From traffic in towns to people in streets: exploring the relationships between behaviour, design, and regulation

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A thesis submitted in partial fulfilment of the requirements of the South West Doctoral Training Partnership and the University of the West of England, Bristol for the degree of Doctor of Philosophy, College of Arts, Technology and Environment, University of the West of England, October 2022.

Declaration

"This study was completed for the degree of Doctor of Philosophy at the University of the West of England, Bristol. The work is my own. Where the work of others is used or drawn on it is attributed".

Signed this 10th October 2022:

Jonathan Flower

Word count: 87, 445 (including footnotes and text boxes, but excluding ancillary data, such as references and appendices). Note: this PhD thesis incorporates research outputs within the body of work submitted and as such may be expected to be longer than a written thesis submission that does not incorporate them and may exceed the maximum permitted for the discipline, in this case 80,000 words, by up to 10,000 words.

Abstract

This research investigates how street environments and culture are shaped by behaviour, design, and regulation, and explores the implications of this shaping for street users who walk and cycle. The work of Buchanan and Smeed in the 1960s helped create urban street planning that allowed motor traffic to dominate, with the consequence that some would-be street users have been marginalised. Such marginalisation is a manifestation of a lack of justice in the context of everyday travel. Street environments, culture and justice have been researched using Q-methodology, which lends itself to the study of subjectivity and is appropriate for exploring the opinions of street users in relation to behaviour, design, and regulation.

Focus groups with 19 street users, and interviews with seven professionals, developed a set of 64 statements that characterise behaviours, infrastructure designs and regulations, that either contribute to, or detract from, streets that are conducive to movement on foot, a cycle, or using other human-scale modes. These statements were used in a Q-method ranking exercise undertaken by 49 participants. Factor analysis generated five groupings of viewpoints. These are summarised as follows: 'we are the traffic', a view that streets are places people pass along; 'safety and comfort first', streets are places where some street users want to stop and linger; 'access is not optional', streets deny access to some; 'designed for all', which suggests that unless streets are designed for everyone, many people will never choose to walk or cycle; and 'rules matter', street rules should prompt those that can harm most to take a greater share of responsibility for others. In an innovation of Q-methodology, thresholds that need to be exceeded to allow people to walk or cycle were also identified.

To guide the research a new theory was postulated, the Social Ecological Model of Ability, which combines the part-behavioural and part-anthropological Social Ecological Model (SEM) with the Social Model of Disability (SMD). The model defines the interrelations among the relevant factors, with a particular focus on barriers in relation to personal abilities. It fills a gap that exists between behavioural and anthropological theories, and theories of disability. Drawing on the SMD, some individuals are marginalised by layers of barriers in the ecosystem of their environment that remove choices and may hinder participation, and this is a highly relevant adaptation of the SEM for street environments. The Q-methodology findings confirm there are layers of barriers, validating the need to have developed the new theory. The SEMA is a way to understand street use and to promote more inclusive sustainable travel, and this has not been done before in transport

studies. The research is important given the emergence of (electric) micromobility and connected and automated vehicles in urban areas.

There was strong consensus among the research participants that physical separation between means of travel would contribute the most to the creation of street environments conducive to human-scale movement. Practitioners and decision makers have the authority to develop the policy, design and regulation changes to streets that will enable active travel. However, drivers of motor vehicles and other street users need to address their own intimidating behaviours (such as speeding, close passing, and inappropriate interaction with strangers in the street) otherwise many potential street users will remain deterred from walking, cycling, and using other human-scale mobility.

Dedication

To North Street, South Street, East Street and West Street and all who use your footways, carriageways, shops, bars, cafés, and other facilities, or live along your edges. These streets within 500m of my home in south Bristol are typical of streets in the UK and around the world where people walk, run, scoot, skate, cycle, push prams, use mobility scooters and wheelchairs, sit, and chat every day. They are residential, or mixed use, with 20 mph speed limits. While I have been writing my thesis seven people were seriously injured on my local streets and one person died in road traffic collisions, three of them on cycles and three on foot, and another 27 cyclists, 24 pedestrians and six children were slightly injured. Streets in other parts of the city have many times been filled with thousands of protesters, mostly on foot, but sometimes cycling, rolling or sitting, to raise their voices in protest about issues that could profoundly change street environments and culture: about the climate emergency and chronic air pollution, 'black lives matter', 'reclaim these streets' so that streets are safe for all, and 'kill the bill' (Police, Crime, Sentencing and Courts Bill) so that people retain the right to protest.

