknown	NYC's first kerb extension at a bus stop, or 'bus bulb', was tested along Manhattan's Broadway, south of Spring Street (Goodyear 2007; Naparstek 2007b; Neuman 2007). **Stabilisation:** yes, made permanent (Google Streetview) **Institutionalisation** and **scaling up:** bus bulbs were incorporated in the NYC DOT Street Design Manual (NYC DOT 2009e; subsequent editions) and in the DOT/NYCT Select Bus Service Station Design Guidelines (NYCDOT 2018e; including 2009 edition). The use of bus bulbs have been expanded city-wide, e.g. in the 2009 Street Design Manual the usage was already indicated as 'wide'.
Busmobility	Sidewalks to Buses – Mosholu Parkway pilot	After 2007	NYC (PlaNYC operational)	NYC DOT only	As part of PlaNYC Transportation initiative #6 and DOT's new Safe Routes to Transit programme (Kaehny 2007; City of New York 2007c), DOT launched a 'Sidewalks to Buses' initiative focused on improving pedestrian access to bus stops. 2 pilot locations were identified, Hylan Boulevard in Staten Island and Mosholu Parkway in the Bronx (City of New York 2007b). The

Busmobility					experiment at Mosholu Parkway was implemented at some point after 2007. **Stabilisation:** yes, featured on DOT website (NYCDOT 2021c). **No further embedding:** One additional location (in Queens) was subject to intervention under the Sidewalks to Buses initiative (City of New York 2009c), but there is nothing to link this to the Mosholu Parkway experiment. From 2010, the Sidewalk to Buses initiative was put on hold, due to budget cuts (City of New York 2010d). There is no PlaNYC commitment to expand Sidewalks to Buses from 2011 onwards (City of New York 2011a).
Busmobility	Sidewalks to Buses – Hylan Boulevard pilot	2008	NYC (PlaNYC operational)	NYC DOT only	Another Sidewalks to Buses experiment was undertaken on Staten Island, with installation of a new sidewalk to a bus stop along Hyland Boulevard (City of New York 2007b), testing a new type of rubber paving material (NYC DOT 2009f). **Stabilisation:** yes, still present in 2016 (Google Streetview) **No further embedding:** The rubber paving material was included in the NYC DOT (2009e) Street Design Manual, but there is no evidence to link this to the Hylan Boulevard experiment.
Busmobility	Victory Boulevard TSP demonstration	2007	NYC, FTA	NYC DOT-NYCT	The first experiment with Transit Signal Priority in NYC was undertaken along Victory Boulevard, on Staten Island (NYCDOT 2018b), as part of a Transit Signal Priority Demonstration Project. "The objectives for this demonstration project were to develop, design and deploy a TSP system as the basis for a larger-scale citywide deployment of TSP" (NYC DOT 2009g, p.44). The pilot tested infrared line-of-sight technology for TSP. **Circulation:** yes. the SBS Bx12 experiment tested a somewhat similar TSP technology based on radio GPS (NYC DOT 2018b; Barr et al. 2010) and this followed and was part of the same technology experimentation process as the Victory Boulevard experiment (NY10). **No further embedding:** By 2018 this technology was no longer in use in NYC and nor along this Boulevard (NYC DOT 2018b). Despite proving effective in reducing bus delays, the infrared line-of-sight technology had high installation costs (*ibid.*).
Busmobility	Bx12 SBS demonstration	2008	NYC, MTA	NYC DOT-NYCT	See Appendix B. **Stabilisation, circulation, institutionalisation**, **scaling up.**

Busmobility	M15 SBS demonstration	2010	CMAQ, NYC, MTA	NYC DOT-NYCT	The next SBS route that was launched after the Bx12 route was the redesigned M15 route along Manhattan's First and Second Avenue. This qualifies as an experiment with a different a novel SBS configuration because it tested a number of elements different to Bx12: bus lanes offset from the kerb, camera enforcement of bus lanes, weatherproof ticketing machines, low-floor articulated buses with three-door boarding, integrated corridor redesign to include new cycling infrastructure (Beaton et al. 2012). **Stabilisation:** yes, the SBS route and elements were retained. **Institutionalisation** and **scaling up:** yes, most of the novel elements tested were institutionalised as part of DOT's SBS 'toolkit', as standard or optional features for other routes (see Table 6.6). Offset bus lanes, camera enforcement, weatherproof ticketing machines, integration with cyclist/pedestrian infrastructure were all scaled up as part of other SBS routes.
Busmobility	Bus tracking + countdown clocks pilot - 34th Street	2009	Private	NYC DOT-NYCT and private contractor Clever Devices	The agencies experimented with bus GPS tracking and 'countdown clocks' (also known as real-time information displays, at bus stops) on the M16 and M34 bus routes in Manhattan (NYC DOT 2009f). The experiment was funded by the private sector supplied, Clever Devices (Grynbaum 2010). **Circulation:** In 2010, the MTA's newly developed BusTime system was incorporated alongside the hardware tested in this experiment for 34th Street bus routes including M34 SBS route (MTA 2012). Bus Time is the MTA's comprehensive GPS system for bus tracking, passenger information and real-time information, which allows user access through smartphone, SMS and displays at bus stops. Basically, there was circulation of hardware elements from the 2009 experiment to the 2010 configuration. Real-time information displays at bus stops, linked to MTA BusTime, has since been scaled up across most SBS routes (as one element of the SBS 'toolkit').
Busmobility	Opticom TSP pilot	2013	CMAQ, NYC, MTA	NYC DOT-NYCT and private contractors	Another experiment tested Transit Signal Priority (TSP) wireless communication technology, developed by private company Opticom (NYC DOT 2017), on the already operational M15 SBS route (GTT 2018; Beaton et al. 2012; NYCDOT and NYCT 2011). Private contractors included the makers of Opticom TSP Technology, traffic engineering firm Greenman-Pederson, Inc., Transcore for the development of a traffic management

					center to support TSP, and Peek traffic to provide the software to implement TSP at each intersection (GTT 2018). **Stabilisation:** yes, a comprehensive review of TSP in NYC contains no indication that this configuration for the M15 route was removed (NYC DOT2018b). **Scaling up** and **institutionalisation:** yes, Opticom technology scaled up by retrofitting traffic signalled intersections along the S79, B44, Bx41 and B46 SBS routes (NYCDOT 2018b). Virtually all NYC traffic signals and MTA buses had been equipped with Opticom TSP capability compatible with this technology by 2019 (NY10), demonstrating that this configuration had been institutionalised as the preferred technology (NYCDOT 2018b).
Busmobility	Queue jump bus lane – M86 SBS route	2015	CMAQ, FTA, NYC, MTA	NYC DOT-NYCT	The M86 SBS does not include priority bus lanes along most of its route across Manhattan; instead, a novel type of 'queue jump' bus lane was tested as part of this SBS upgrade in 2015 (NYCDOT 2017c). This type of configuration includes short sections of bus priority lanes implemented up to key intersections only, seeking to ensure buses do not get stuck due to poorly aligned traffic and can depart swiftly from intersections. **Stabilisation**: 'queue jump' lanes have been retained along the M86 route (Google Streetview) No other embedding – configuration had not been expanded along other routes, as of 2020.
Busmobility	Temporary bus boarding platform – B46 SBS route	2016	CMAQ, FTA Bus Livability, FTA 5310, MTA, NYC	NYC DOT-NYCT	For the B46 SBS route along Utica Avenue (Brooklyn), NYC DOT became the first city in the US to test a temporary bus 'bulbout' or 'boarding platform' – essentially a rubber platform placed between the kerb and an offset bus lane, procured from a Spanish manufacturer (TransitCenter 2016b; Garcia and Wall 2019). This configuration allows a 'bus bulb'/kerb extension to be delivered in advance of capital street reconstruction, in line with NYC DOT's general quick-delivery approach. **Stabilisation:** the platform was moved elsewhere from Utica Avenue, but retained (Garcia and Wall 2019). **Institutionalisation:** yes, the temporary boarding platforms have been institutionalised as an element in the NYC DOT Better Buses toolkit, its new initiative for improving bus services city-wide, launched after 2016 (NYCDOT 2021a).

Velomobility	Chevron markings	2005-6	CMAQ, NYC	NYC DOT only	DOT tested a double-arrow 'chevron' road marking on certain cycle routes, to indicate that the road was to be 'shared' by users, in the absence of a dedicated cycle lane (NYCDOT 2005b). **Stabilisation:** unknown, since the original location of the experiment is unclear. **Institutionalisation** and **scaling up:** the road marking was incorporated into DOT's updated configuration for 'shared' cycle lanes, i.e. institutionalised as a design for the city's Class 3 lane (NYCDOT 2006a; see also 2009 Street Design Manual). As the expansion of this lane type, the configuration has been scaled up city-wide.
Velomobility	Green-painted cycle lanes	2005-6	CMAQ, NYC	NYC DOT only	As recommended in the *Bicyclist Fatalities and Serious Injuries* report (Nicaj et al 2006), DOT experimented with green-painted cycle lanes, after securing the required approval from the FWHA for a MUTCD deviation (NYCDOT 2005b). The deviation was required because painted cycle lanes were not in widespread use in the US at the time. DOT submitted an evaluation Experiment to FWHA in 2011, with 28 interventions of green marking implemented at that point (NYCDOT 2011a). **Stabilisation:** unknown, since the original location of the experiment is unclear. **Institutionalisation** and **scaling up:** yes, green lane markings institutionalised as part of Class 1b and Class 2 cycle lane configurations in NYC, as per the NYC DOT (2009e) Street Design Manual. The configuration has been scaled up city-wide as part of the expansion of these cycle lane types. Green-painted lanes became compliant with national regulation, as MUTCD granted 'interim approval' for green-coloured bicycle lanes was granted in 2011 (FWHA 2015).
Velomobility	Tillary Street two-way protected cycle lane	2005	NYC	NYC DOT only	As part of the Downtown Brooklyn Traffic Calming project, DOT experimented with a stretch of two-way cycle lane physically protected from the street through temporary materials (granite blocks) along Tillary Street in Brooklyn (Russo 2006). This appears to have been the very first protected cycle lane in NYC. **Stabilisation:** yes (Google Streetview) **Circulation:** yes. The configuration became a 'model' for things DOT did later (Fried 2017). DOT cited the Tillary Street protected cycle lane as a reference point in its presentation of the design of a later experiment with a protected cycle lane along Manhattan's Ninth Avenue (NYCDOT 2007a). The Ninth Avenue cycle

Velomobility					lane was a one-way parking-protected cycle lane, however, so it was only certain elements of the Tillary Street configuration that were replicated – hence circulation.
Velomobility	Montgomery Street Bike Box	2007	NYC, CMAQ	NYC DOT only	An experiment with a 'bike box' or Advanced Stop Box for bicyclists at intersection of Montgomery Street in Manhattan (NYCDOT 2007e). This was an entirely new configuration to NYC at the time, which had been recommended for implementation in the NYC Bicycle Master Plan (NYCDCP and NYCDOT 1997). **Stabilisation:** yes, the bike box remained at the experiment location (Google Streetview). **Scaling up but not institutionalisation:** the configuration has subsequently been scaled up city-wide; but there is no evidence of institutionalisation as it is not formally codified in the Street Design Manual.
Velomobility	Ninth Avenue Bike Lane	2007	NYC, CMAQ	NYC DOT only	See Appendix B. **Stabilisation, circulation, institutionalisation, scaling up.**
Velomobility	Grand Street	2008	NYC, CMAQ	NYC DOT only	Inspired by the Ninth Avenue pilot, an experiment with a parking-protected cycle lane at a narrower cross-town location on Grand Street was undertaken, adding in a 'mixing zone' element inspired directly by Copenhagen (NYCDOT 2008b). Instead of having signal protection for cyclists at every intersection, 'mixing zone' design meant that physical protection from parking ended further from the intersection, with an unprotected kerbside 'zone' where cyclists and cars would mix freely (NY08). **Stabilisation:** yes (Google Streetview) **Circulation:** the 'mixing zone' element circulated back to be integrated into a slightly modified configuration for the expansion of the cycle lane along Ninth Avenue (NY08), from 23rd Street to 33rd Street, in 2008, and then further uptown along from 33rd Street to 59th Street in 2012 (Mead n.d.). **Institutionalisation** and **scaling up:** yes, this configuration was institutionalised within NYC DOT, as what would later be codified as the standard design for a Class 1b cycle lane (2009, 2015 Street Design Manual), and expanded city-wide as part of implementation of that cycle lane type.

Velomobility	Bicycle parking shelters	2008	Private	NYC DOT and private company (Cemusa)	DOT implemented four on-street sheltered bicycle parking structures on a pilot basis, providing weather-protected cycle racks inside a structure mimicking the city's bus shelters (NYCDOT 2008e). The installation and maintenance was funded under the existing DOT street infrastructure franchise contract, operated by Cemusa. **Stabilisation:** unclear, because unknown experiment locations. Not all of the shelters were retained in their original location (Aaron 2009). **Scaling up:** the overall number of bike shelters was expanded (NYCDOT 2015b). However, in 2020 there were currently only a total of 20 shelters in NYC.[170] **Institutionalisation:** configuration was institutionalised in the 2009, 2015 Street Design Manual.
Velomobility	Kent Avenue – parking protected two-way lane	2009	NYC, CMAQ	NYC DOT only	Kent Avenue, along Brooklyn's waterfront, was first redesigned as a one-way Class 1b lane, but was then revised to feature a two-way design and became the first experiment with a two-way parking-protected cycle lane including mixing zones (NYCDOT 2009c). **Stabilisation:** yes (Google Streetview) **Scaling up:** yes, this two-way configuration of a Class 1b lane has been scaled up city-wide. However, there is no specific evidence of institutionalisation, as the design is not codified in the DOT Street Design Manual.
Velomobility	Bike corral – Smith Street	2011	NYC	NYC DOT, local business	NYC DOT tested the city's first cluster of CityRacks cycle parking stands placed on-street on a repurposed parking space, referred to as a 'bike corral' in the US, at Smith Street in Brooklyn (Fried 2011; NYCDOT 2021b). This configuration preserves pedestrian space as the sidewalk is not used to accommodate cycle parking, and partnered with the local businesses in front of the structure to keep it free from litter. **Stabilisation:** yes, the corral on Smith Street was still there in 2021 (Google Streetview; NYCDOT 2021b) **Scaling up:** the configuration expanded to over 20 locations by 2013 and 65 by 2020 (NYCDOT 2021b). **Institutionalisation:** from 2012, the configuration was institutionalised within NYC DOT as an application-based BikeCorrals Program (NYCDOT 2013c), where maintenance partners (responsible for clearing snow and debris) including

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[170] Public data on the locations of bike shelters, NYC DOT website (kml file). Available online at: https://www1.nyc.gov/html/dot/html/about/datafeeds.shtml#bikes.

					businesses, community groups of individual volunteers can apply for a corral. **No transformative impact** - expansion by 2016 cannot be characterised as city-wide. The diffusion of innovative cycle parking configurations in NYC was limited overall. DOT expanded the supply of its standard 'CityRacks' cycle parking stands city-wide since 1997: from 600 units in 1996 (Nicaj et al. 2006) to 28,000 in 2016 (City of New York 2017b). Yet, access to cycle parking continues to be problematic for many New Yorkers (T.A. 2021).
Velomobility	Bike & Ride pilot	2015	MTA (NYC contribution unclear)	NYC DOT-NYCT	The de Blasio administration's OneNYC plan announced that DOT would work "with the MTA to pilot external bike racks on buses that cross bike-inaccessible bridges" (City of New York 2015b, p.14). NYCT tested bicycle racks on two Staten Island bus routes under a 'Bike & Ride pilot' in 2015 (ibid). **Stabilisation** and **scaling up**: in 2018, the MTA Bus Company announced that following this successfully pilot program, cycle racks would be permanently available on these two bus routes plus two others (MTA 2018).
Public space	Coenties Slip Plaza	1997 - 1999	NYC, CMAQ	NYC DOT and Downtown Alliance BID	Following the Lower Manhattan Pedestrianization Study (City of New York 1997a), the DOT Pedestrian and Bike Projects Group converted a small stretch of street called Coenties Slip into a public plaza using temporary materials (NY06), notably granite blocks left over from a DOT bridge project, with the Downtown Alliance BID as a maintenance partner. **Stabilisation:** yes, the temporary plaza was later made permanent through capital reconstruction, and was extended in the 2010s to close the street fully to traffic (Aaron 2013b; Lydon and Garcia 2015; Figure 6.11). However, at the end of the 1990s, the approach used at Coenties Slip was not institutionalised or replicated in other locations, however, "because most DOT staff… were unaware of the project and its potential scalability… the treatments were not that visible and they were not connected to a larger political or policy platform" (Lydon and Garcia 2015, p.159). **Circulation:** Despite the lack of immediate institutionalisation, DOT employee Randy Wade's projects, which includes Coenties Slip, have been cited by other employees as a 'precursor' to Willoughby Plaza (Fried 2017; Lydon and Garcia 2015; NY06). Former DOT staff attributed the lack of scaling up to Weinshall's lack of

				leadership and the fact that the quick-build approach had not yet been institutionalised (NY06).
Public space	Herald Square – sidewalk widening	2000	NYC	NYC DOT and 34th Street Partnership BID	At Herald Square at the intersection of Broadway and 6th Avenue, NYC DOT tested a redesign of the sidewalks for a one-year trial in 2000 (City of New York 2000; NYCDOT 2018c), in partnership with the local BID. This was implemented using temporary materials and the 'quick-build' approach drawing on DOT operational funds (NY06). **Stabilisation:** yes, widening/redesign of the square was later made permanent (NYCDOT 2018c). **Circulation:** lessons/elements from the experiment, including quick-build implementation approach and specific BID partnerships, circulated to the later 'Broadway Boulevard' experiment (that encompassed Herald Square), transforming the street through a modified configuration (see below). Times Square 'operational sidewalk widening' also cited by DOT employees as precursor to a later experiment with quick-build implementation at Willoughby Street Plaza (Fried 2017 NY06).
Public space	Times Square – pilot program for sidewalk widening	2001	NYC, CMAQ	NYC DOT and Times Square Alliance	The CMAQ-funded Midtown Manhattan Pedestrian Network Development project (NYCDCP and NYCDOT 2000) spawned a 2001 'pilot program' at Times Square, where pedestrian space was expanded using the quick-build approach, using "raised asphalt, signs, pavement markings, planters and plastic cylindrical devices" to separate pedestrians and traffic (City of New York 2001a, p.86). It is highly likely that this experiment involved

				the local BID, the Times Square Alliance, as a maintenance partner. **Stabilisation:** yes, the temporary sidewalk extensions were still in place in 2003 (Design Trust for Public Space 2004). **Circulation:** lessons/elements from the experiment, including quick-build implementation approach and specific BID partnerships, circulated to the later 'Broadway Boulevard' experiment (that encompassed Times Square), transforming the street through a modified configuration (see below). Herald Square 'operational sidewalk widening' also cited by DOT employees as precursor to a later experiment with quick-build implementation at Willoughby Street Plaza (Fried 2017; NY06).
Public space	Willoughby Street Plaza	2006	NYC only	NYC DOT-Metrotech BID	Ideated by NYC DOT staff in close partnership with Metrotech BID staff, a new public plaza was implemented on an experimental basis, by closing a short stretch of Willoughby Street in Downtown Brooklyn to traffic, using the quick-build approach (Fried 2017; NY06).The road was reclaimed virtually overnight, with the road blocked using big planters and moveable chairs placed in the street (NY06). The configuration included elements of/was influenced by earlier experiments at Coenties Slip, Herald Square and Times Square (see above). **Stabilisation:** yes, the plaza was made permanent through capital reconstruction in 2012 (Google Streetview) and remains in 2019 (field visit). **Institutionalisation:** The visual impact and speed of the immediate transformation had excited the public and influenced Doctoroff's team developing PlaNYC at the time (Fried 2017; NY06). Willoughby Plaza was included in PlaNYC as a case study and the open space goal of PlaNYC was envisaged by Doctoroff's team to be achieved through replication of the Willoughby Plaza model (City of New York 2007c; Lydon and Garcia 2015; NYCDOT 2008e).
Public space	Gansevoort Plaza	2008	NYC	NYC DOT-Meatpacking District Initiative	From 2005, a civil society coalition called the NYC Streets Renaissance Campaign started working with businesses and residents in Manhattan's Meatpacking District to develop a vision for reclaiming a wide intersection using temporary materials, to form a new public space (Naparstek 2006; PPS 2008; NY01; NY05). The DOT Pedestrian Projects group became involved eventually, finally launching the official new Gansevoort Plaza using temporary materials and quick-build implementation in 2008; in partnership with the Meatpacking District