I dedicate this work to street users everywhere.

Acknowledgements

A lot happens in the four years that it takes to undertake a PhD. My father was diagnosed with terminal cancer and my mother-in-law with dementia, my mother was fitted with a pacemaker, I have had another cornea graft, my parents turned 80, my four children left home and became adults, the UK left the European Union, changed prime minister twice and proclaimed a new monarch, there was an outbreak of a global pandemic, a war broke out in Europe, my supervisor, Professor John Parkin, became a 'compleater' having climbed all 283 Munros in Scotland and my second supervisor, Professor Ian Walker, broke the world record for cycling north to south across Europe, 6,367 km in less than 17 days.

I would like to thank…

…my family and their support, especially my long-suffering wife Siân, who, much as she loves streets, does not feel the need to talk any more about continuous footways, or advisory cycle lanes.

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List of abbreviations

ASL - advanced stop line

ATG - Welsh Government Active Travel Guidance

BRT - bus rapid transit

CAV - connected and automated vehicle

DPE - Decriminalised parking enforcement

EAPC - electric assist pedal cycle

EU - European Union

EV - electric vehicle

ITF - International Transport Forum

km/h - kilometres per hour

LTN - low traffic neighbourhood, sometimes referred to as liveable neighbourhoods

MAMILs - middle-aged men in lycra

MaaS - Mobility as a Service

mph - miles per hour

PLOS - pedestrian levels of service

PSMS - probabilistic surrogate measures of safety

RoSPA - the Royal Society for the Prevention of Accidents

SEM - Social Ecological Model

SEMA - Social Ecological Model of Ability

SI - statutory instruments

SMD - Social Model of Disability

SUV - sports utility vehicle

TPB - Theory of Planned Behaviour

TfGM - Transport for Greater Manchester

TfL - Transport for London

TRO - traffic regulation order

Glossary

Active travel: walking, cycling, or using other human-powered modes for full journeys, or in combination with public transport.

Complete streets: street networks that are easy, attractive, and safe for movement for people of all ages and abilities, on foot, cycle or rolling, while retaining access for motorised vehicles as appropriate.

Cycle: any hand-cranked or pedal-powered vehicle with wheels and a saddle or seat, including bicycles, tandems, tricycles, hand cycles and cargo bikes. A vehicle capable of speed.

Cycle track (see also cycleway): a way over which the public has the right to pass and repass for the (usually exclusive) use of cycles; in the UK this is the legal term.

Cycle traffic: the movement of a stream of cycles.

Cycleway (see also cycle track): a way over which the public has the right to pass and repass on a cycle; although this is not the legal term in the UK it is a term preferred by some commentators to cycle track, with its similarity to carriageway and footway (see other definitions). London has adopted the terminology of cycleways for its developing cycle network.

Footway: The technical term for what is commonly called a pavement in the UK, and a sidewalk in the US. The part of the highway for the exclusive use of pedestrians. Footways differ from footpaths which are paths away from the highway.

Highway (UK common law): a way over which the public has the right to pass and repass.

Human-scale mobility: mobility using modes that are broadly at the scale of the human and include: human-powered (cycles, manual Class 1 wheelchairs, and skateboards), e-assist (e-cycle and pedelecs) or electric powered (e-scooter and Class 3 mobility scooter).

Micromobility: alternative term for human-scale mobility.

Mobility justice: is defined as justice relating to mobility and transport covering accessibility, affordability, safety, greenhouse gas emissions, health, pollution, and space taken for infrastructure.

Pedestrian: a person moving on foot; walking or running on foot; of or relating to walking or running. Not everyone walks in ‘pedestrian areas’ as some use wheelchairs, mobility scooters, pushchairs and prams and others run.