				Initiative who were involved in the actual design (Varone 2008). **Stabilisation:** yes, the plaza was made permanent through several rounds of capital reconstruction (Google Streetview). No further embedding: The NYC Streets Renaissance Campaign launched with an exhibition in 2006, which featured renderings of the envisioned transformation of Gansevoort Plaza, and Project for Public Spaces claims that it was this exhibit that inspired the head of the DUMBO BID in Brooklyn (PPS 2012; NY05). It has not been possible to triangulate this claim, however.
Public space	Pearl Street Plaza	2007	NYC, CMAQ	NYC DOT-DUMBO BID	Planned simultaneously with Meat Market Plaza, a new plaza at Pearl Street in the DUMBO district of Brooklyn was unveiled in August 2007, coinciding with the launch of DOT's public plaza initiative by newly-appointed Janette Sadik-Khan (Chan 2007b; NYCDOT 2007d). The PlaNYC plaza initiative was thus put in motion, just four months after the launch of the plan. The plaza had been planned for collaboratively between DOT and the DUMBO BID, with the latter having taken the initiative in contacting DOT (NY06; NY05). The triangular space was delineated with road striping and planters, featuring a bright green epoxy gravel surface and granite blocks and moveable chairs and umbrellas for seating – captured in an iconic 'before and after' photo featured in the New York Times (Kimmelman 2013). The experiment used federal CMAQ funding (Gates Patrick 2008). **Stabilisation:** the temporary plaza was made permanent in that it has remained in place, but with temporary materials – in 2019, the plaza has still not been subject to capital reconstruction (field visit). **Institutionalisation** and **scaling up:** the configuration tested simultaneously at Pearl Street and Meat Market Plazas – including materials, implementation process and partnership model – was institutionalised as part of the NYC DOT Public Plaza Program launched the following year (Sadik-Khan and Solomonow 2016, p.85), and the associated temporary materials 'toolkit' for plazas (NY02). The configuration constituted by a standard set of elements from the plaza toolkit would be expanded to plazas city-wide.

Public space	Meat Market Plaza	2007	NYC	NYC DOT and local BID	Planned simultaneously with Pearl Street Plaza, and one block north of the to-be-finalised Gansevoort Plaza experiment, at Ninth Avenue and 14th Street, DOT redesigned an intersection to create an experiment with the so-called 'Meat Market Plaza', opened in September 2007 (Naparstek 2007a). DOT employed the now-institutionalised configuration from Willoughby Plaza, but also tested a new element: a road surface treatment composed of gravel bound by epoxy plastic ('epoxy gravel') to which colours could also be added (Lydon and Garcia 2015). This allowed plazas to be made more attractive and easily distinguishable from the roadway through different colouring – a significant materials innovation for DOT (Sadik-Khan and Solomonow 2016).[171] **Stabilisation:** yes, the plaza was later made permanent through capital reconstruction (Google Streetview). **Institutionalisation** and **scaling up:** the configuration tested simultaneously at Pearl Street and Meat Market Plazas – including materials, implementation process and partnership model – was institutionalised as part of the NYC DOT Public Plaza Program launched the following year (Sadik-Khan and Solomonow 2016, p.85), and the associated temporary materials 'toolkit' for plazas (NY02). The configuration constituted by a standard set of elements from the plaza toolkit would be expanded to plazas city-wide. This included the institutionalisation of the 'epoxy', coloured gravel in the NYC DOT (NYCDOT 2009e, p.147).
Public space	Madison Square Plazas	2008	NYC	NYC DOT and 23rd Street/ Flat Iron Partnership BID, Madison Square Park Conservancy	In September 2008, NYC DOT unveiled the redesigned intersection next to Madison Square Park, which had created several public plazas in front of the Flatiron building (NYCDOT 2008f; NYCDOT 2009f). These temporary plazas were implemented using the quick-build approach, drawing on the then-institutionalised public plaza 'toolkit', i.e. the configuration established by Pearl St/Meat Market Plaza was scaled up. **Stabilisation:** yes, the temporary plazas were kept in place and expanded over the

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[171] There are conflicting accounts regarding at which plaza epoxy gravel was first tested. Sadik-Khan and Solomonow (2016, p.80) claim that the first experiment with this element was at Pearl Street Plaza, while Lydon and Garcia's (2015, p.159) interview with Randy Wade, a DOT employee who led the Pedestrian Projects Group at the time, suggests that it was at Meat Market Plaza. While the fact that Pearl Street Plaza was officially opened in August 2007, prior to Meat Market Plaza in September the same year, logically supports Sadik-Khan and Solomonow's account; the interview data from the DOT employee in charge of designing and implementing both interventions is deemed more reliable.

				years (Google Streetview), with the planning of reconstruction in permanent materials beginning in 2019 (NYCDOT 2019b). Today the plazas are known as the Flatiron Plazas.
Public space	Broadway Boulevard	2008	NYC	NYC DOT and multiple BIDs	Developed simultaneously with the Madison Square plazas, In the summer of 2008 NYC DOT launched an experiment called 'Broadway Boulevard', where on a pilot basis, two out of four vehicle lanes were converted into a ribbon of new plazas and a continuous bicycle lane between Times Square and Herald Square (NYCDOT 2009a; NYCDOT 2009f). This was launched separately to the application-based DOT Plaza Program, as part of a more DOT-led process of redesigning the area (NY01; NY02). **Stabilisation:** no, the temporary street redesign layout was not made permanent (NY21). **Circulation:** drawing on the lessons of the Broadway Boulevard experiment, the 'Green Light for Midtown' experiment was implemented the following year, featuring a modified configuration to address design issues (NY21).
Public space	Green Light for Midtown Pilot Program	2009	NYC only[172]	NYC DOT and several BIDs and non-profits (NYC DOT 2009)	Following the positive public reception of the Broadway Boulevard experiment, DOT designed a more formal pilot project that expanded the recently created pedestrian space significantly along a longer stretch of Broadway, entirely closing stretches of the street to traffic, with a somewhat modified design based on lessons learned from Broadway Boulevard (NY22). The experiment was named 'Green Light for Midtown' and officially authorised and launched in February 2009 by Mayor Bloomberg for a trial period of six months (City of New York 2009a; NYCDOT 2009b). The experiment involved both significant ex-ante traffic modelling, monitoring using GPS data from taxicabs during the trial period (NY18), and an extensive ex-post evaluation report (NYCDOT 2010a). It was the most extensive and sophisticated evaluation exercise ever conducted by NYC DOT, according to one former employee (NY18). **Stabilisation:** yes, the following year, Mayor Bloomberg announced that the changes would be made permanent (City of New York 2010c). This decision has been widely attributed to Bloomberg's style of technocratic, data-driven

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[172] In 2008, NYC DOT was awarded a CMAQ grant for a project called 'Midtown Manhattan Pedestrian and Vehicular Circulation' (State ID X500.70), but it has not been possible to verify whether this was used for the Green Light for Midtown experiment.

					governance (Luberoff 2016; Sadik-Khan and Solomonow 2016). **Institutionalisation:** yes, the use of taxicab GPS data for monitoring traffic trends was institutionalised within NYC DOT evaluation processes, as evidenced by the annual Sustainable Street Index reports (starting with NYC DOT 2010). Sadik-Khan and Solomonow (2016, p.100) also argue that the Green Light for Midtown evaluation exercise "marked a shift in how we would measure out streets and projects from this moment on". The plazas implemented along Broadway, Times Square and Madison Square were later **incorporated into** the DOT Public Plaza Program, which had been running in parallel on a neighbourhood application basis (NY02).
Public space	Diversity Plaza	2011	NYC, philanthropic (JP Morgan Chase Foundation, Horticultural Society)	NYC DOT, Horticultural Society, Friends of Diversity Plaza, Sukhi New York	See Appendix B. **Stabilisation** and **institutionalisation.**
Public space	Summer Streets Park Avenue	2008	NYC, private sponsorship	NYC DOT, other NYC agencies, BIDs and private sector sponsors, civil society organisations	In July 2008, NYC DOT launched an experiment called Summer Streets (City of New York 2008a), drawing inspiration from Bogota's Ciclovia and Paris Plage (Sadik-Khan and Solomonow 2016) – the very first time such an initiative had been implemented in NYC. During three weekends, a seven-mile route along Park Avenue, between the Upper East Side and Brooklyn Bridge, was closed to traffic and opened as a car-free street for all New Yorkers. NYC DOT partnered with other NYC agencies on this major event, securing private sector sponsorship in lieu for marketing opportunities, and programming contributions from BIDs and civil society organisations. **Stabilisation:** yes, following evaluation, Summer Streets was renewed for 2009 (City of New York 2009b) and has been an annual occurrence, since then. **Scaling up:** the extent/length of the Summer Streets route has also been expanded over the years northwards and southwards from Park Avenue, but not city-wide.
Public space	78th Street Play Street	2008	Primarily by civil society and elected officials	Led by local community groups, with NYC DOT facilitation	Linked to the 2008 Summer Streets launch, NYC DOT also invited expressions of interest from local businesses and community groups outside Manhattan, to create smaller-scale temporary pedestrian streets (NYCDOT 2008a; T.A. 2009). The Jackson Heights Green Alliance, a neighbourhood association in Queens, had been campaigning for more open space in the neighbourhood (JHGA 2019)

Public space					
					and contacted DOT, managing to convince DOT to let them organise a Play Street on 78th Street, closing a street along the local Travers Park every Sunday for four months to allow for children's play (T.A. 2009). The experiment was made possible largely by community fundraising, a small grant from Transportation Alternatives, and contributions from local elected officials; rather than direct DOT support (T.A. 2009). It was thus a civil society-led effort, enabled by DOT through informal partnership working (ibid.). **Stabilisation:** yes, the event was held again in 2009; with the community groups successfully lobbying for the Play Street to be converted into a year-round temporary plaza as part of the DOT Plaza Program (Kazis 2012), and into a permanent-materials plaza through capital reconstruction in 2017 (JHGA 2019). **Circulation:** yes, after supporting the 78th Street experiment, Transportation Alternatives explored this configuration further in a more formal experiment called 'Harvest Home Play Street' (T.A. 2012) - see below.
	Summer Space Brooklyn	2008	NYC DOT and local businesses	Led by Montague Street BID, with NYC DOT facilitation	Also linked to the 2008 Summer Streets 'neighbourhood' programme (NYCDOT 2008a), this experiment with a temporary pedestrianisation of Montague Street in Brooklyn Heights was undertaken by the local BID and community organisations, with informal and flexible DOT facilitation (T.A. 2009). **Stabilisation:** yes, the street closure became an annual occurrence (Aaron 2012). **Scaling up:** yes, the configuration of local events to accompany Summer Streets was scaled up in 2009 to 13 sites across the five Boroughs (The City of New York 2009), involving both BIDs and community organisations. **Institutionalisation:** in 2010, the configuration was institutionalised as the DOT Weekend Walks Program, as mentioned in the PlaNYC 2011 update (City of New York 2011a). **Transformative impact -** the Weekend Walks Program supports multi-day, multi-block temporary closures of commercial streets throughout the year, with some financial support by DOT; and had gradually expanded to 56 locations city-wide by 2016 (NYCDOT 2017i).

Public space	Williamsburg Walks	2008	Mostly civic fundraising, with some NYC DOT support	Led by local residents and businesses, with NYC DOT facilitation	Also linked to the 2008 Summer Streets 'neighbourhood' programme, this experiment with a temporary pedestrianisation of Bedford Avenue in Williamsburg, Brooklyn was led by local entrepreneurs and community organisations, with informal and flexible DOT facilitation (T.A. 2009). **Stabilisation:** yes, the street closure became an annual occurrence (Miller 2013a). **Scaling up:** yes, see Summer Space experiment (row above). **Institutionalisation:** yes, see Summer Space experiment (row above).
Public space	Pilot pop-up café – Financial District	2010	Local businesses, with NYC DOT support	Led by local businesses, with NYC DOT	At the request of local businesses in the Financial District for more sidewalk space catering to customers, NYC DOT provided flexible facilitation for an experiment with a novel 'pop-up café' configuration, with seating provided in a converted parking lane on Pearl Street (UCLA 2012; Kazis 2010). This was essentially modelled on the 'parklets' pioneered in San Francisco. The 2011 PlaNYC update described the experiment as a 'successful pilot' (City of New York 2011a). **Stabilisation:** yes, the original structure tested in front cafés on Pearl Street remained in place (re-installed on annual basis) until 2014 (Google Streetview). **Scaling up:** yes, a formal Pilot Program launched in 2011 scaled up the configuration to additional locations (see below).
Public space	Curbside Public Seating Pilot Program	2011	Local businesses, with NYC DOT support	NYC DOT, with local businesses	Following the first experiment with a pop-up café on Pearl Street, DOT launched a more formal, two-year Curbside Public Seating Platform Pilot Program in 2011, which tested the pop-up café configuration at three additional locations (NYCDOT 2012a). Businesses submitted formal applications and DOT acted mainly as a bureaucratic partner, reviewing applications and providing some support. The evaluation reported increases in footfall, street activity and general popularity among locals (*ibid.*). **Stabilisation:** yes, but only at 1/3 additional locations. The pop-up café on Sullivan Street was in place until 2017; however the installations at 708 3rd Avenue and Smith St/Warren St were not in place post-2011 (Google Streetview). **Institutionalisation:** Yes. Based on the evaluation, NYC DOT institutionalised the pop-up café configuration in the form of the DOT Street Seats Program, similarly featuring an application-based, public-private partnership model (Janoff 2012).

| Public space | Harvest Home Play Street | 2010 | US Department of Health and Human Services (unclear NYC contribution) | Led by Transportation Alternatives in partnership with Strategic Alliance for Health and Harvest Home Farmer's Market, New York Academy of Medicine. | **Scaling up:** yes, through the Street Seats Program, the configuration expanded to additional locations city-wide, with 19 locations in 2019 (NYCDOT 2019d).

Transportation Alternatives built a coalition of non-profit organisations and research institutions to undertake an experiment with two community-run Play Streets in East Harlem and the South Bronx (T.A. 2011a). The Play Streets stretched across two blocks that were part of regularly permitted street closures (since late 1990s) to accommodate Harvest Home Farmer's Markets, a non-profit running markets in low-income NYC neighbourhoods. The experiment included a formal evaluation of physical activity and social impacts by the New York Academy of Medicine (2010). While the NYC Department of Health and Mental Hygiene facilitated the experiment, it appears NYC DOT was not involved at all (based on T.A. 2011a).

Stabilisation: unknown, has not been verifiable.
Institutionalisation: A Transportation Alternatives (T.A. 2011a, p.4). (T.A. 2011) case study report called for NYC city government to "institutionalize the Play Street Program and application process" and "incorporate Play Streets into PlaNYC 2.0" (p.4). Play Streets was indeed included in the PlaNYC update (City of New York 2011a) as an open space initiative; a specific, novel permit for Play Streets was created within the NYC Street Activity Permit Office; and a new Play Streets Program was eventually launched, led by the NYC Department of Health and Mental Hygiene.
Scaling up: the experiment was scaled up to 12 temporary play streets, in 2011; led by the NYC Department of Health and Mental Hygiene (Appelbaum 2011).

No transformative impact: It appears that by 2017, there were zero applications to the Program (Aaron 2017). Although the number of applicants has not been verifiable, it is clear that while the NYC Department of Health and Mental Hygiene's website had a page on the Play Streets Program in 2018 (NYCDHPC 2018), this was removed in 2019 and the website contains no other mention of play streets (Colon 2020); neither does the NYC Street Activity Permit Office website. This suggests the programme was discontinued – with municipally-sponsored Play Streets only to be relaunched to much fanfare by Mayor de Blasio during the COVID pandemic (City of New York 2020). |

Public space	Car-free Central Park – pilot project	2006	NYC only	NYC DOT	Sustainable transport advocates in NYC have long fought for closing Central Park to vehicle traffic, and car-free times and zones have gradually been expanded over the last four decades (T.A. 2013; Warner 1992). In 2006, DOT implemented a 'six-month pilot project' reducing the number of hours that cars could access parts of Central Park, finding that the impact on traffic in the surrounding area was modest (NYCDOT 2007b). **Circulation:** yes, a second experiment with a modified configuration was undertaken in 2013 (see below). **No further embedding:** the experiment configuration was not made permanent (stabilisation), as DOT only extended the number of daily car-free time by one hour (Chan 2007b).
Public space	Car-free Northern Central Park – summer trial	2013	NYC only	NYC DOT	NYC DOT (2013c) tested closing the Northern part of Central Park entirely to traffic, temporarily over the summer months of 2013. **Stabilisation:** yes, the summer closure configuration was made a regular annual occurrence **Circulation:** yes, the experiment influenced the later permanent traffic closure of the Northern loops (City of New York 2015a). DOT cited that the "success car-free Central Park summer pilot during 2013 points the way to permanent car-free park loop roadways", and recommended "pilot closure of Central and Prospect Park to cars year round" in the future (*ibid.*, p.151). The last private car entered Central Park in 2018, following a permanent park-wide ban. (This cannot be described as transformative for the city as a whole, however).
Public space	Shared Streets pilot – Lower Manhattan	2016	NYC, private sponsorship	NYC DOT with Downtown Alliance BID, other city agencies, local businesses and civil society organisations	NYC DOT (2013c) had discussed the potential of Manhattan's Financial District for implementing 'shared streets', or streets designed to function as 'shared space' between vehicles and other users. The idea was bolstered by meetings between DOT, Project for Public Spaces and English urban designer Ben Hamilton-Baillie (Miller 2014). In 2016, NYC DOT decided to first pilot the shared space configuration across a large area of Lower Manhattan, with streets shared by pedestrians and vehicles travelling at a maximum of 5mph, and events programming (NYCDOT 2016e; 2017h). **Stabilisation:** no, configuration not made permanent in testing location.

				Circulation: yes, to two separate interventions. "Building on the success" of the pilot, DOT decided to create a permanent/"full-time" Shared Street just next to Madison Square/the existing Flatiron Plazas (NYCDOT 2017e; 2017h). DOT staff cited that the Lower Manhattan experiment gave them the confidence move ahead (Meyer 2017).[173] Furthermore, NYC DOT also launched an other experiment with the Shared Streets experiment in Chinatown (see below).
Public space	Shared Streets – Chinatown	2017	NYC and Chinatown BID	NYC and Chinatown BID	NYC DOT launched an experiment with 'Shared Streets' in Chinatown in partnership with local businesses and associations, including a 'shared space' configuration that allowed for 5mph vehicle traffic, alongside public art, programming and moveable furniture (NYCDOT 2017d; Meyer 2017). **Stabilisation** and **institutionalisation:** yes, the temporary pedestrian-priority zone was made permanent, including some shared space (NYCDOT 2019a). However, after 2017, the name of the institutionalised DOT Program that subsequent Chinatown events became part of, changed to 'Seasonal Streets' (NYCDOT 2021e).
Automobility	Downtown Brooklyn Traffic Calming Pilot Program	1999	NYC only (DOT and elected officials)	NYC DOT only (although the interventions were co-designed with communities)	NYC DOT launched a Pilot Program with a series of experiments with different traffic calming configurations, including 'neckdowns', raised intersections, leading pedestrian intervals. pedestrian islands – many of them novel to NYC (NYCDOT 2004a). **Stabilisation** and **scaling up**: many configurations made permanent; and later implemented at other locations in Downtown Brooklyn (NYCDOT 2006b; 2005a). **Institutionalisation:** some of the configurations tested became codified as part of a 'blueprint' for the area and the agency's capital programme (NYCDOT 2009d); influenced the evolution of the agency's approach and were 'replicated' elsewhere (Russo 2006).
Automobility	Grand Concourse Pedestrian Safety Demonstration Project	1998	NYC only	NYC DOT only	Implemented on a pilot basis, one part of the Project focused on providing more pedestrian refuge space at the median of a particular stretch of the Concourse, but interestingly used temporary materials such as concrete and plastic planters (NYCDOT 2005c, p.17). The evaluation found that the street redesign had

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[173] The Flatiron Shared Street was not implemented as an experiment, and thus not included in the NYC sample. A 'shared street' street layout configuration has subsequently been institutionalised within the third edition of the NYC DOT (2020, p.76) Street Design Manual.

Automobility					reduced improved pedestrian safety and was judged a success (*ibid*.). **Stabilisation:** the new street layout was made permanent (NYCDOT 2006b). **Scaling up:** other stretches of the Grand Concourse were also subject to capital construction process in line with the experiment layout (NYCDOT 2007f).
	THRU Streets pilot program	2002	US DOT	NYC DOT and NYPD	One of Iris Weinshall's legacy initiatives included the 'Thru Streets Pilot Project', which was labelled an innovative initiative for improving traffic flow and managing congestion (NYCDOT 2004b; FWHA 2020b). The pilot included a series of experiments in Midtown Manhattan with traffic control measures designating certain streets for through-traffic, changing signal phasing to make these streets flow better and moving commercial delivery parking away to other streets. Thru Streets was part-funded by US DOT and launched in 2002 with comprehensive evaluation after one year. **Stabilisation** – the reconfiguration of Midtown traffic along the pilot streets was made permanent (NYCTLC 2005; NYC DOT 2004b).
	T.A. Safe Routes to School Bronx pilot	1997	Federal grant	Led by T.A., with some NYC DOT support	As one of the first of such initiatives in the US, Transportation Alternatives launched its own Safe Routes to School pilot programme in the Bronx in collaboration with local elected officials (NHTSA 2004; T.A. 2013). NYC DOT was eventually convinced to lend some implementation support. T.A. developed detailed traffic calming plans for NYC DOT to design and build (NHTSA 2004). NYC DOT was eventually convinced to lend some implementation support. **Stabilisation:** unclear, since experiment locations unknown. **Institutionalisation** and **scaling up:** the federally-funded experiment was included in a national best practice review of similar bottom-up initiatives, reporting that NYC DOT "will take over program in October 2001 and expand-citywide" (NHTSA 2004, p.74); indeed, the DOT did launch a new School Safety Engineering Division in 2000 with a $2.5 million project for all the city's elementary schools. Building on the earlier SRTS initiatives (T.A. 2013), NYC DOT launched a formal Safe Routes to School Program, with interventions slated for priority locations city-wide (City of New York 2004a). By 2012, safety engineering had been undertaken at 124 locations (Muennig et al. 2014).

Automobility	School Speed Limits - Pilot I	2005	NYC	NYC DOT only	Pilot to test reduced speed limits surrounding 10 schools in the Bronx, on streets with existing speed humps. The evaluation found that the impact of speed limits, as distinguishable from humps, was inconclusive and required further study (NYCDOT 2008c). **Stabilisation:** unclear, no indication to the contrary, but not been possible to verify whether interventions were permanent, for each school **Circulation:** yes, experiment repeated with a different configuration in 2007 (see below).
Automobility	School Speed Limits - Pilot II	2007	NYC	NYC DOT only	Repetition of Pilot I experiment (2005) in a different configuration, testing only speed limits (with signage and beacons), on one-way streets without speed humps. Evaluation demonstrated a reduction in vehicle speeds (NYCDOT 2008c). **Stabilisation:** unclear, no indication to the contrary, but not been possible to verify whether interventions were permanent, for each school **Scaling up:** the configuration was expanded as part of NYC DOT's 'School slow speed zone' pilot project (NYCDOT 2008e) to 20 locations by 2009 (NYCDOT 2009f) and thousands of schools by 2020 (NYCDOT 2021d). **Circulation:** experiment repeated in a modified configuration on two-way streets - see below.
Automobility	School Slow Speed Zones pilot project	2008	NYC	NYC DOT only	The reduced speed limit zones around schools became branded as 'school slow speed zones' by NYC DOT (2008e); with a 'pilot project' established. This project was designed to be implementable using NYC DOT operational process and funds, in the interim of capital improvements under the Safe Routes to School Program. This included expanding speed limits on one-way streets (existing approach), and testing of a different configuration for two-way streets (NYCDOT 2009f). **Stabilisation:** unclear, no indication to the contrary, but not been possible to verify whether interventions were permanent. **Institutionalisation** and **scaling up:** by 2013, the approach had become institutionalised as 'School speed zones' and was no longer marked as to be implemented on a pilot basis, with 189 zones were implemented (NYCDOT 2013c); and with the two-way street configuration also expanded to other locations (Google Streetview).

Automobility	Safe Streets for Seniors pilot neighbourhoods	2008	NYC	NYC DOT only	Analysis of pedestrian safety data led to the launch of the Safe Street for Seniors Program in 2008, with identification of 25 focus areas (NY03). 5 neighbourhoods were chosen as pilot locations for a configuration of safety improvements, including street narrowing, pedestrian islands, sidewalk extension, countdown clocks at traffic signals and adjusted traffic signal timing (NYCDOT 2008e). As a long-standing DOT programme, Safe Streets for Seniors has received a range of federal support includes from the New Freedom, Highway Safety Improvement, High Priority and CMAQ funding programmes (FWHA 2017), but it is unclear whether federal funding was used at the pilot stage. **Stabilisation:** no - no indication that interventions at pilot locations were removed, but not possible to confirm that they were made permanent **Scaling up:** following the initial pilot, the configuration was scaled up, to cover 41 focus areas by 2017 (NYCDOT 2017f).
Automobility	Hydrogen vehicles and fuelling station	2008	Private – possible state or federal support	Led by NYC DCAS, with other city agencies and Shell Hydrogen	PlaNYC included a commitment to "pilot new technologies and fuels, including hydrogen and plug-in hybrid vehicles" (City of New York 2007c, p.123) within the municipal fleet. A specific PlaNYC initiative launched a three-year 'demonstration project' to test the potential of hydrogen vehicle technology through public-private partnership. In 2009, Shell Hydrogen built two hydrogen fuelling stations in NYC - one of them at JFK airport - and automotive companies (General Motors, Toyota) provided prototype vehicles for testing with NYC DCAS coordination (City of New York 2010d; Curtin et al. 2010). The experiment aligned with a 2005 New York State Hydrogen Energy Roadmap that had recommended a fuelling station demonstration at a NYC airport (NYSERDA 2005). It has not been possible to establish the exact funding mix, but Shell Hydrogen operated the fuelling stations, whereas vehicles were leased by auto manufacturers, likely at no cost. PlaNYC mentions a pending grant application to NYSERDA to fund the project. The launch of the project was labelled as in partnership with the US Department of Energy, which indicates some degree of federal support. **No embedding**: no indication that these hydrogen vehicle-related experiments resulted in embedding, since in 2020 there was not a single hydrogen fuelling station within New York state (US DOE

				2020); thus suggesting that the NYC stations were decommissioned.
Automobility	PARK Smart pilot - Greenwich Village	2008	NYC, US DOT Value Pricing Pilot Program	NYC DOT, co-creation with Community Board and local businesses	DOT sought to launch a 'parking pricing pilot' to free up kerb space and take a small step towards parking reform (NYCDOT 2008e). An experiment was launched in Greenwich Village under the name 'PARK Smart', where the price of parking was increased during peak hours on commercial streets (NYCDOT 2009g). **Stabilisation:** the experiment successfully reduced parking space occupancy and was made permanent in Greenwich Village (NYCDOT 2009g). **Scaling up:** the configuration was expanded to a second location in Brooklyn's Park Slope in 2009, and to two more neighbourhoods in 2013, but no further neighbourhoods had been added to the PARK Smart program by 2015 (Miller 2015a). **No transformative impact** - In a rare example of direct federal project-based innovation funding, DOT secured match-funding under the US DOT Value Pricing Pilot Program for the initial 2008 experiment as well as an additional $950,000 for additional parking data collection and analysis city-wide under a 2.0 programme (FWHA 2020a). However, it is unclear why no further experiments were undertaken with this funding, with planned expansion to at least two neighbourhoods cancelled (Miller 2015a).
Automobility	NYC DOT carpool pilot	2010	NYC	NYC DOT, Zipcar	Following the 2008 crash, the Bloomberg administration's priority with respect to the municipal fleet switched to reducing the overall number of vehicles (NYC MOO 2010). This spawned an experiment with car-sharing within DOT, where 50 vehicles were removed from the fleet and staff given access to Zipcar service (NYCDOT 2011c). **Stabilisation:** public-private partnership contract with Zipcar was initially renewed for one year (NYC DOT 2013) **Scaling up:** car pool was expanded to 420 staff by 2013 (NYCDOT 2013c). **No further embedding:** NYC city government's partnership with Zipcar has expanded since then, to cover other city agency staff through NYC DCAS and a car-sharing experiment for NYC residents launched beyond 2016 (with Zipcar as one of the providers). However, these initiatives cannot be causally linked to the

Automobility				specific DOT experiment with Zipcar on car-pooling for staff.
Automobility	ChargePoint America project	2010	American Recovery and Reinvestment Act (ARRA)	Led by Coloumb Technologies in partnership with private parking garages, NYC OLTPS	See Appendix B. **Scaling up** and **institutionalisation.**
Automobility	Neighbourhood Slow Zone – pilot program	2011	NYC	NYC DOT only	The NYC DOT (2010b, p.6) Pedestrian Safety Study and Action Plan recommended a "pilot program to test the safety performance of neighbourhood 20mph zones".The 'Neighborhood Slow Zone' concept was first tested at a pilot location in the Bronx, involving an area of some 35 city blocks, lowering the speed limit to 20mph accompanied by pavement markings, signage at gateways around the zone and speed humps (NYCDOT 2011b). Evaluation found reductions in speeding by 10% at the pilot location (City of New York 2013a). **Stabilisation:** Bronx pilot made permanent **Institutionalisation:** Neighborhood Slow Zone configuration was institutionalised as an application-based DOT program (City of New York 2013a). **Scaling up:** expansion of configuration to 13 neighbourhood's in 2013 (City of New York 2013a) and a further 15 neighbourhoods between 2014-16 (NYCDOT 2014a).
Automobility	Electric taxi pilot	2013	NYC	Led by NYC Taxi and Limousine Commission, with Nissan and taxi drivers	The PlaNYC 2011 update (City of New York 2011a) committed to the Taxi and Limousine Commission launching an 'electric vehicle taxi pilot' featuring the new Nissan Leaf vehicles, which was implemented from 2013 to 2015. Nissan (2013) has won the competition to have its NV200 model as the future standardised model of NYC taxi licensed by TLC; and thus likely provided the Nissan Leafs on an in-kind basis, based on its existing relationship with NYC city government. Although an interim evaluation found that (volunteer) drivers were satisfied and the vehicle worked well (NYCTLC 2013), the final evaluation found that drivers had to significantly alter their driving habits and that the available charging infrastructure was insufficient (NYCTLC 2016). **No embedding**: the use of the Nissan Leafs was discontinued in 2015 (Hirschfeld 2019).
Automobility	Pay-by-phone parking pilot	2013	Private	NYC DOT with PayByPhone (private company)	Experiment with smartphone parking payments at a municipal lot, including roadway sensors that could transfer real-time information of parking space

				availability to the smartphone platform (NYCDOT 2013c). The experiment was funded by private company Pay-By-Phone (PayByPhone n.d.) as part of a DOT Request for Information. **Circulation:** citing lesson-drawing from the Pay-By-Phone pilot, NYC DOT introduced smartphone payments across all municipal parking meters in 2016, using a new ParkNYC app service provided by a different company called Parkmobile (City of New York 2016b).
Automobility	Speed camera pilot program	2013	NYC	NYC DOT only	As part of Vision Zero, the de Blasio administration sought municipal control over speed cameras (under State jurisdiction). A legislative provision allowing NYC to install 20 speed cameras near schools, as a 'pilot program', passed in the NY State legislature in 2013, authorising their use for the first time in the state. NYC was required by the State Governor to evaluate and report on a five-year demonstration period (NYS 2013), and the evaluation found speeding and injuries in school zones had reduced (NYCDOT 2018a). **Stabilisation:** because the State reauthorised the school camera bill in 2019 (NYS 2019), the program has been permanent to date. However, State legislative approval remains time-limited. **Scaling up:** de Blasio successfully fought to get the legislative approval to scale up the pilot to 140 cameras to match an equal number of designated school speed zones (City of New York 2015d); with further scaling up to hundreds of locations beyond 2019.
Automobility	Vehicle Safety Technology Pilot for taxis	2015	NYC	Led by NYC Taxi and Limousine Commission, with NYC DOT	As part of Vision Zero Action Plan (City of New York 2014c), the NYC Taxi and Limousine Commission was commissioned to undertake a Vehicle Safety Technology pilot program for its fleet, which included a range of technologies to be tested in taxis (e.g. automatic speeding alert systems, black box data recorders). The experiment was launched in 2015 with eight taxi drivers and eventually expanded to 2000 vehicles (NYCTLC 2018). **Stabilisation:** the pilot evaluation found that the evidence of impacts on driver behaviour were weak and thus the initiative was kept running, but participation was not made mandatory for drivers (NYCTLC 2018) – i.e. there was no further embedding.

	Safer left-turn design on intersections - pilots	2016	NYC	NYC DOT only	The Vision Zero Action Plan (City of New York 2014c) emphasised addressing left turns within DOT safety improvement initiatives, and a new study focusing specifically on left-turning crashes between vehicles, pedestrian and cyclists confirmed these findings (NYC DOT 2016b). DOT initiated an experiment where 100 left-turn intersections were treated with a range of experimental traffic calming configurations, using temporary materials such as flexi-bollards and rubber structures installed to harden the street centre line, thus forcing drivers to make slower turns (NYC DOT 2016b; 2017b). **Stabilisation:** unclear whether the interventions for the first round of pilot locations were kept in place. **Scaling up:** after finding that the interventions reduced traffic speeds the experiment was scaled up to a further 110 intersections in 2017 (NYC DOT 2018f).
Automobility					

One intervention that was prominent in the NYC context, the CitiBike public bike-sharing service introduced in 2013, did not qualify as an experiment. It was a contextually-novel configuration, but was not implemented in a tentative manner. Indeed, the feasibility study underpinning NYC DOT's decision to launch CitiBike (NYCDCP 2009, p.98) explicitly states a 'small pilot' implementation of bike-sharing in NYC would likely fail, pointing to evidence that smaller-scale implementation in other cities had been successful. Thus CitiBike was launched with 6,000 bikes and 332 stations.

APPENDIX B: EMBEDDED EXPERIMENTS

Detailed narratives for the experiments studied in-depth (n=8) in Bristol and NYC (embedded units of analysis) are provided below.

Bristol experiment I: Geo-fenced hybrid bus trial

BCC was awarded £1.4 million in one-off grant funding from the UK Department for Transport (Dft) as part of UK government's effort to support the European Green Capital Year, to test a specific 'geo-fenced' hybrid electric bus technology (BCC 2015d). This technology allows the bus to switch to 100% electric power within a GPS-designated low-emission zone, thus enabling targeted mitigation of air pollution. BCC issued a tender for a partner bus operator, which First Bus won (*ibid.*). This experiment was chosen for in-depth study to examine the influence of national funding and public-private partnership on experiment outcomes.

Two bus vehicles were tested in 2015. The configuration was an R&D prototype, rather than commercially-produced model, including an imported induction plate for charging, special battery pack modules and bespoke manufacturing, which meant that the cost was more than double that of typical vehicles purchased by First Bus (B19). First Bus' financial contribution was limited to the cost of two conventional buses, with the DfT grant covering the additional cost associated with the bespoke technology. Through working in partnership, BCC and First Bus[174] successfully tested two operational buses. The partnership involved close informal collaboration, with considerable investment of human resources to make this complex and innovative trial 'work' (B19) – the company's pride with the project is illustrated by the poster hanging on the wall when I visited three years later (Figure B.1). The experiment featured a mix of governance logics: although the partnership was formed through

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[174] The third partner was the University of the West of England, who provided space on its Bristol campus – which the trial buses served – for a special induction plate that was mounted on the road surface and through which the electric batteries were charged.

tendering, subject to contractual agreement and thus involved a *market logic*, it was *network* collaboration that enabled the partners to successfully adapt the prototype and enable it to be run on First Bus routes in Bristol.