Pedestrian traffic: the movement of a stream of pedestrians.

Regulation: a rule or law. All laws are regulations, but not all regulations are law. In the UK Statutory Instruments (SIs) are a form of regulation which allow the provisions of an Act of Parliament to be subsequently brought into force or altered without Parliament having to pass a new Act. Traffic Regulation Orders (TRO) are a form of SI that local highway authorities can use to place temporary, experimental, or permanent restrictions on traffic within their areas, such as implementing parking restrictions.

Road: any highway, but also a way that is made up to be a road, even if there is no right of way.

Road user / Street user: this thesis uses the term road user for vehicle drivers and street user for pedestrians, cyclists, and others more immersed in the environment than drivers.

Rolling: includes the use of a range of human-scale wheeled devises other than cycles that people might use in streets. They could be active modes (e.g., manual wheelchairs, and skateboards), pushed by someone else (e.g., a pram), e-assist (e.g., power assist wheelchair), or fully powered (e.g., mobility scooters and e-scooters). Some people use the word 'wheeling' instead of rolling.

Segway: a two-wheeled, self-balancing personal transporter.

Separation: the state where different modes of traffic do not mix with each other, for example cycle traffic with motor traffic or pedestrians. This can be achieved using kerb separation, with different modes at different levels (grade separation); light separation, for example using wands or armadillos to protect a cycle lane; or paint separation, but paint fails to address the needs of visually impaired pedestrians and can easily be ignored by drivers. The term is often used interchangeably with segregation.

Street: a road in a built-up area.

Vulnerable street users: people in streets the most at risk of harm - typically people with mobility difficulties or visual impairments, children, other pedestrians, cyclists, and motorcyclists - from those in a position to cause the most harm, namely, drivers of large lorries, buses, vans, and cars.

Foreword

Two of the founding fathers (the field was monopolised by men) of transport studies were Professor Colin Buchanan, the first Chair of Transport at Imperial College, London, and his peer Professor Reuben Smeed, the first Professor of Traffic Studies at University College London (UCL). At that time, the field was dominated by the disciplines of engineering and economics. The works of Buchanan and Smeed are explored and challenged in this study, particularly their relevance for streets in the urban context. Smeed was instrumental in establishing the Universities' Transport Study Group (UTSG). I presented my research at UTSG's 2021 conference, and it was awarded second place in the Smeed Prize competition.

I am a trained social scientist working in transport planning. As well as being a PhD candidate, I am a Research Fellow in the interdisciplinary Centre for Transport and Society, University of the West of England (UWE). My supervision team reflects the multifaceted nature of the research topic of the street environment, comprising of one engineer / transport planner and one behavioural psychologist. Professor John Parkin, Professor of Transport Engineering at UWE is the Director of Studies and Professor Ian Walker, Head of Department of Psychological Sciences at the University of Surrey (University of Bath until August 2021) is the second supervisor. The funding for the work was from the Economic and Social Research Council South West Doctoral Training Partnership on the Sustainable Futures pathway. I was funded as part of that to undertake an MRes in Social Science research methods. This adds to my two previous masters level qualifications of MSc in Transport Planning (UWE, 2018) and MSc in Community Disability Studies (UCL, 1998). In addition to this prior learning, I studied 30 credits at Masters level in public law at the University of Bristol Law School in academic year 2017/18 under the tutelage of Professor Julian Rivers, Professor of Jurisprudence.

Something as complex as urban life and mobility are not amenable to simple solutions. In response I have taken an interdisciplinary approach to the research, as described in the thesis. As a PhD candidate and supervisory team, we have developed a conceptual framework suitable for the under-researched topic area from the perspective of all street users. New models have been created to aid understanding of how an individual's street - use behaviour evolves in a way that is influenced by the multi-levels of the ecosystem of their environment, and how those individuals can be marginalised by the environment they find themselves in. Interestingly, when engaging the public as participants in this study, they had little difficulty responding and thinking in a transdisciplinary way. Unlike specialists (for example highway engineers, the police, or psychologists) who tend to use a unidisciplinary lens, members of the public are familiar with streets through their life experience and naturally accept that the environment is shaped by several different influences. They each have their own opinions on the street environment, which are explored in this study using Q-methodology, which is good for dealing with subjectivity.