Figure B.1. Poster of Bristol experiment with geo-fenced hybrid bus, at First Bus' office. Image source: author.

Although the buses were still in operation within Bristol in 2018 (*stabilisation*), the experiment had resulted in no other embedding by 2020 (B14). The configuration was not scaled up: the key reason for this cited by First Bus was that the bespoke configuration was prohibitively expensive from the company's point of view (B19). Although the geo-fenced bus was a bespoke 'outlier', First Bus suggested that the experiment reinforced the company's previous experiences with poor performance of hybrid buses, as part of in-house experimentation (B19). BCC commissioned UWE to undertake an evaluation three years after the experiment finished (B01), which found that the emission reduction benefits had been unclear, with one of the evaluators suggesting that the primary outcome had been confirming biomethane gas buses as First Bus' technology of choice (B14). The fact that the bus manufacturer is

not going to commercially produce the series of hybrid buses used in Bristol also suggests issues with the cost-benefit ratio of the technology (B14). Another factor is that the Managing Director of First Bus (West of England), James Freeman, was personally in favour of biomethane bus technology, as a result of previous experiences with this technology when working for Reading Buses (B13; B19).

This narrative could be interpreted as a straight-forward story of a company tinkering with different technologies, before settling on a dominant design compatible with private sector business models. Interestingly, however, in response to Transport for London's rejection of biomethane buses on grounds of limited air quality benefits, Freeman defended First Bus' opting for biomethane buses in Bristol on the grounds that "conditions were different in Bristol - and that TfL had the public investment and resources to go for electric buses ultimately... The fundamental difference between operating buses in Bristol and elsewhere in the UK is the amount of money available to fund them, which in London is huge, whereas here in Bristol the market - i.e. the passenger - has to pay" (Cork 2020a). Beyond the specific geo-fenced prototype tested in Bristol, Freeman's statement points to how the broader governance context plays into Free Bus' assessments of what constitutes a sufficiently affordable technology.

More broadly, the question that can be asked is why *this particular* technology was tested (using significant public funds), if the configuration appeared unlikely to be scalable due to prohibitive cost, i.e. this being known ex-ante? The answer is linked the nature of the funding involved. DfT had already agreed with Transport for London to test this particular bus technology, and BCC 'bought in' to the project to secure some additional funding as part of its Green Capital year – with the Department being equally keen to share the PR limelight (B19). This meant that external funding determined the experiment scope from the outset, requiring the experiment to be delivered within 12 months – as the Department required that the buses would be running during the Capital Year (B19). BCC thus managed to use the Green Capital status to secure funding and developed a successful public-private collaboration, but the experiment was based on unclear objectives, in the pursuit of central government

'handouts'. In this case, while the public-private partnership was conducive to successful implementation of the experiment, the prescriptions of national funding thus inhibited embedding.

Bristol experiment II: Working with Registered Social Landlords

In the UK, social housing tenants often have poor access to cycle parking infrastructure, as many do not have private outdoor space or communal facilities. Registered Social Landlords (RSLs) are the technical name for housing associations: non-profit organisations independent from the government that provide low-cost housing. In 2016, BCC partnered with five RSLs on the 'Working with Registered Social Landlords' pilot programme, a 12-month experiment to provide cycle parking facilities for tenants. BCC staff ideated the experiment based on an identified need for cycle parking at social housing estates (B17). The experiment was chosen to explore the influence of UK government funding through the Local Sustainable Transport Fund (LSTF) and a BCC-civil society partnership.

Sustrans was contracted to deliver the LSTF Active Neighbourhoods Grant Fund on behalf of BCC, with 'Community Active Travel Officers' (CATO) employed by Sustrans and seconded to work within BCC, to engage with seed-funded community initiatives on the ground (B17). The experiment involved the CATO approaching RSLs for partnership, discussing residents' cycle parking needs, organising consultation events, negotiating appropriate designs with suppliers and procuring for the installation of bespoke infrastructure. The experiment was thus marked by both *market* logics in the arrangement between BCC and Sustrans, and *network* logic based on personal relationships cultivated by the CATO with RSLs staff in working together in a flexible manner (B17). Approximately 267 secure bicycle parking places were provided in 35 locations across Bristol, and this infrastructure is still mostly in place (*stabilisation*). BCC provided 50% of the funding (through a small budget of £35,000) and the RSLs had to invest the remaining half. BCC had never worked with RSLs in

this way before, and thus the main aim of the pilot was to learn whether there was sufficient interest from RSLs and tenants, and whether RSLs were willing to match-fund cycle parking (B17). While the answer to both these questions was positive and the detailed evaluation report written up by the CATO pointed to new relationship of trust and mutual collaboration between BCC and RSLs and unmet demand from tenants (B17; BCC 2016f), the configuration was not embedded further.

According to a BCC interviewee, the experiment was seen as 'very positive' within the Council, but not institutionalised/scaled up because a lack of resources and limited financial viability (B20). Limited 'scalability' was linked to the configuration involving bespoke infrastructure tailored to individual housing estate typologies, and requiring BCC to pay for the salary of employees to engage with communities, in order to deliver the cycle parking (B20). The experiment had ended with the expiry of the LSTF funding and the fixed-term contracts of the Sustrans-employed CATOs – illustrating the challenges of BCC resorting to 'contracting out' to deal with a lack of external funding continuity (*organisational form)*. While BCC had been able to divert sizeable LSTF funding to focus on social exclusion and community grants, the next tranche of central government transport funding secured by BCC in 2017 (Access Fund) was considerably smaller, and with a more strongly enforced focus on access to employment and business engagement (B20). While the original Working with RSLs configuration, or a follow-up scheme, could arguably have been designed with a scalable funding model in mind, from 2017 onwards, any BCC activities relating to cycling and community engagement have increasingly been entirely externally funded due to continuing austerity cuts (B20). Despite being a successful instance of co-provision with the third sector and a network-logic partnership, this experiment illustrates how austerity politics limited BCC capacity to engage with and provide infrastructure for socially excluded groups, at the end of the study period.

Bristol experiment III: Street Pockets

Undertaken during the European Green Capital year , the Street Pockets experiment tested parklet-style public spaces on residential streets, where one or more parking spaces were converted into public seating and greenery, complemented with community art and paint-based treatment of the street surface to alert drivers and calm traffic (Sustrans 2016). The 'Pockets' were tested using a modular, moveable 'toolkit' of temporary materials called a 'Street Kit' (e.g. using brightly-painted car tyres), with a view to later converting them into permanent spaces – echoing 'tactical urbanism' principles (Lydon and Garcia 2015).

The experiment was chosen to explore the impact of municipal seed-funding for civil society on experiment outcomes, and to examine a partnership between BCC and Sustrans in-depth. The funding package awarded to BCC by the UK Department of Energy and Climate Change in support of the European Green Capital year allowed BCC to set up a Strategic Grants Fund under its own discretion, which awarded Sustrans with approximately £44,000 for the experiment (BCC 2014d): an example of BCC *governing by enabling*. All aspects and stages of the experiment were led by Sustrans, while BCC played a smaller, passive role in signing off on technical drawings for permanent street designs, taking on legal liability and risk management aspects (B11; B16). The partnership between Sustrans and BCC was thus characterised by a *hierarchical logic,* in the sense that it was based on formal, bureaucratic coordination (B11) and a grant funding agreement (Bristol 2015 Ltd 2016b), rather than informal collaboration.

Sustrans had already been developing its Street Kit system, after identifying the need for an approach that could enable communities to change aspects of their own streets, and the Strategic Grant Fund provided the perfect opportunity to test this (B11). 30 Bristol resident groups expressed interest, with 11 streets/groups chosen for experiments and five interventions made permanent (*stabilisation*) in 2015 (B11; Sustrans 2016). The experiment featured intensive community engagement by Sustrans, offering training, technical and financial support. Sustrans perceived the experiment as a great success, citing empowerment of local residents, increased

neighbourhood interactions and improved street environments as benefits – as well as significant unmet demand from other Bristol residents when the experiment finished (B11; Sustrans 2016). The European Green Capital Strategic Grant Fund award gave Sustrans an 'exceptional' space for creativity – the funding under BCC's discretion was highly flexible (B11).

Sustrans was keen to extend the Street Pockets programme and continue working with BCC after the grant funding ran out. The experiment was featured in Bristol's Method+ best practice dissemination module on 'liveable communities', i.e. showcased as part of the Green Capital year (Bristol 2015 Ltd 2015a). Yet there was no further embedding. The findings point to the limits to UK municipal governments supporting community-led public space experimentation under conditions of severe austerity politics. An interviewee from Sustrans cited limited funding as the key reason that the configuration was not upscaled, and noted that the BCC Highways team appeared overwhelmed by the unconventional materials and process, lacking staff time to engage, despite a generally positive working relationship (B11). An interviewee from BCC could not give a decisive reason for the lack of embedding, but stated that no formal evaluation or post-implementation monitoring of the Pockets had been undertaken by the Council (B16). The fact that in November 2018, this informant was the only BCC staff member who had been somewhat involved with the experiment, who was still working at BCC due to organisational restructuring, points to how the Green Capital year ended with a wave of further BCC cuts. Indeed, considering the dire financial state of municipal resources in early 2017, it is unsurprising if financial support or institutionalisation of many of the civil society initiatives funded through the Strategic Grants Fund during 2015 could not be sustained.

Street Pockets did spawn another experiment that supports this conclusion – one of the 'lead' local residents for one of the Pockets ideated and secured external funding for undertaking a modified experiment called 'Community Corners' in 2018 (*circulation, B16*). From BCC's perspective, the key data points of interest from the evaluation of this experiment (Davidson et al. 2019) were how resource-intensive implementation

this type of community-led intervention is for the Council, e.g. how much municipal resource needs to be spent on resident consultations to ensure there is no backlash (B16). A Sustrans interviewee argued that while for Sustrans, Street Pockets was about empowering communities, BCC was hesitant to raise people's expectations and create further demand for street redesigns they could not accommodate (B11).

To conclude, the Street Pockets experiment demonstrates that although BCC had consistently sought to govern by enabling civil society, by 2016 austerity had made the Council view operational expenditures on community engagement activities as untenable.

Case study: ICT4EVEU

The ICT4EVEU (ICT Services for Electric Vehicle Enhancing the User-Experience) project was funded by the European Commission's ICT Policy Support Programme. The experiment was chosen to explore the influence of EU funding, and a case where BCC pursued innovation on its own (no partnership). In-depth study revealed that the project involved collaboration between BCC and private company Charge Your Car, even if the latter was not named as a formal partner.

The focus of ICT4EVEU experiment was to develop the software element of the city-regional Source West electric vehicle (EV) charging network, whereas LSTF provided funding for the purchase and installation of charging point infrastructure. The core elements of the configuration tested in ICT4EVEU were the development of a back-office ICT system connecting different charging points, and a user engagement approach including a marketing campaign, smartphone app and Source West website (B09; ICTEVEU 2014).[175] Charge Your Car was tendered by BCC to deliver the back-office system and app (*market logic*). Because the ICT4EVEU funding was awarded

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[175] A so-called 'back-office' system (or General Management System) for EV charging networks connects different charging points into a network, by real-time communication between charge points and a central system regarding operations (e.g. payment, user profiles, charging point availability, maintenance).

solely to BCC, the Council essentially paid for and led the development of software aspects of Source West, on behalf of the other West of England authorities.

ICT4EVEU successfully delivered a functioning back-office system allowing the operation of the Source West network until 2019 (*stabilisation*; B09), and gradual expansion of charging points and user growth (Bartle et al. 2016). An interviewee argued that a key enabling factor was Charge Your Car's expertise, which allowed Source West to achieve interoperability between existing charging points in the West of England (B09). Because the development of the charging network had been 'market-led rather than government-led' (B09), charging points installed by different private manufacturers could not communicate via one system. Although the partnership between BCC and Charge Your Car was formally characterised by a *market logic*, in practice the collaboration was closer to a *network logic* with in-kind contributions, R&D tinkering and adaptation of existing company products to suit the Bristol context (B09).[176] This guaranteed success despite very rigid EU funding prescriptions of exactly what was to be tested within the experiment, over what timeframe and with a focus on technical ICT evaluation (*experiment scope, evaluation process, organisational form*), and the fact that the ICT4EVEU project could only afford one staff member due to BCC austerity cuts (B09). The experiment thus illustrates the strength of high-quality *network* collaboration between public and private sectors and supports the broader finding regarding EU funding bureaucracy.[177]

The ICT4EVEU experiment resulted in institutionalisation that paved the way to larger-scale transformative change. BCC, in partnership with other West of England authorities, secured a further £7.1 million from OLEV Go Ultra Low funding for an EV infrastructure programme called Go Ultra Low West (GULW). The software

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[176] Following the ICT4EVEU experiment, as part of the expansion of Source West, BCC relations with Charge Your Car shifted to a more regular *market logic* relationship (REPLICATE 2018).

[177] Charge Your Car was established as a commercial company following spin-out from research at Newcastle University (Hubner et al. 2013), with a BCC interviewee suggesting the public value-orientation associated with this background explained high degree of in-kind contributions provided by Charge Your Car (B09).

elements developed within ICT4EVEU were *scaled up* as part of the expansion of charging units within the Source West network (Spalding 2015).

An interviewee mentioned success in attracting further funding as a key outcome of ICT4EVEU (B09) and indeed the project is mentioned in the GULW funding application (BCC 2016e). With GULW, the concept of publicly-provided EV charging infrastructure was *institutionalised* within BCC,[178] as it moved from the 'projectised mode' of ICT4EVEU into being under the purview of the newly established BCC Energy Service department (B09). Under GULW, the West of England authorities launched a new EV charging network called 'Revive' in 2019, replacing Source West (BCC 2019d). There was very limited *circulation* of elements from Source West to Revive: the entire network model, back-office system and customer interfaces were re-tendered to new suppliers (B18). Only a minority of the charging units that had been installed were retained, and the remainder were being decommissioned in 2019, as they had turned out to not be fully interoperable and performed unreliably (B18). This illustrates the risk of stranded assets and sunk costs for the public sector, when experimenting with immature technologies where initial diffusion has been led by the private sector.[179] To mitigate against such risks in the future, BCC and the other local authorities decided to opt for municipal ownership and operations of the Revive network, i.e maintaining control over contracted private sector suppliers; an interviewee suggested this decision was in line with BCC's ambition in having set up its own waste and energy companies (B19). This trajectory of experimentation thus ended in BCC pivoting from co-provision with the private sector, to governing by provision in the form of 'EV municipalism'. While other experiments have suggested

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[178] For example, EV charging infrastructure is mentioned as a key area of action within the 2015 update of the Climate Change and Energy Security Framework (BCC 2015e).

[179] Interoperability of EV charging infrastructure is a key issue globally, including within the NYC ChargePoint America experiment (below). Industry standards such as Open Charge Point Protocol (OCPP) have been developed to ensure private manufacturers design charge units to be interoperable with different types of back-office systems, which was also discussed in the Bristol case (B09; B19), however monitoring and enforcing compliance is challenging.

that BCC capacity was depleted by austerity at the end of the study period, this trajectory simultaneously points to ambitious governance approaches beyond 2016.

NYC experiment I: Bx12 Select Bus Service

The experiment with the Select Bus Service configuration on the Bx12 bus route in the Bronx[180] was the first-ever introduction of a BRT-style package of elements in NYC. The experiment aimed to test how such a configuration could be implemented in practice, and what impact it would have on service performance and rider satisfaction, prior to wider roll-out (NY15; NY10). The intervention thus qualifies as an experiment, despite the fact that it was more of a *demonstration*, nested within the BRT Phase I demonstration *programme* that PlaNYC had already committed to, with this longer-term organising enabled by committed NYC city government (NY10) and MTA Capital Program funding (NY15).

The combination of elements involved in the SBS configuration necessitated partnership working between NYC DOT and NYCT. The Bx12 experiment was chosen for in-depth study to examine the influence of a partnership between a municipally-controlled and state-controlled agency, involving a related mix of state (MTA) and municipal (NYC) funding. The planning of the experiment was funded by NYCT, while implementation was largely funded by NYC city government funding tied to PlaNYC (Barr 2012), but also involved some internal MTA resources on the operational side (NY15). The Bx12 Select Bus Service began operating on 29 June 2008.

Bx12 was ranked as number two of the 15 corridors recommended by the NYCBRT planning study (McNamara et al. 2006), based on its high level of pre-existing ridership. Interviewees indicated that Bx12 was chosen as the first route to be

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[180] Prior to 2008, two Bx12 bus routes ran east-west through the Bronx along Fordham Road and Pelham Parkway: the Bx12 Local and Bx12 Limited. The Bx12 limited-stop service was converted into Select Bus Service, while the local service with more frequent stops was retained.

implemented among the five Phase I routes because of the existing kerbside bus lane and limited-stop service (NY15; Silverman et al. 1998), as well as the Bronx being seen as a good place to start – underserved in terms of transit improvements and thus likely to have a more receptive community (NY18). The Bx12 configuration had already been pre-determined by the NYCBRT study recommendations (McNamara et al. 2006), with elements including (Barr et al. 2010):

A. Speed and reliability elements:

- Dedicated kerbside bus lanes, red-painted

- Extra-large bus lane sign cantilevered over the bus lane

- Transit Signal Priority, with on-bus GPS communicating with traffic signal controller

- Off-board fare collection, using a 'proof of payment' system where riders pay at bus stops using one of two machines accepting MetroCards or coins

- Enhanced service pattern, through removal of some stops on the existing limited-stop service, and enhance scheduling frequency

- Timed windows for deliveries to businesses along the route

B. Comfort and convenience elements:

- Enhanced bus shelters, including improved customer information (non-real time)

- Branding on all vehicles and infrastructure

- On-board cameras, for security and fare evasion

C. Launch elements:

- Customer ambassadors, in NYCT and NYC DOT employees on site for a month

- Enforcement of fare collection and bus lanes (manual, by mobile units)

- Training of operational staff

The use of NYC city government operational funding (DOT budget) provided discretion with respect to implementation, enabling the NYC DOT and NYCT project team to operate with creativity and flexibility, which interviewees also indicated was a feature of the increasingly close collaboration between the agencies (NY10; NY15). This voluntary DOT-NYCT partnership and these informal relationships were clearly characterised by a *network* logic. The Bx12 experiment was implemented quickly (within 1 year) and at low-cost cost; approximately $10 million across both partners (Barr et al. 2010). Implementation was undertaken using existing NYC DOT and NYCT materials wherever possible, and avoided a capital construction process (NY10). DOT employees have highlighted this style of quick-build implementation as a positive distinguishing feature of the Bx12 demonstration project (Sadik-Khan and Solomonow 2016; Barr et al. 2010), with some commentators pointing to it as an example of 'tactical transit' corresponding to the 'tactical urbanism' implementation approach more commonly referred to in relation to NYC DOT public plazas and street redesigns (TransitCenter 2016b).

While the general elements of the SBS configuration were pre-determined, the specific Bx12 configuration involved several new elements, as a result of practical challenges that had to be solved. One aspect was making the kerbside bus lane more visible than existing lanes of this type, so the Bx12 SBS route was included within a NYC DOT trial programme for the use of terracotta-coloured paint *(circulation),* which had been launched in 2007 (NYCDOT 2007c) as an officially approved experiment by the FWHA[181] (Barr et al. 2010). Another challenge was how the off-board payment system would be delivered in practice. Bus riders needed to be able to pay on-street to obtain a 'proof of payment', and as NYC buses accept both coins and Metrocard, the MTA needed to replicate both of those payment systems at bus stops. While it was easy to reprogram Metrocard machines typically used in subway stations, the MTA did not

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[181] Under the federal regulation *Manual for Uniform Traffic Control Devices* (MUTCD).

have access to a machine that accepted coins. DOT employees had access to parking meters that accepted coins and printed receipts, and handed these over for NYCT to repurpose (NY10). This system worked well, and as SBS expanded, NYCT retained Parkeon as a supplier for the meters (NY15). Interviewees highlighted this as an example of the resourceful spirit of the expriment (NY10; NY15). Considering the number of elements that had to delivered as part of Bx12 that were new to the city, the *network logic* between NYC DOT and MTA was crucial to the success of the experiment.

The SBS upgrade to the Bx12 route was made permanent (*stabilisation*), and expanded eastwards along Pelham Parkway (*scaling up*). Data collection was important to Bx12 as a demonstration. Barr et al. (2010) detail that from the Bx12 launch (October 2007) to evaluation (October 2008):

- average weekday ridership increased by 11.4%, in contrast to flat ridership elsewhere in the Bronx and declining ridership city-wide;

- overall travel times decreased significantly across the corridor;

- fare evasion did not increase;

- a pre- and post-implementation survey found that 98% of SBS customers were satisified or very satisfied with the service.

However, it is clear that expansion of SBS did not hinge on these formal evaluation data. First, interviewees highlighted that customer satisfaction was the key piece of data on the basis of which Bx12 was judged a success (NY15), but this involved manual data collection of staff surveying customers on board buses, and was thus shaped by municipal planners' experiences of 'seeing' people using the service and talking to them (NY10). Second, interview data indicated that it was the general effect of demonstrating that the SBS configuration could 'work' in the NYC context, that was crucial for embedding: "*the key was… showing that the sky doesn't fall in*" (NY18).

Because the Bx12 experiment was part of a five-year programme, once success had been demonstrated, the team immediately moved on to the next four demonstrations identified in the NYCBRT study (NY15). The next route that was relaunched as SBS was the M15 along First and Second Avenue in Manhattan (Beaton et al. 2012; NYCDOT and NYCT 2011). Two lessons had been learned from Bx12, however: that kerbside bus lanes did not work well, as they had to accommodate deliveries, and that the red bus lane paint was wearing quicker than expected, thus posing a maintenance issue (Beaton et al. 2012; NY10). M15 SBS thus featured bus lanes offset from the kerb, as well as some other new elements not included in Bx12 (*circulation*). In terms of *institutionalisation*, the success of the Bx12 experiment had a number of decisive long-term impacts:

- for the first time, it extended 'quick-build' as an approach to bus experimentation within NYC DOT, from earlier cycling and public space applications;

- it institutionalised the core BRT elements in the SBS configuration within NYC DOT and NYCT, as a 'toolkit' with proven results;

- and it launched the planning of BRT Phase II *as soon as* Bx12 had been launched and demonstrated success (Barr et al. 2010; NYCDOT and NYCT 2009).

Despite the mix of city and state government agencies and funding, in-depth study revealed a notable lack of state-city politics, in the sense that the partnership between NYCT and NYC DOT was central to the success of the experiment, rather than posing constraints. An interviewee argued that the partnership between NYC DOT and the NYCT Long-term Bus Planning Division has been an 'island' of innovation within NYCT as an agency otherwise relatively marked by institutional inertia (NY17). As the wider MTA and NYCT in itself as an agency are very large organisations, NYCT staff evidently still had some space to collaborate with city government and improve bus services in NYC.

NYC experiment II: Ninth Avenue Bike Lane

After the pedestrianisation of Times Square, the experiment with a fully-segregated cycle lane along Manhattan's Ninth Avenue is perhaps one of the most widely-cited NYC DOT experiments (NACTO 2021). The implementing DOT staff cite this as "the first urban on-street parking- and signal-protected bicycle facility in the United States" (Russo et al. 2009, p.1), and one of the first protected cycle lanes in NYC.182 The experiment with a protected cycle lane along Ninth Avenue was for the stretch between 16th and 23rd Street, implemented in 2007. This experiment was chosen to explore a case with no municipal partnership, i.e. NYC DOT acting alone, and the use of federal grant funding. However closer study revealed that although the planning of the experiment was funded through CMAQ grants secured for Bicycle Network Development, the 2007 experiment was *implemented* using NYC DOT operational funds.

Following the PlaNYC commitment to expansion of cycling infrastructure, NYC DOT was tasked with figuring out how to make this happen and what kind of cycle lanes would be built. One aspect was figuring out how to deal with the redesign of Manhattan's broad avenues, three of which were marked as priority routes in the Bicycle Master Plan (8th, 1st and 2nd Avenue), to improve a holistic redesign of the street environment for both pedestrians and cyclists. From the outset, the experiment was planned to test a scalable 'Complete Streets' treatment for the city's avenues, not as a bespoke design for Ninth Avenue alone (NY08). A civil society vision for the redesign of Ninth Avenue – in addition to the ongoing redesign of Gansevoort Plaza at the bottom of the Avenue – had already been developed with support from the NYC Streets Renaissance Campaign, presenting a cycle lane segregated by a planted median from a parking lane as one of the possible design options, and recommending a series of quick-delivery experiments as an implementation method (CHEKPEDS 2007; Donovan 2007). In relation to the fact that the Ninth Avenue experiment tested

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[182] Class 1 cycle paths in NYC had historically been off-street 'Greenways', rather than on-street lanes. A few protected cycle lanes had been implemented a few years prior to Ninth Avenue, e.g. at Tillary Street, with DOT citing this as a reference point in its consultation on 9th Avenue, with some *circulation* (NYC DOT 2007a).

NYC's first parking-protected cycle lane, a DOT interviewee cited long-standing advocacy by NYC cycling groups for this (NY08), and the popularity of such a design in European cities including Copenhagen. Sadik-Khan had travelled to Copenhagen with a NYC DOT team and liked the parking-protected cycle lanes she saw (Waters 2018), influenced by Jan Gehl (NY08), which created leadership at the top of the agency (NY06). In other words, the ideas, public interest and political capital were already in place - in a lot of ways, Ninth Avenue was chosen as a pilot location because it was low-hanging fruit (NY08).

However, it was the work of the DOT Bike and Pedestrian Projects group in assembling a technical design and implementation processthat enabled a configuration found to 'work'. The DOT team reviewed design typologies used internationally, but found none suitable for Ninth Avenue, and thus "developed an entirely new design" (Russo et al. 2009, p.2). DOT has emphasised that Ninth Avenue was about 'Thinking (and Building) Outside the MUTCD/AASHTO Box', in reference to developing a design beyond limited federal guidelines for cycling infrastructure (Benson 2008). The first innovative element was the parking protection, with a cycle lane at the kerb, a median buffer and 'floating' parking thereafter adjacent to the vehicle lane. This was entirely new to American cities – at the time, AASHTO guidance explicitly instructed that "bike lanes should never be placed between the parking lane and curb lane" due to issues with visibility and turning vehicles (Benson 2008, p.15). The second innovative element was the use of bicycle-exclusive traffic signals, to protect cyclists as intersections.

The second crucial feature was the use of quick-build approach through NYC operational funds and temporary materials. An interviewee described how the DOT Bike and Pedestrian Projects group purposedly using 'federal dollars' and capital construction, as the bureaucracy associated with both would have slowed down implementation, and instead the approach was to implement things using immediately available in-house resources, pending further funding (NY08; see also Russo et al. 2009 on avoiding capital construction). The use of NYC operational funds also

circumvented the need for review of the Ninth Avenue design configuration by New York State officials (as part of NYMTC federal funding allocation): state-level review is required for federally-funded projects classed as capital construction, but because of the use of NYC DOT operational funds for Ninth Avenue, this was exempt (Fried 2013b). The quick-build approach thus enabled DOT to tentatively test an innovative protected cycle lane on Ninth Avenue, rather than go through a review process for a permanent design, where compliance with federal MUTCD and AASHTO standards would also have been considered. In other words, by using NYC operational resources, there was no 'conditioning' of *experiment scope* or the specific configuration by external funding.

In its entirety, Ninth Avenue was reduced from four to three lanes (plus turn lanes) and the pedestrian crossing distance significantly reduced. The basic elements of a parking-protected lane was implemented in a first phase (striping and flexi-bollards), bicycle signals and 'operational' pedestrian islands (concrete but different from the design used in capital construction) then added in a second phase, costing more and for which dedicated PlaNYC funds were an important enabling factor (NY06).

At this early stage of NYC cycling infrastructure expansion, there were no sophisticated before-and-after analysis processes in place, and thus the decision to make the initial stretch of the Ninth Avenue cycle lane permanent (*stabilisation*) was based on the demonstrated ability of the configuration to 'work' (e.g. bicycle-exlusive traffic signals), and seeing people, including children, using the lane (NY06). 9 months after implementation of the experiment, weekday cyclist numbers had increased by 40%, judged by NYC DOT staff as a 'success worth replicating' (Benson 2008).

The Ninth Avenue cycle lane configuration was *institutionalised* within the NYC DOT Street Design Manual as a Class 1 lane (NYC DOT 2009e). The cycle lane was then extended from 23rd Street to 33rd Street in 2008 (using federal Transportation Enhancement funding) and then further uptown along Ninth Avenue from 33rd Street to 59th St in 2012 (*scaling up*). These two extension phases used a slightly different configuration, in that instead of having signal protection for cyclists at every

intersection, DOT included 'mixing zones' with less physical protection at some intersections (NY08).[183] Both configurations (signal protection and mixing zones) were scaled up for cycle lanes along Eight Avenue from 2009 onwards, and for 1st and 2nd Avenue from 2010 (Mead n.d.).

It is fair to say that the Ninth Avenue experiment provided the 'seed' for the city-wide expansion of the cycling network, in demonstrating the feasibility and benefits of the parking-protected design. The Ninth Avenue experiments represents, among all the experiments studied in-depth, the purest illustration of the quick-build experimentation process that NYC DOT is renowned for, in the sense of municipal resourcefulness in drawing on readily-available resources. NYC DOT acted alone rather than depending on partners, and had the municipal capacity to undertake a radically novel experiment – DOT controlled the street, and had the operational funding and processes to transform it. Ninth Avenue illustrates how innovative ideas often originate 'elsewhere' (e.g. Copenhagen) or outside the public sector (civil society vision for Ninth Avenue), but also how municipal bureaucrats played a crucial role in assembling the resources and processes to successfully reconfigure infrastructure.

NYC experiment III: Diversity Plaza

Diversity Plaza is a public space located in the lower-income neighbourhood of Jackson Heights, Queens. The plaza was chosen for in-depth study becausr it was one of the first experimental locations for the Neighbourhood Plaza Partnership (NPP), a

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[183] Inspired by Ninth Avenue, an experiment with a parking-protected cycle lane on narrower cross-town Grand Street was implemented in 2008 (*circulation*), integrating the mixing zone element (NYCDOT 2008b). This configuration became institutionalised within NYC DOT (as what would later be codified another type of Class 1 lane) and the mixing zone element then *circulated* 'back' into the expansion phase of the Ninth Avenue cycle lane. This nuance of a modified design (rather than scaling up the original signal protection) is important because DOT staff highlighted that although cyclist compliance at the exclusive bicycle lights had been poor, one of the key reason for introducing mixing zones was that it allowed street redesigns to maintain somewhat better traffic flow for turning vehicles and be implemented with less loss of parking spaces (NY08).

new type of partnership model developed by The Horticultural Society of New York and NYC DOT. NPP represents a municipal-civil society partnership, with a mix of city and philanthropic funding.

The Jackson Heights neighbourhood was marked by NYC DOT as a place of significant congestion and safety issues, with a large-scale technical study recommending a stretch of 37th Road (Queens) between two parallel streets for closure to traffic, which in 2011 created a new car-free space referred to as '37th Road Plaza' (NYC DOT 2012c). The space was then incorporated into the NYC DOT Plaza Program and converted into a plaza using the temporary DOT toolkit. Business owners around the new plaza were concerned about dwindling custom as a result of the loss of parking spaces, and littering issues (Maslin Nir 2012). Local resident groups felt that the plaza was being 'dumped' on the neighbourhood without much care for how it would fare (NY12). The local NYC City Councilmember Daniel Dromm threw his political weight behind the plaza, paying for cleaning services out of personal discretionary funds and organising businesses and residents to figure out a future plan (NY02; NY12).

In a complete turnaround of the local mood, the plaza was christened Diversity Plaza in 2012 and two groups formed in support, Sukhi New York representing a local internet café owner who became the plaza maintenance partner, and Friends of Diversity Plaza as a coalition of local citizens. Since then, the plaza has become an widely celebrated public place, with a vibrant range of programmed and spontaneous community gatherings, cultural events, and political protests drawing together the neighbourhood's significant Pakistani, Indian, Nepali and Bangladeshi populations. Mayor Bill de Blasio broke ground for the permanent capital reconstruction that finished in 2017 (*stabilisation)*, and Diversity Plaza was named one of 100 Reasons to Celebrate America in TIME Magazine (Pesantez 2017). In this sense, the plaza has demonstrated, arguably more than any other in NYC, what a powerful role a new open space can play for communities (NY02) in a dense city largely lacking in them (Gehl Studio 2015).

Beyond this, Diversity Plaza also evolved into a configuration novel within NYC, in becoming one of the pilot locations for the Neighbourhood Plaza Partnership, which interviewees cite as a (governance) experiment in itself (NY16). As the background work on NPP and debates around Diversity Plaza evolved simultaneously during 2012, the emerged as a case-in-point location where the local organisations were in need of support, to be able to maintain the plaza. NPP was created in response to challenges demonstrated in Jackson Heights and other low-income neighbourhoods. The work took off when the NPP team within the Horticultural Society managed to secure a $800.000 donation from the JP Morgan Chase Foundation for subsidised ACE maintenance services to support plazas in four Queens neighbourhoods (Miller 2013b). This philanthropic funding allowed NPP staff to support Friends of Diversity Plaza and Sukhi New York with technical and organisational assistance. The funding was also flexible enough for NYC DOT and NPP staff to work together in exploratory *network* collaboration, to explore new ways of funding and maintaining plazas (NY16), which extended to the informally negotiated nature of relations with local Diversity Plaza groups.

However, the Chase funding was only for two years, and it became clear to NPP staff that city government funding would be necessary to sustain the initiative – indeed, securing public money for low-income plaza partners had been an objective of NPP from the outset (NY16). NPP and NYC DOT staff thus lobbied senior NYC decision-makers for plazas to be included in the DOT funding ask feeding into the development of de Blasio's OneNYC strategy (NY16, NY02). Since none of the NPP plaza partners had the capacity to form a separate agreement with DOT that would allow them to generate revenue from commercial concessions (Miller 2015b; Urban Omnibus 2015), NPP staff argued for dedicated support.

With the support of DOT Commissioner Trottenberg (NY02), NPP and DOT succeeded in pushing for the establishment of the OneNYC Plaza Equity Program in 2015. The OneNYC Program has since then provided, for the first time, city funding for plaza maintenance to plaza partners in low-income communities who are ranked

by DOT to be most in need of assistance. NPP essentially morphed into the OneNYC Program (NY16). From starting as a *network* partnership between the Horticultural Society and NYC DOT, today NPP refers to services provided by the Horticultural Society for 14 plazas city-wide that are contractually procured by NYC DOT using Plaza Equity Program funds.

Diversity Plaza is an instance of remarkably effective civil society mobilisation in creating new institutions within city government. Friends of Diversity Plaza as an advocacy coalition organised community programming to demonstrate the value of the plaza as a democratic and intercultural space, while also targeting NYC political figures and the City Council with powerful messages about plaza inequity and the need for financial support from the city for partners in low-income neighbourhoods (NY12; NY16). Friends of Diversity Plaza thus played no small role in achieving the win that was the OneNYC Plaza Equity Program. Considering the broader backdrop of the privatisation of public space maintenance in NYC, in *institutionalising* the norm of plaza equity and special support for community organisations – rather than BIDs –NPP and the Friends of Diversity Plaza can thus be credited with a rather historic 'win'. According to NYC DOT, the Public Space Unit now has a staff member in charge of Plaza Outreach, who spends significant time on support Diversity Plaza, among others (NY02).

Although (purposedly) not chosen as an in-depth case study, an account of experimentation with street space along Manhattan's Broadway is included below, because it is the most well-known mobility intervention within NYC during the last two decades.

Supplementary data: Pedestrianisation along New York's Broadway

The first experiment with reclaiming pedestrian space around Times Square was undertaken by NYC DOT in 2001, championed by the Times Square Alliance. The Alliance then partnered with the Design Trust for Public Space (2004), a local think

tank, to come up with further proposals resulting in a 2003 plan for the redesign of mobility at Times Square. The New York Streets Renaissance Campaign also set their eyes on Broadway, hosting a public exhibition in 2006 with proposals for the pedestrianisation, and Project for Public Spaces was then hired by the Alliance to do further groundwork in preparing the plan (PPS 2012). By 2006, Iris Weinshall as NYC DOT Commissioner had reluctantly approved the Alliance's plan, however, upon becoming Commissioner Janette Sadik-Khan significantly increased the ambition of the planned transformation by enlisting internationally renowned architect Jan Gehl to study public space quality along Broadway (Luberoff 2016).

Based on Gehl Architect's recommendations, in the summer of 2008 NYC DOT launched an experiment called 'Broadway Boulevard', where on a pilot basis, two out of four vehicle lanes were converted into a ribbon of new plazas and a continuous bicycle lane between Times Square and Herald Square – thus considerably scaling up the earlier expansion of pedestrian space in the early 2000s (NYCDOT 2009a). Simultaneously, NYC DOT also redesigned the intersection next to Madison Square Park, to create a large public plaza in front of the Flatiron building (made permanent, expanded and today called the 'Flatiron Plazas').

Based on positive public reception of the Broadway Boulevard experiment, DOT designed a more formal pilot project that expanded the recently created pedestrian space significantly along a longer stretch of Broadway, entirely closing stretches of Broadway to traffic, with a somewhat modified design based on lessons learned from Broadway Boulevard (*circulation*, NY22). The experiment was named 'Green Light for Midtown' and officially authorised and launched in February 2009 by Mayor Bloomberg for a trial period of six months (see details in Appendix A). 74% of New Yorkers surveyed by the Times Square Alliance agreed that Times Square had improved dramatically (NYC DOT 2010a). Based on the evaluation results, in 2010 Mayor Bloomberg announced that the changes along Broadway would be made permanent. Green Light for Midtown quickly became one of the most widely discussed case studies of pedestrianisation in recent history.

The pedestrianisation of Broadway and Times Square is often discussed as a heroic municipal effort achieved 'virtually overnight' using 'guerrilla tactics'. The pedestrianisation of Broadway and Times Square illustrates the confidence and competence of Janette Sadik-Khan and her new core team at NYC DOT. Yet, the street space experiments of Madison Square, Broadway Boulevard, and Green Light for Midtown were all implemented using the same quick-build approach, materials toolkit and partnership approach already institutionalised within NYC DOT and used for Willoughby and Pearl Street plazas in 2006 and 2008. While new pedestrian plazas could not have been created at scale without NYC DOT, the attribution of Broadway's transformation to the leadership of municipal bureaucracy does not ring quite true, either. In many ways, it is also a case of the Times Square Alliance as a powerful BID ($14.6 million in revenues for Fiscal Year 2010), successfully pushing through the transformation of Times Square – with the help of the NYC Streets Renaissance Campaign – and the surrounding area to achieve a commercially-friendly pedestrian environment, indeed even publishing its own evaluation after Green Light for Midtown (Times Square Alliance 2010). In many ways, the pedestrianisation of Broadway thus illustrates the extent to which BIDs have risen to become powerful actors in governing NYCs's public realm.

Furthermore, as iconic as the Broadway experimentation is, it was always driven by the specific challenges of that area of the city, rather than a vision or experimentation with city-wide upscaling in mind. Although reclaiming the centre of a city from cars certainly often triggers a shift in the public conversation around mobility, such projects often remain relatively isolated – even if iconic – in themselves. In other words, they don't necessarily trigger a city-wide reconfiguration of street space.

NYC experiment IV: the ChargePoint America project

On the 14th of July 2010, Mayor Bloomberg cut the ribbon on the first public EV charging station in NYC (City of New York 2010b). The launch took place at Edison

ParkFast on Manhattan's Ninth Avenue, a privately-operated, publicly accessible pay-for-parking facility. This piece of charging infrastructure had been funded under the ChargePoint America, a 3-year project involving a $15 million federal investment coordinated by the US Department of Energy under the ARRA stimulus effort. The primary objective of ChargePoint America was to create jobs through stimulating EV-related industries; auto manufacturers Ford, smart USA and Chevrolet were partners. Federal grant funding had been awarded to Coloumb Technologies, a domestic EV charging network provider, to deliver 5000 charging points in nine US metropolitan regions including the NYC city-region.[184] The charging point at Edison ParkFast was the first of 196 publicly accessible points installed in by the end of the project in 2013. ChargePoint America, in combination with another federal programme called the EV Project, were referred to as the "largest PEV (plug-in electric vehicle) demonstration in the world", with the purpose to not only install charging infrastructure but "to build a living laboratory to study its use" (Idaho National Laboratory 2016, p.1). The charging stations installed in the NYC city-region were experimental in the sense that they sought to test a novel configuration within the NYC context - even if less easily reversible.

The ChargePoint America experiment was studied in-depth to explore the influence of federal government funding and a public-private partnership between the NYC city government and Coloumb Technologies. Since Bloomberg launched the first charging point at Edison ParkFast, this pointed to municipal involvement. However, interviews revealed that NYC city government's role was minor, e.g. did not contribute financially to the experiment, and Coloumb worked directly with private companies operating parking garages to install charging points, leveraging federal funds (NY23). There was thus no contractual relationship between NYC city government and Coloumb, however Coloumb did informally collaborate with the NYC Office for Long-term Planning and Sustainability in the spirit of a *network logic*. For example, Coloumb Technologies advised the NYC Office for Long-term Planning and Sustainability on

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[184] The final infrastructure installed included residential, private non-residential and publicly accessible charging points, this case study discussed publicly accessible charging points only.

how to develop their EV policy (NY23) and NYC Office organised a symposium for private garage owners to encourage them to take advantage of the ChargePoint America funding (NY07).

In terms of the experiment's *scope*, the configuration was pre-established to some extent in the federal selection of Coloumb Technologies as a partner, with the EV charging infrastructure deployed consisting of the mature charging network product developed by Coloumb, including AC Level 2 charging stations, a back-office system, payment system with RFID smartcard readers, etc. The task of Coloumb was to identify partner organisations in NYC who owned publicly-accessible parking facilities and would be interested to leverage federal funds for a charging station, while being willing to pay for installation costs (NY23).

The federal funding thus left partners and different infrastructure use cases up to the discretion of Coloumb. NYC is unique among US cities in its density, real estate market and constrained parking supply, and NYC city government had decided against municipal investment in publicly-accessible EV charging points. Thus Coloumb had to find private partners operating parking facilities in the city. The fact that Coloumb could freely work with different types of private facilities in NYC with ChargePoint America funding provided for a productive R&D process, generating a lot of valuable data for Coloumb and acted as a 'kickstart' to its rise as one of the US leaders in EV charging market share today (NY23).[185] At a formal level, the federally-mandated project evaluation focused on comparing charging rates at publicly-available station with private and residential types across the tri-state New York metropolitan area (NY23). This part of the *evaluation process* was thus not context-specific in relation to NYC, and subsequent NYC city government policy documents do not refer to the experiment outcomes.

While the first public charging station at Edison ParkFast was still in place in 2020, it is unclear how many other stations are in place a decade or so later (unknown

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[185] Prior to ChargePoint America, Coloumb Technologies operated approximately 400 charging stations across the US. In 2019, the renamed company ChargePoint Inc. operated approximately 90,000 stations (NY23).

stabilisation). By 2016, the number of ChargePoint-operated charging points in private NYC garages totalled 260 (NYCDOT 2016c), thus suggesting relatively limited *scaling up* of the experiment by approximately 60 stations. Other public EV charging points of different specifications have since been installed city-wide by other private network providers in private garages,[186] however, there is no indication that these were connected to ChargePoint America (no *circulation*). Indeed, interviewees indicated that irrespectively of ChargePoint America, around 2011 there were several other private charging point providers who quickly moved to deploy infrastructure in NYC (NY07). A clear outcome of the experiment was *institutionalisation* of EV charging provision in private garages through the enactment of Local Law 130 of 2013 by the NYC City Council, which amended the NYC Building Code to require new and to-be-reconstructed parking garages and open parking lots to establish sufficient electrical supply infrastructure to enable at least 20% of the parking spaces to have EV charging points installed (City of New York 2013b). The extrapolation of this was that up to 10,000 new EV parking spaces could be provided over seven years starting from 2013, and because Mayor Bloomberg quoted this figure, it was widely reported in local media as a city government target (City of New York 2013f). In the long-run, however, private garages were not found to be optimal 'anchor tenants' by EV charging providers within NYC (NY07).

ChargePoint America represents a unique instance, within the broader NYC case study, of strong federal intentionality with respect to funding mobility innovation, in this case a technology push in relation to EVs. The project generated an extraordinary degree of learning and value for Coloumb Technologies as a private company.[187] However, the project's living laboratory aspect treated NYC largely as a passive testing ground for technology development, rather than a learning process tailored to or focused on the local context. While the network logic between Coloumb Technologies/ChargePoint Inc. and NYC city government continued beyond

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[186] Providers include Blink, GE WattStation, Greenlots, EVgo, EVConnect, Tesla Destination.

[187] A US Department of Energy (US DOE 2012) press release remarks that: "the success of the ChargePoint America Program has enabled the... California-company to raise more than $50 million in investment from the private sector and grow from 16 ChargePoint employees in June 2009 to more than 150 employees today".

ChargePoint America, with the company providing regular data input into the NYC EV policy process for a few years,[188] this collaboration did not morph into NYC city government becoming a key client for ChargePoint.

Beyond 2016, NYC city government pivoted to governing EV charging by more active co-provision. Local Law 160/16 mandated NYC DOT to implement a public EV charging station "pilot program" and for city government to commit municipal funds to on-street charging. This evolved into DOT-led experiments announced in 2017, testing on-street kerbside Level 2 and rapid charging stations city-wide.

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[188] For example, ChargePoint data cited in NYC Electric Advisory Committee reports of 2015 and 2016.

APPENDIX C: DOCUMENTS ANALYSED FOR CONSTRUCTION OF LARGE-N DATABASES

The tables below present the municipal documents analysed to construct the large-N databases of experiments undertaken in Bristol and NYC (section 3.4.2). The type of documents varied slightly between cases, reflecting their unique governance landscapes. For both Bristol and NYC, strategic policy strategies, progress reports and relevant topic-specific studies were analysed. For the Bristol case, documents related to major externally-funded grants was also analysed, as the reliance of Bristol City Council on such funding means that these are notable documents in terms of local mobility governance. For the NYC case, I analysed MTA investment plans, to identify possible busmobility experiments.

Table C.1. Documents analysed to construct the Bristol large-N database.

Type of document	Title	Reference
Policy strategies and progress reports	Bristol Local Transport Plan 2001/2-2005/6	BCC (2000)
	Final Joint Local Transport Plan 2006-2010	West of England Partnership (2006a)
	Joint Local Transport Plan – Joint Delivery Report (July 2006)	West of England Partnership (2006b)
	Joint Local Transport Plan 2006/07-2010/11 Five Year Progress Review	Travelwest (2011a)
	Joint Local Transport Plan 3 2011-2026	West of England Partnership (2011)
	Joint Local Transport Plan 3 – Progress Report 2011/12	Travelwest (2012)
	Joint Local Transport Plan 3. 2013 refresh and supplementary documents	Travelwest (2013b)

	Joint Local Transport Plan 3 – Progress Report 2012/13	Travelwest (2013a)
	Joint Local Transport Plan 3 – Progress Report 2013/14	Travelwest (2014b)
	Joint Local Transport Plan 3 – Progress Report 2014/15	Travelwest (2015)
	Joint Local Transport Plan 3 – Progress Report 2015/16	Travelwest (2016)
	Bristol Cycle Strategy	BCC (2015c)
	Our Resilient Future: A Framework for Climate Change and Energy Security	BCC (2015e)
	Bristol Resilience Strategy	BCC (2016b)
Applications for external funding	Local Sustainable Transport Fund application – West of England Sustainable Travel (WEST)	Travelwest (2011b)
	West of England Sustainable Travel (WEST) – List of Appendices: Strategic Case	Travelwest (2011c)
	Local Sustainable Transport Fund 15/16 Revenue Application Form (Travel WEST)	Travelwest (2014b)
Project/programme delivery plans and progress/evaluation reports	CIVITAS VIVALDI: Final Publishable Report	VIVALDI (2006)
	CIVITAS VIVALDI: Evaluation Results Report (Volume 1 of 3)	VIVALDI (2005)
	Greater Bristol Cycling City: The Delivery Strategy (2008-2011)	BCC (2008)
	Greater Bristol Cycling City End of Project Report	BCC (BCC 2011b)
	The Greater Bristol Bus Network Showcase routes: Summary June 2014	Travelwest (2014a)
Documents relating to Bristol's	Bristol European Green Capital 2015 Citywide review	Bristol 2015 Ltd (2016a)

European Green Capital year	Bristol Method+: 'How to get more people riding bikes and walking'	Bristol 2015 Ltd (2015b)
Including the Bristol Method+ series of reports, showcasing mobility policy innovations implemented in Bristol.	Bristol Method+: 'How to increase public transport use'	Clayton (2015)
	Bristol Method+: 'How to create liveable communities'	Bristol 2015 Ltd (2015a)
	Bristol Method+: 'How to reduce traffic and its impacts'	Barnes et al. (2015)

Table C.2. Documents analysed to construct the NYC large-N database.

Type of document	Title	Reference
Policy strategies and progress reports	Mayor's Management Report: Fiscal 1997 Preliminary Summary Volume	City of New York (1997b)
	Mayor's Management Report: Fiscal 1998 Preliminary Summary	City of New York (1998)
	Mayor's Management Report: Fiscal 1999 Summary Volume	City of New York (1999)
	Mayor's Management Report: Fiscal 2000 Summary Volume	City of New York (2000)
	Mayor's Management Report: Fiscal 2001. Volume I - Agency Narratives.	City of New York (2001a)
	Reengineering Municipal Services 1994-2001. Mayor's Management Report Fiscal 2001 Supplement	City of New York (2001b)
	Mayor's Management Report: Preliminary Fiscal 2002. Volume I - Agency Narratives	City of New York (2002)
	Mayor's Management Report: Fiscal 2003 Preliminary	City of New York (2003a)
	Mayor's Management Report: Fiscal 2004 Preliminary	City of New York (2004a)
	Mayor's Management Report: Fiscal 2005 Preliminary	City of New York (2005a)
	Mayor's Management Report: Fiscal 2006	City of New York (2006a)
	Mayor's Management Report: Fiscal 2007	City of New York (2007a)
	Safe Streets NYC: Traffic Safety Improvements in New York City 2005	NYCDOT (2005c)
	Safe Streets NYC: Traffic Safety Improvements in New York City 2006	NYCDOT (2006b)

	Safe Streets NYC: Traffic Safety Improvements in New York City 2007	NYCDOT (2007f)
	PlaNYC: A Greater, Greener New York	City of New York (2007c)
	PlaNYC Progress Report 2008	City of New York (2008b)
	Sustainable Streets: Strategic Plan for New York City Department of Transportation, 2008 and Beyond	NYCDOT (2008e)
	World Class Streets: Remaking New York City's Public Realm	NYCDOT (2008f)
	PlaNYC Progress Report 2009	City of New York (2009c)
	Sustainable Streets Progress Report 2009	NYC DOT (2009f)
	PlaNYC Progress Report 2010	City of New York (2010d)
	PlaNYC Update April 2011	City of New York (2011a)
	PlaNYC Progress Report 2012	City of New York (2012a)
	Sustainable Streets: 2013 and beyond	NYCDOT (2013c)
	PlaNYC Progress Report 2013	City of New York (2013d)
	PlaNYC Progress Report 2014	City of New York (2014a)
	Vision Zero Action Plan	City of New York (2014c)
	Vision Zero One Year Report	City of New York (2015d)
	One New York: The Plan for a Strong and Just City	City of New York (2015b)
	New York City's Roadmap to 80 x 50	City of New York (2016a)
	Vision Zero Two Year Report	City of New York (2016d)
	NYC DOT Strategic Plan 2016	NYCDOT (2016f)
Topical policy studies	World Cities, Best Practices: Innovations in Transportation	NYCDCP (2008b)
	The New York City Pedestrian Safety Study & Action Plan	NYCDOT (2010b)
	Exploring Electric Vehicle Adoption in New York City	City of New York (2010a)
Reports by special committees	Electric Vehicle Advisory Committee Report of Recommendations 2015	NYCDOT (2015a)
	Electric Vehicle Advisory Committee Report of Recommendations 2016	NYCDOT (2016c)
Public transport authority investment plans	MTA Preliminary Capital Program 2005-2009	MTA (2004)
	MTA Capital Program 2010-2014	MTA (2010)

APPENDIX D: LIST OF INTERVIEWEES

The tables below provide a full list of interviews conducted for the Bristol and NYC case study. The ID refers to the identifier used to cite the interview, within the thesis text. The level of detail indicated in the 'Organisation' and 'Affiliation/role' columns is based on each informant's preference regarding anonymity.

Table D.1. Interviews conducted for the Bristol case study.

ID	Date	Medium	Actor type	Organisation	Affiliation/role
B01	17.09.2018	Face-to-face	Academia	Confidential	Local researcher
B02	18.09.2018	Face-to-face	Civil society, Public sector	Bristol Cycling Campaign; Bristol City Council	Member; Former employee
B03	18.09.2018	Face-to-face	Public sector	Bristol City Council	Director, Transport department
B05	19.09.2018	Face-to-face	Public sector	Bristol City Council	Employee
B06	19.09.2018	Face-to-face	Civil society	Bristol Green Capital Partnership	Member of Sustainable Transport Network
B09	20.09.2018	Face-to-face	Public sector	Bristol City Council	Employee
B10	21.09.2018	Face-to-face	Public sector	Bristol City Council	Manager, Transport Department
B11	21.09.2018	Face-to-face	Civil society	Sustrans	Director
B12	27.09.2018	VOIP	Public sector	Bristol City Council	Former employee
B13	24.05.2019	Telephone	Academia	University of the West of England, Bristol	Researcher
B14	17.05.2019	Face-to-face	Academia	University of the West of England, Bristol	Researcher
B15	24.05.2019	Telephone	Private sector	First Bus	Former employee
B16	02.11.2018	Telephone	Public sector	Bristol City Council	Manager, Transport department
B17	17.10.2018	Face-to-face	Public sector	Bristol City Council; Sustrans	Former Officer
B18	09.08.2019	Telephone	Public sector	Bristol City Council	Manager, Energy Service
B19	17.10.2018	Face-to-face	Private sector	First Bus	Director
B20	29.08.2019	Telephone	Public sector	Bristol City Council	Employee, Transport Department

B21	15.01.2018	Face-to-face	Public sector	Bristol City Council	Former employee
B22	11.01.2018	Face-to-face	Public sector	Bristol City Council	Manager, City Innovation
B23	11.02.2018 20.09.2018	Face-to-face	Public sector	Bristol City Council	Former member, European Transport Team
B24	10.01.2018	Face-to-face	Private sector	GenECO	Manager
B25	10.01.2018	Face-to-face	Public sector	Bristol City Council	Officer, Transport Department
B26	09.01.2018	Face-to-face	Public sector	Bristol City Council	Former Director, City Innovation
B27	15.02.2018	Face-to-face	Public sector	Bristol City Council	Former political leader
B28	12.01.2018	Face-to-face	Public sector	West of England Combined Authority	Director
B29	09.02.2018	VOIP	Public sector	Bristol City Council	Former Manager, City Innovation

Table D.2. Interviews conducted for the NYC case study.

ID	Date	Medium	Actor type	Organisation	Affiliation/role
NY01	12.03.2019	Face-to-face	Public sector	NYC DOT	Former Manager, Public Space Unit
NY02	13.03.2019	Face-to-face	Public sector	NYC DOT	Manager, Public Space Unit
NY03	14.03.2019	Face-to-face	Public sector	NYC DOT	Former official
NY04	15.03.2019	Face-to-face	Public sector	NYC DOT	Former Director, Office for Strategy and Planning
NY05	15.03.2019	Face-to-face	Civil society	Project for Public Spaces	Director
NY06	15.03.2019	Telephone	Public sector	NYC DOT	Former employee, Pedestrian and Bike Projects group
NY07	18.03.2019	Face-to-face	Public sector	Mayor's Office for Long-term Planning and Sustainability	Former employee
NY08	19.03.2019	Face-to-face	Public sector	NYC DOT	Director, Pedestrian and Bike Projects Group

NY09	20.03.2019	Face-to-face	Civil society	Riders Alliance	Employee
NY10	21.03.2019	Face-to-face	Public sector	NYC DOT	Former Senior Director for Transit Development
NY11	22.03.2019	Face-to-face	Civil society	Transportation Alternatives	Former Director
NY12	22.03.2019	Face-to-face	Civil society	Friends of Diversity Plaza	Member
NY13	25.03.2019	Face-to-face	Local Expert / Public Sector	NYC DOT	Former Director
NY14	26.03.2019	Face-to-face	Public sector Private sector	Mayor's Office for Long-term Planning and Sustainability	Employeee
NY15	26.03.2019	Telephone	Public sector	MTA New York City Transit	Former Director
NY16	26.03.2019	Telephone	Civil society	Horticultural Society of New York	Former employee
NY17	27.03.2019	Face-to-face	Local expert / Civil society	TransitCenter	Employee
NY18	28.03.2019	Face-to-face	Public sector	NYC DOT	Former official
NY20	14.08.2019	VOIP	Public sector	NYC city government	Former employee
NY21	28.01.2019	Face-to-face	Public sector	NYC DOT	Former Senior Project Manager, Pedestrian Projects Group
NY22	08.01.2017	Face-to-face	Public sector	NYC DOT	Former planner, Pedestrian Projects Group
NY23	29.08.2019	Telephone	Private sector	Anonymous	Anonymous

APPENDIX E: INTERVIEW GUIDES

As discussed in section 3.5.2, three interview guides were used for three different types of informants. The guides below refer to 'pilot' as a term equivalent to experimentation; the term actually used during the interview depended on the intervention in question and the discourse used by the interviewee, including 'project', 'trial', 'experiment'.

Type 1: Embedded Experiment Informants

This guide was prepared for interviews focusing on the experiments chosen for in-depth study (n=8).

Background on informant

- Could you please state your full job title?

- How long have you worked for this organisation?

- What are the responsibilities of your current role?

Partnership & funding

- What team within your organisation was in charge of this pilot?

- I have read that the partners in this pilot were XYZ. Is that correct?

- I have read that the funding sources for this pilot were XYZ. Is that correct?

- What aspect of the pilot was each source of funding used for?

Planning stage

- Could you tell me a bit about how this pilot came about?

    o Probe: Why do you think this pilot was planned at that point in time?

- o Probe: What were the original motivations for implementing policies of this type?

- How was this pilot linked to the city's policy strategies at the time?

- What were the specific objectives of the pilot?

- What was this pilot designed to test?

  - o Why were elements XYZ tested in this specific pilot?

- Would you say this pilot was delivered as a project or part of a programme?

- Do you think the source(s) of funding influenced the planning and design of the pilot?

- Were there any particular constraints on the design of the pilot?

Implementation process

- Could you describe the implementation process briefly?

- Were there any challenges that arose?

- How did you work to overcome those challenges?

- Do you think the source(s) of funding influenced the implementation process?

Evaluation process

- What would you say were the key lessons from this pilot?

- Was there a specific evaluation process?

  - o Probe: Formal or informal/internal

- How would you say the source(s) of funding influenced the evaluation process?

- How were the lessons used within your organisation?

Outcomes

- Would you describe this experiment as a success?

- I read that the outcomes of this pilot were XYZ. Is this correct?

  - Probe: Are the outcomes of the pilot still visible in the city today?

  - Probe: Was this pilot linked to another pilot that happened later?

- This pilot was/was not scaled up to cover a greater area within the city, why/why not?

- Do you think this pilot influenced the city's transport policy?

  - Probe: what elements of the pilot? Technology/approach/partnership model

  - Probe: was this technology/policy mainstreamed?

- How would you describe the legacy of this pilot?

Funding

- How long was the funding for this pilot awarded for?

  - Probe: short-term or long-term

- How did your organisation manage to secure funding for this pilot? (for municipal government)

- How come funding was available for launching this pilot? (for municipal government)

- What were your financial contributions to this pilot? (for non-state partner)

  - Probe: up front or in-kind

- Without X type funding, do you think this pilot would have gone ahead?

  - Probe: what do you think this pilot would have looked like, without this funding?

- What do you think was the key factor that allowed for/stopped this pilot having a legacy?

Partnership

- Who would you describe as the lead partner in this pilot?

- How come organisations XYZ ended up working together on this pilot?

  - Probe: what motivated you to join this pilot as a partner?

- When you formed this partnership, was it formalised?

  - Probe: MoU, contract, or informal collaboration

- Could you tell me a bit about the roles played by the different partners, in the pilot?

  - Probe: planning, implementation, evaluation stage

- How would you describe the experience of working together?

- In terms of partnership working, what worked well and what was more challenging?

- How would you rate municipal government X's capacity for innovative transport policy?

    - Probe: track record, how would you say it has evolved?

- What is the future looking like for this policy area (represented by the pilot)?

Type 2: Municipal staff at the strategic level

This guide was prepared for interviews with municipal government staff, focusing on municipal institutions and resources (RQ2), and to a lesser extent these informants' perspectives on governance institutions (RQ3), at the strategic level of policy-making.

Background on informant

- Could you please state your full job title?

- How long have you worked for this organisation?

- What are the responsibilities of your current role?

Municipal institutions

- To what extent would you say municipal government has the freedom to determine its own transport policies?

    - Probe: what about the influence of higher levels of government?

- How is innovation organised currently within municipal government?

    - Probe: is there a specific team? new teams or departments over time?

- What is your approach to evaluating pilots or policy interventions in general?

- To what extent are your evaluation approaches affected by external funding processes?

- How would you describe the importance of small-scale pilots vs major infrastructure investments, for realising your policy objectives?

Funding

- How would you rank these funding sources in order of importance, for transport innovation undertaken by municipal government:

    o National government

    o State government (NYC)

    o European Union (Bristol)

    o Municipal revenues

    o Private sector contributions

- What have been the most important external funding programmes for enabling transport innovation in the last decade?

- Do you think there has been an increased reliance on short-term, project-based funding over time?

    o Probe: as opposed to core/longer-term funding

- What impact has austerity had on transport innovation pursued by municipal government?

- What are the challenges of the current funding landscape for transport innovation/policy area XYZ?

<u>Local governance</u>

- How would you rate the track record of local public transport operator X for innovation with respect to XYZ?

- What actors do you think have the responsibility to lead on innovation in relation to mobility type X?

- Who do you think should pay for innovation in relation to mobility type X?

- How does the city-regional context affect your efforts to move towards a sustainable transport system?

- How would you describe the relationship between municipal government and surrounding municipalities?

- Why was city-regional governance structure X established?

- To what extent does inward commuting from the city-region affect mode share/mobility flows in the city?

Type 3: Non-state actors

This guide was prepared for interviews with employees of non-state actors (civil society and private sector organisations), focusing on governance institutions, including the evolving relations of these actors with municipal government (RQ3) and their 'outsider' perspectives on municipal institutions (RQ3). Parts of this guide was also used for interviews with local experts and academic researchers.

<u>Background on informant</u>

- Could you please state your full job title?

- How long have you worked for this organisation?

- What are the responsibilities of your current role?

<u>Questions for all types of actors</u>

- How would you describe the role played by your organisation in relation to successful transport innovations introduced within city X, in the last decade?

- Could you tell me about how your (organisation's) relationship with municipal government has evolved over time?

    o Probe: what is your relationship like now?

- What are the main mechanisms or processes through which you interact with municipal government?

    o Probe: informal or formal

- How would you describe the track record of municipal government for being innovative in relation to mobility type X?

- Within the last decade, what actors within the city do you think have been leading on innovation in relation to mobility type X?

- What actors do you think have the responsibility to lead on innovation in relation to mobility type X?

- Who do you think should pay for innovation in relation to mobility type X?

- What do you think have been the key barriers to achieving an even larger shift away from private car use within the city?

- What additional policies do you think would be required to generate an even larger shift away from private car use within the city?

<u>Questions for public transport operators</u>

- How would you describe the key constraints on your capacity to innovate with respect to X?

APPENDIX F: CODEBOOK

Table F.1. Codebook used to analyse interview data.

RQ	Code family/theme	Code	Type
RQ1.1	Experiment outcome	Stabilisation	Deductive
RQ1.1	Experiment outcome	Scaling up	Deductive
RQ1.1	Experiment outcome	Circulation	Deductive
RQ1.1	Experiment outcome	Institutionalisation	Deductive
RQ1.1	Experiment outcome	City-wide upscaling	Deductive
RQ1.1	Experiment outcome	New policy institution	Deductive
RQ1.1	Experiment outcome	New governance institution	Deductive
RQ1.1	Experiment outcome	Mobility flows	Deductive
RQ1.1	Embedding	Technology issues	Inductive
RQ1.1	Embedding	Success, failure	Inductive
RQ1.1	Embedding	Obduracy	Inductive
RQ1.1	Embedding	Demonstration effect	Inductive
RQ1.1	Embedding	Cost barrier	Inductive
RQ1.1	Embedding	Causality	Inductive
RQ1.1	Embedding	Maintenance	Inductive
RQ1.2	Municipal institutions	Organisation structure	Deductive
RQ1.2	Municipal institutions	Evaluation processes	Deductive
RQ1.2	Municipal institutions	Experiment scope	Deductive
RQ1.2	Municipal institutions	Organisational form	Deductive
RQ1.2	Municipal institutions	Funding criteria	Inductive
RQ1.2	Policy mobility	Policy mobility	Inductive
RQ1.2	Municipal resources	Staff size	Deductive
RQ1.2	Municipal resources	Staff continuity	Deductive
RQ1.2	Municipal resources	Short-term funding	Deductive
RQ1.2	Municipal resources	Long-term funding	Deductive
RQ1.2	Municipal resources	Internal revenues	Deductive
RQ1.2	Municipal resources	External funding	Deductive
RQ1.2	Municipal resources	Philanthropic funding	Inductive
RQ1.2	Municipal resources	Low cost intervention	Inductive
RQ1.3	Governance institution	Network gov	Deductive
RQ1.3	Governance institution	Hierarchical gov	Deductive
RQ1.3	Governance institution	Market gov	Deductive
RQ1.3	Governance institution	Informal institutions	Deductive
RQ1.3	Governance institution	Partnership quality	Inductive
RQ1.3	Governance institution	PT gov structure	Inductive
RQ1.3	Governance institution	Civil society role	Inductive
RQ1.3	Governance institution	Public service	Inductive
RQ1.3	Leading innovation	Risk	Inductive
RQ1.3	Leading innovation	Reputation	Inductive
RQ1.3	Leading innovation	Paying for innovation	Inductive
RQ1.3	Leading innovation	Individual leadership	Inductive

RQ1.3	Leading innovation	Business model	Inductive
Primary RQ1	Intra-city politics	Electoral politics	Inductive
Primary RQ1	Intra-city politics	Public engagement	Inductive
Primary RQ1	Scalar relations	Municipal-regional	Deductive
Primary RQ1	Municipal autonomy	Fiscal autonomy	Deductive
Primary RQ1	Municipal autonomy	Functional powers	Deductive
Primary RQ1	Municipal autonomy	Policy autonomy	Deductive
Primary RQ1	Exogenous drivers	Projectification	Deductive
Primary RQ1	Exogenous drivers	Privatisation	Deductive
Primary RQ1	Exogenous drivers	Growth competitiveness	Deductive
Primary RQ1	Exogenous drivers	Gov rescaling	Deductive
Primary RQ1	Exogenous drivers	Austerity	Deductive
Primary RQ1	Exogenous drivers	Funding bureaucracy	Inductive
Primary RQ1	Exogenous drivers	Design guidelines	Inductive
Primary RQ1	Endogenous strategies	Policy vision	Deductive
Primary RQ1	Endogenous strategies	Revenue generation	Deductive
Primary RQ1	Endogenous strategies	Public-private partnership	Inductive
Primary RQ1	Endogenous strategies	Institutionalising exp	Inductive
Primary RQ1	Endogenous strategies	Municipalism	Inductive
Primary RQ1	Endogenous strategies	Branding	Inductive
Primary RQ1	Endogenous strategies	Bidding	Inductive
Primary RQ1	Endogenous strategies	Repurposing funding	Inductive
Primary RQ1	Endogenous strategies	Institutionalising exp	Inductive
Primary RQ1	Endogenous strategies	Municipalism	Inductive
Primary RQ1	Endogenous strategies	Branding	Inductive
Primary RQ1	Endogenous strategies	Regional cooperation	Inductive
Primary RQ1	Experimentation meta	Experimentation language	Inductive
Primary RQ1	Experimentation meta	Role/limits of experimentation	Inductive
Primary RQ1	Experimentation meta	Relative novelty	Inductive
Primary RQ2	Transition	Mode shift	Deductive
Primary RQ2	Transition	Future action needed	Inductive

APPENDIX G: SELECT BUS SERVICE DETAILS

Table G.1 and G.2 below present detail on how expansion of NYC's Select Bus Service was funded. Federal funding information in Table G.2 below was retrieved from analysis of sources indicated in section 3.5.3.

Although interviewees reported that competitive FTA grants generally had stricter requirements than other federal funding programmes (NY18; NY22), there is no evidence that these constrained the impacts of the SBS trajectory. Some FTA projects required environmental review under federal legislation, but most NYC projects were exempt.

Vincent (2010) argues that BRT-Lite has been prevalent because full BRT configurations have not been able to compete against rail projects for FTA New Starts funding, and the fact that the alternative FTA Small Starts funding programme offers a federal cost share of 80% for BRT projects capped at $250 million in total cost, resulting in an incentive to develop lower-cost BRT-Lite projects. This argument does not apply to NYC SBS, because: the Small Starts funding programme was only launched in 2007, after the initial BRT configuration had been developed by the NYCBRT study team; NYC city government had planned to fund BRT locally through SMART; and NYC DOT only received Small Starts funding for one SBS route.

Table G.1. MTA Capital Program allocations for Select Bus Service. Data source: MTA Capital Program Dashboard (http://web.mta.info/capitaldashboard/CPDPlan.html). Figures for expenditure by 12.03.2019, when 2015-2019 Capital Program allocations were still being spent.

MTA Capital Program	Item(s)	Original committed	Total expenditure
2005-2009	BRT Phase I Bx12, M15, B44	$21,984,300	$24,170,796
2010-2014	BRT Phase I M34, S79 Transit Signal Priority	$25,000,000	$30,427,233
2015-2019*	SBS Phase II (specific routes not named)	$24,000,000	$24,055,536
	Transit Signal Priority for SBS	$4,951,304	$4,015,166

Abbreviations for federal funding programmes

CMAQ = Congestion and Air Quality Mitigation Program (US Federal Highway Administration)

FTA Bus Livability = US Federal Transit Administration Bus and Bus Facilities Livability Initiative

FTA 5307 = FTA Section 5307 Urbanized Area Formula Grant Program, providing grants for public transport directly to urban beneficiaries (e.g. NYC DOT)

FTA 5310 = FTA Section 5310 Enhanced Mobility of Seniors and People with Disabilities

High Priority Projects = ear-marked special projects under federal transport Acts

FTA Small Starts = US Federal Transit Administration Small Starts Program (part of the Capital Investment Grants Program)

Table G.2. Federal funding used for Select Bus Service expansion.

Launch year	SBS route	NYC Borough	Federal funding
2008	Bx12 Fordham Road	The Bronx	None (Barr 2012)
2010	M15 First/Second Ave	Manhattan	CMAQ for TSP, bus bulbs (Barr 2012), technical study under DOT Citywide congested corridors programme
2011	M34 34th Street	Manhattan	FTA Bus Livability (Barr 2012)
2012	S79 Hylan Boulevard	Staten Island	FTA MISC; High Priority Projects
2013	B44 Nostrand Avenue	Brooklyn	CMAQ for citizen engagement; High Priority Projects; FTA Small Starts, approx. $28 million, 71% of total cost covered by federal grant (FTA 2010); FTA 5309 Bus Discretionary grant funding
2013	Bx41 Webster Avenue	The Bronx	CMAQ; FTA MISC
2014	M60 125th St-La Guardia	Queens-Manhattan	FTA 5539 Alternatives Analysis CMAQ; FTA MISC
2015	M86 86th St Crosstown	Manhattan	CMAQ; FTA MISC
2015	Q44 Bronx-Flushing Jamaica	Queens	Likely FTA 5307, since funding granted under this programme was marked for BRT
2016	B46 Utica Avenue	Brooklyn	CMAQ; FTA Bus Livability;

			FTA 5310
2016	M23 23rd St	Manhattan	Likely FTA 5307 (see above)
2016	Q70 Woodside-Jackson Heights	Queens	Likely FTA 5307 (see above)

APPENDIX H: 'LOCAL' POLITICS AS A FACTOR

A full account of inductive findings on 'local' politics as a factor influencing municipal capacity for transformative experimentation, summarised in section 7.5, are presented here. The analysis covers three dimensions: civil society advocacy, individual leadership, and the politics of public contestation.

Civil society advocacy

I found that the role of civil society in enabling transformative impacts from experimentation was much greater in NYC, than in Bristol. This influence was not limited to CSOs partnering with municipal government to implement specific experiments or receiving municipal seed-funding, but extended influence over municipal visions and municipal/governance institutions, more broadly.[189]

In Bristol, prior to 1996, there was a strong tradition of civil society activism in relation to cycling prior, which had successfully influenced municipal policy in the 1980s (section 4.3.4). However, by the early 1990s, cycling campaigners had become employed by BCC, and other campaigners saw less need for contestation with municipal government as they were now on the 'inside' (B02). The CSO Cyclebag had effectively died out and its successor Sustrans had transformed into a national organisation focused on infrastructure delivery (Aldred 2012). Sustrans was perceived locally to have lost its zeal:

> "Sustrans are intimately involved in Bristol, have been, will be… but… sits in an interesting role because Sustrans is seen by the local authorities as being… a stamp of quality for delivery. Sustrans is seen by cycle campaigners as hopelessly compromised sell-outs… just focused on delivering wherever they can around the margins of pavement cycling… they're the friendly face of the transport consultancies, they've lost any campaigning zeal… I think both of those perceptions are true… it's the role of the campaigners to try and get some

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[189] My methodology was designed to allow for data collection on the broader influence of civil society, by including interviews with CSOs that were active locally, but not necessarily partnered on specific experiments in my large-N databases ('Type 3' interviews, section 3.5.2).

decision-makers to say yes, there is an issue… it's on Sustrans to say [to decision-makers], now, this is what you can do" (B02).

Sustrans' role continued to evolve along the path of assuming state functions. For example, Sustrans (2017) essentially took over cycling policy monitoring from BCC, with its collection of cycling data and progress tracking on cycling infrastructure and other types of policy delivery, published in biannual 'Bike Life' reports. A new CSO, Bristol Cycling Campaign, was established in 1991 to re-invigorate velomobility politics in the city (BCyC 2019). As described in section 6.1.2, the calls of CSOs for more radical policies to be implemented with Bristol's Cycling City project were somewhat sidelined, and CSOs were instead given some funding to conduct their own 'shadow planning' process, producing the *Greater Bristol Cycling Strategy 2011-2*026 (ARUP 2010). This strategy was never officially endorsed by the BCC, but a member of Bristol Cycling Campaign claimed that it influenced BCC's (2015c) Cycle Strategy (B02), published under Mayor George Ferguson, who was a Campaign member.[190] This is the only indication of civil society influence on BCC policy, during the study period. There was no evidence that the 800-member governance network that Bristol is known for, the Bristol Green Capital Partnership (BGCP), had a significant influence on BCC mobility policy nor experimentation. This is an interesting contrast to previous research, which has argued the BGCP represents sustainability-oriented network governance *par excellence,* exemplifying a forum for 'reflexive governance' that acknowledges "problems are best understood through multiple frames rather than the pursuit of an all-inclusive consensus", as a result of an extraordinarily wide range of stakeholders from 'dreadlock activists' to 'suits' (Ersoy and Hall 2020, p.408).[191]

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[190] Comparing the map of a proposed strategic cycling network in the Greater Bristol Cycling Strategy (ARUP 2010) and Bristol Cycling Campaign's manifesto (BCyC 2014), with the BCC 2015 Cycle Strategy, supports this claim.

[191] I did not find any mobility experiments linked to BGCP. The Partnership includes a 'Sustainable Transport Network' formed by a subset of members, including Sustrans, BCC representatives, businesses and a range of non-profits. As part of this sub-network, Sustrans coordinated the development of a 'shadow' transport strategy, *A Good Transport Plan for Bristol* (BGCP 2016). This Plan reads like quite a superficial vision that appears based on a 'least common denominator' type of consensus, in contrast to Ersoy and Hall's (2020) argument. There was no evidence that the Plan or Sustainable Transport Network had significant influence on BCC policy (B02; B03).

Reflecting on the Bristol case after data collection in NYC, I was struck by the greater influence of civil society in the latter context. The story of NYC experimentation presented in section 6.1 can be told in a different way, when paying special attention to civil society influence. Although it is challenging to ascertain cause-and-effect, my findings suggest that CSOs played a significant role in influencing all major NYC city government policy strategies during the study period. At the end of section 6.1.1, I described how NYC Deputy Mayor Dan Doctoroff became interested in promoting public plazas and protected cycle lanes after being recommended that this would support private real estate development. My findings also suggest that it was civil society advocacy that put cycling and public space on Doctoroff's agenda.[192] A coalition between Transportation Alternatives (T.A.) and Project for Public Spaces (PPS), the NYC Streets Renaissance Campaign (NYCSRC), was established in 2005-6: several sources attribute PlaNYC's cycling initiatives (T.A. 2007) to NYCSRC 'meetings' with Doctoroff (NY11; NY06; NY08; Levels 2019). NYCSRC paid for Jan Gehl to visit NYC and talk to municipal government and business leaders about sustainable mobility in November 2005 (Chan 2005), paving the way to Gehl Architects' later study of Broadway that formed the basis of NYC DOT's 2008 World Class Streets strategy (NY11; Levels 2019). As part of NYCSRC, a PPS (2006) report recommended that the Bloomberg administration launch a new agenda for the creation of new or improved public spaces in each of the city's 59 community districts (NY05), which was the exact form that the PlaNYC intiaitive for plazas and DOT Public Plaza Program would later take (section 6.1.2). T.A. has also been credited with the de Blasio administration's adoption of the Vision Zero policy platform (Fried 2013a; Luberoff 2016). T.A. (2011b) published a report that recommended that the next Mayor adopt Vision Zero as the primary policy goal for mobility, in 2011 when no US city had adopted such a goal (Luberoff 2016). T.A. then commissioned opining polling and organised protests that it claims succeeded in securing de Blasio's support for continuing DOT's sustainable mobility programmes (NY11; Luberoff 2016), by framing these as linked to safety and justice. Although it is impossible to triangulate cause-and-

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[192] Transportation Alternatives' account of this can be found in the organisation's 2012-2013 annual report (T.A. 2013).

effect, the de Blasio administration did launch the first Vision Zero strategy of any US city government.

Civil society did not only influence the direction of NYC mobility policy, but also prefigured specific experimental configurations that NYC DOT later would test. many significant strands of experimentation originated with experiments led by T.A., including 'safe routes to school' and play streets.[193] As mentioned in section 6.1.2, civil society played a crucial role in the adoption of quick-build experimentation as a preferred implementation mechanism within NYC DOT, and in the fact that the DOT public space programmes adopted a BID partnership model. Here I pick up on the discussion of the role of CSOs in enabling transformative impacts from two trajectories: public plazas (Table 6.13) and protected cycle lanes (Table 6.11). PPS had developed its own quick-build approach since the mid-1970s, testing temporary interventions like seating and planters for improving public spaces in NYC (PPS 2011), and in 1994-5 used temporary road markings to test a new intersection design at Mulrey Square (NY05; PPS 2005; PPS 2012), directly prefiguring DOT's later approach. Later, NYCSRC advocated for NYC DOT to adopt quick-build experimentation as a specific implementation strategy (Naparstek 2007b) and had designed a vision for the redesign of Gansevoort Plaza using the approach (Naparstek 2006). Randy Wade, the planner who first developed DOT's quick-build approach in the late 1990s, attributes the institutionalisation of this approach to NYCSRC advocacy (Lydon and Garcia 2015). Rather than focusing on whether DOT or PPS was the 'true inventor' of the quick-build approach, it is pertinent to draw attention to the fact that DOT and CSO professionals were connected through informal professional networks – indeed, one interviewee referred to Wade as NYCSRC's 'mole' within city government (NY05). Prior to DOT's first cycle lane experiment at Ninth Avenue, a civic coalition had developed a street redesign vision that included a protected cycle lane (CHECKPEDS 2007), supported by NYSRC. These CSOs were not involved as formal partners when the Ninth Avenue experiment was launched. It was down to the

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[193]T.A. implemented the first experiment with a 'Safe Routes to School' initiative in NYC (and in the US), resulting in the institutionalisation of a NYC DOT programme with the same name (see 'T.A. Safe Routes to School Pilot Program' in Appendix A). T.A. launched an experiment with play streets in 2011, on the basis of which it called on NYC city government to institutionalise a Play Streets Program in 'PlaNYC 2.0', and this was indeed launched with the 2011 PlaNYC update (see 'Harvest Home Play Street' in Appendix A).

DOT Pedestrian and Bike Projects group – alone – to assemble a feasible technical design, quick-build implementation process and the required resources, to undertake the experiment (NY08; Russo et al. 2009). Similarly, the DOT quick-build approach for plazas was repurposed by Wade to draw on *municipal* resources, like in-house materials, construction crews, and operational funding. This highlights the role of 'bureaucratic work' by municipal government in introducing novelties on city streets: in NYC, many *ideas* or 'general' configurations stemmed from civil society, but developing a *working configuration*, implementing and institutionalising it was the product of municipal work. One of these 'phases' of experimentation is not necessarily more important than the other, and the NYC findings point to the fluid boundaries between civil society and municipal government in terms of policy innovation, since mobility professionals in NYC were exchanging ideas through dense informal networks (Goodman 2012).

These inductive findings regarding the NYC case are highlighted here for two reasons. First, the point made directly above relates to general state-civil society dynamics in relation to experimentation, and the 'origins' and diffusion of *novelties* within urban systems. The findings highlight how actors exercise agency in relation to experimentation beyond specific partnerships, to influence municipal visions more broadly through informal networks. Because of the fluid boundaries between state and civil society, the NYC findings suggest that (municipal) capacity for transformative experimentation should be theorised as relational. These points are picked up in chapter 9, in discussing possible refinements to my theoretical framework. Second, the findings add nuance to the established (iconic) narrative regarding NYC DOT 'tactical urbanism' under Sadik-Khan, by making clear that the quick-build approach to experimentation had little to do with her (or Bloomberg) as individual leaders, to acknowledge the role of civil society.[194] As attested by the global policy mobilities related to Sadik-Khan (chapter 1), *the stories we tell about the dynamics behind urban transitions matter.*

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[194] Indeed, two interviewees who had been involved in civil society advocacy argued that Sadik-Khan has been given sole personal credit for a lot of ideas and approaches that had in reality been developed by Transportation Alternatives and and Project for Public Spaces (NY05; NY11).

Civil society advocacy may have had a greater influence in Bristol than my research focus and design was able to reveal. My data does not lend itself to comprehensive explanation of the differences between Bristol and NYC, in relation to civil society influence. We can contrast the NYC style of civil society advocacy as one of informal networking, political contestation, and policy lobbying, with the Bristol style as one of co-governing, and with consensus-oriented and formal network organisations. Partly, this is related to the path-dependencies discussed in section 4.3.4: Sustrans became professionalised already prior to 1996, whereas T.A. has always remained an advocacy-focused CSO. Another potential explanation relates to differences in resource mobilisation: whereas Bristol Cycle Campaign, for example, is sustained by volunteers, T.A. is partly member-funded by also dependent on philanthropic donations (NY11), and T.A. and NYCSRC received large injections of funding from Mark Gorton (NY11; NY05; Levels 2019; Friss 2019). Gorton is is an entrepreneur who developed a personal interest in cycling and street space in the early 2000s (Levels 2019), and who was one of T.A.'s biggest donors from the early 2000s to 2010.[195] NYCSRC was in some ways the vehicle for Gorton's personal goal to unseat Weinshall as DOT Commissioner, and with the Campaign, Gorton also exerted his vision for how T.A. could professionalise its activism to achieve greater policy impact (NY05; Levels 2019). Gorton's influence raises broader questions about 'donor politics' (cited for NYC: NY04; NY11) in relation to civil society (Montero 2018), however, the most pertinent counterfactual question for my comparison is: what would civil society in Bristol have looked like, if CSOs had access to millions of pounds from philanthropic funders?

Individual leadership and public contestation

Existing narratives about urban mobility experimentation in Bristol and NYC emphasise the importance of leadership by individuals within municipal government (section 4.3.4). I purposefully did not include individual leadership in my theoretical framework, because rigorous treatment of this would require engagement with (yet another) set of theories on

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[195] In the early 2000s, Gorton was the single most important funder of T.A.'s projects (Levels 2019) and as of 2010, still provided one-fifth of T.A.'s annual budget (Frassica 2010 cited in Levels 2019). In 2012, the *New York Times* reported that Gorton had donated more than $10 million to T.A. over the preceding decade (Goodman 2012). With Gorton's support, T.A. transformed from a small CSO with four staff in 2004, to a more professionalised organisation with 24 staff in 2011 (Friss 2019, p.40; Goodman 2012).

(city) leadership (Rapoport et al. 2019). However, this factor was emphasised by interviewees, again more so for the NYC than Bristol case. I discuss these findings because I think they provide indications on how to advance the poorly-conceptualised understanding of individual leadership within research on sustainable mobility.

BCC had weak political leadership throughout most of the study period, with an elected Mayor with executive powers only introduced in 2012 (4.2.1), whereas the long-standing NYC Mayoral system has strong executive powers. This difference in executive leadership between BCC and NYC reflects wider debates regarding national differences between the UK and US in this respect, within which it is common to lament the weak leadership of UK local government (Hambleton and Sweeting 2004). Bristol interviewees rarely mentioned specific Council Leaders or like councillors, nor bureaucratic leaders within the non-political administration of BCC. The only leader who was emphasised was George Ferguson as an elected Mayor. Many NYC interviewees argued – largely unsolicited by the author – that the leadership of Mayor Bloomberg and Sadik-Khan was important in determining municipal capacity for transformative experimentation (NY11; NY04; NY06; NY08; NY10; NY15; NY19; NY03; NY13; NY17). Interviewees pointed to the strong executive powers of the Mayor, within the political structure of NYC city government (NY04; NY13; NY17). Based on the Bristol and NYC findings, we can identify three ways in which individual leaders shaped municipal capacity for transformative experimentation: public contestation, civil society advocacy, and forms of organising experimentation within municipal government.

The Bristol findings only point to the Mayor's role in relation to public contestation. As discussed in section 5.1.3, Ferguson's impact on experimentation was limited: his only notable influence was in response to public contestation regarding Resident Parking Zones (RPZ), as a transformative trajectory (section 5.2.6). RPZ had been experimented with prior to the Mayoral election; in 2013, Ferguson announced city-wide roll-out of RPZs, rather than a series of further experiments. He later stated this approach was a mistake based on the public protests that ensued – involving an armoured tank being driven through Bristol streets (BBC 2014). Interviewees credited Ferguson with pushing ahead RPZ despite this controversy (B10; B27). This debate regarding Ferguson's role is

significant because Bristol is the only city in the UK that has introduced an elected Mayor. Hambleton and Sweeting (Hambleton and Sweeting 2014, p.230) argue that Ferguson used his position of power to introduce policies like Resident Parking Zones and 20mph speed limits. Based on these examples, the scholars conclude that these policies demonstrate that potentialities of the elected-mayor model for greater 'speed and momentum' in policy implementation, and greater 'civic leadership'. My findings suggest that this is overstated, as both these novelties were first tested in experiments prior to Ferguson's election. Yet the perceptions of my interviewees and those interviewed by Hambleton and Sweeting indicate that Ferguson did play an important role in the *expansion* of these policies during his term. The role of Mayoral leadership styles in relation to public contestation is bolstered by the contrast provided by Bristol's Mayor from 2016, Marvin Rees, who campaigned on a platform of reviewing the expansion of RPZ (BBC 2016b).

Public contestation was a much more prominent theme among NYC interviewees, as hinted at by the title of Sadik-Khan's book, *Streetfight* (Sadik-Khan and Solomonow 2016). Contestation in relation to cycle lanes, or 'bikelash', is one of the most-cited aspects of mobility experimentation in NYC (Wild et al. 2017; Luberoff 2016).[196] However, I found no evidence that contestation actually constrained transformative impacts.[197] I did find that public contestation likely constrained the transformative impacts of experimentation with Select Bus Service: in this regard, the findings point to the role of NYC's Community Boards as a neighbourhood-level political institutions,[198] rather than the leadership styles in response to this. However, two interviewees cited Bloomberg's leadership, including the political backing he gave Sadik-Khan in the face of controversy, as *the decisive* factor

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[196] 'Bikelash' was coined as a term by a *New York Magazine* cover in March 2011, accompanying an article about fervent resident opposition along Brooklyn's Prospect Park West to the new two-way protected cycle lane recently installed by DOT (Shaer 2011). This controversy was the most prominent among a series of contestations over cycle lanes, involving a struggle fought between DOT and a civic coalition spearheaded by former DOT Commissioner Weinshall. The infamous Brooklyn cycle lane was eventually made permanent, and NYC DOT won the lawsuit filed by this coalition, leading Sadik-Khan (2016) to declare that "the bike wars are over, and the bikes won".

[197] Although one interviewee argued that Sadik-Khan did make NYC DOT slow down cycle lane implementation, following 'bikelash' climax in 2011 (NY08), I found no indication that experimental cycle lanes were removed or that contestation prevented expansion, but then I only examined a handful of cycle lane interventions.

[198] A prominent inductive theme emerging from NYC interviews was the role of the city government's 'Community Boards' in blocking and slowing down mobility experimentation, with these deriving power from highly-constructed notions of 'community' that did not necessarily represent the full diversity of residents in the associated district (NY11; NY17; NY10). Community boards serve an advisory function in relation to planning issues (Berg 2007).

shaping NYC city government capacity for transformative experimentation between 2007 and 2013 (NY04, NY13). The importance of different NYC Mayor's leadership styles in relation to public contestation over experiments is also emphasised by popular histories of NYC mobility policies (Schwartz and Rosen 2015; Friss 2019). Bristol and NYC findings thus point to the role of individual leadership in relation to contestation as a factor shaping municipal capacity for transformative experimentation, but in a rather vague sense, as if this depended on leaders' individual personalities. This falls broadly in line with popular understandings of urban mobility transitions emphasising single visionary leaders.

Theories of city leadership tend to look beyond individuals to understand leadership as relational, for example in mediating state-civil society relations (Rapoport et al. 2019). With respect to the NYC case, I would argue the most significant influence of Sadik-Khan and Doctoroff as leaders was their receptiveness to engaging with civil society advocates (and in the case of Sadik-Khan, hiring them to work at DOT), thus providing a conduit for civil society influence on municipal capacity for transformative experimentation. Had these leadership styles been different, it is likely that experimentation would have looked very different in NYC, due to the centrality of civil sociey influence discussed in section 7.5.1. Further, Sadik-Khan's influence as a leader extended to *mediating between municipal action, civil society advocacy and public contestation.* When Sadik-Khan became DOT Commissioner, an interviewee described the shift in Transportation Alternatives' role as follows (NY11):

> "[We had] built up this playbook of what New York could and should do, and then all of a sudden… Janette [Sadik-Khan] was… appointed and then it was like a lot of meetings with her and Jon Orcutt… [discussing] what are we actually gonna do… and then our role shifted from instigator, provocateur to you know co-author of their playbook to basically providing political cover".

This quote illustrates how T.A.'s relations with NYC DOT shifted from critique to policy advocacy, and then to defender of DOT experiments that became subject to public controversy - particularly in relation to 'bikelash'; essentially, getting T.A. members to turn

up to public meetings and protests to demonstrate public support. The way that Sadik-Khan allied with CSOs to deal with public contestation arguably reflects quite a unique leadership style.

Finally, the NYC findings highlight the role of bureaucratic leadership in relation to forms of organising experimentation within municipal government.[199] Based on my finding that PlaNYC as a policy framework was central to municipal capacity in NYC, one could argue that the fundamental enabler of transformative mobility experimentation was Bloomberg's and Doctoroff's sustainability entrepreneurialism as a form of urban politics. This can be dismissed however: PlaNYC mobility initiatives did not originate with either leader, and sustainability and entrepreneurialism would likely have merged in NYC even without them, as it has in so many other cities globally - including Bristol. Bloomberg and Doctoroff represented a type of entrepreneurial politics that was *generally permissible* of sustainable mobility as an element of economic competitiveness. Sadik-Khan's leadership was crucial for the actual implementation of PlaNYC mobility initiatives (NY18), notably, by her strategy of hiring civil society advocates, who brought a lot of the substantive ideas, and by reorganising DOT's organisational structure to institutionalise experimentation as a mechanism. Thus, Sadik-Khan's leadership as a bureaucratic manager was an important *enabling* factor for the adoption of quick-build experimentation as a governing mechanism (as emphasised in section 6.1.2), and the organisational forms and institutionalisation techniques that were central to transformative experimentation in NYC (NY17).[200]

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[199] The leadership of Barbara Janke, Council Leader between 2005-2009 and 2009-2012, in establishing and spearheading the BCC Bristol Futures department (B26) and the Bristol Green Capital Partnership (B27), was also mentioned.

[200] The Street Design Manual was in many ways Sadik-Khan's 'pet project' (NY06; NY08).

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