1 INTRODUCTION

1.1 Structure of the chapter

The focus of the thesis is urban street use and how design and regulation shape road user behaviour and how, in turn, road user behaviour shapes the design and regulation of streets over time. The primary focus is on UK streets with reference also made to the northern European context given the geographical, social, and cultural similarities, and with occasional references to countries beyond Europe. This is an important topic given the dominance of motor traffic in urban areas, which began in the 1950s, and the contemporary debate (O'Rourke, 2022) about how streets should be managed. The debate has led to the promotion of other methods of moving around that are deemed more environmentally friendly and better for public health. The topic is also pertinent within the current socio-technological transformation of the transport system through electrification of infrastructure, smart technology, and the transition towards electric, connected, and automated vehicles.

This thesis seeks to also explore design, regulation, and travel behaviour from a street user perspective. Street users are people who use streets outside of a motor vehicle, who have greater opportunity to more fully engage their senses with the street environment, as they are more immersed in it. By contrast drivers move around the street within a protected environment and are less connected with their surroundings. This research seeks to better understand how streets work and how they could work better. It is needed to create an evidence base that will help apply the design principles for street improvement articulated in Manual for Streets (Department for Transport, 2007a) and connect them with the regulations and behaviours needed to support the creation of streets for people.

This chapter introduces the idea that there is a new era of urban transport in which walking, and cycling are once again emerging as having an important role to play on streets. This has been evidenced by an increase in their mode share, accentuated during the Covid-19 pandemic lockdowns from March 2020 to summer 2021. The chapter also presents the research aim and questions before summarising the overall structure of the thesis.

1.2 A new era of urban transport

Traffic is commonly understood as being the movement of vehicles on the public highway. The concept of movement by cycle being 'traffic' is well established in countries such as the Netherlands and Denmark where there are specific words for the concept (fietsverkeer and cykeltrafik). The concept of traffic can also be extended to the movement of pedestrians along a route.

Buchanan (1963) in his Traffic in Towns report commissioned by the UK Ministry of Transport concluded that it would be impossible to build adequate roads and infrastructure for everyone to drive to work and the shops and to provide sufficient parking for everyone to own and use cars in unrestricted ways. However, he demonstrated the nature of a road network that would be required if unfettered access for motor traffic was allowed in the Fitzrovia area of London. Buchanan's ideas of designing some streets for 'movement' and others for 'place' continue to be embraced by transport planners. We will return to this report in Chapter 2.

To understand this new era of urban transport, Sub-section 1.2.1 introduces sustainable transport, 1.2.2 discusses the contested nature of urban space, and 1.2.3 explores the balance between regulation, design, and behaviour.

1.2.1 Sustainable transport

Black (1996) defines sustainable transport as transport that meets the current transport and mobility needs without compromising the ability of future generations to meet their needs. An alternative view of sustainability is to meet a wider range of goals beyond just mobility, that could include improved quality of urban space, distributional equity in transport, impacts on the environment (air quality and climate change) and the implications for human health and safety (Low and Curtis, 2012).

Walking and cycling, which may be combined with the use of public transport (Gerike *et al.*, 2016) as part of the first or last mile of a journey, have numerous benefits. These modes not only support public health objectives but can also improve overall quality of life due to their minimal consumption of transport infrastructure space and energy, and minimal creation of air pollution and noise. Private electric cars (EVs) are often also suggested as the sustainable transport solution of the future. However, van Wee, Maat and De Bont (2012) argue that, while EVs are quiet and contribute little to local air pollution, they still make streets inherently unsafe and unpleasant for other people using the street, and they use space and infrastructure inefficiently.

In the UK the mean annual distance travelled per person per day has risen from 10 km in 1960 to 50 km in 2017 (Banister, 2018). People are not necessarily spending any more time travelling, but they are able to travel further in the same amount of time (Metz, 2012). The net increase in travel distance incurs environmental and social costs, such as climate change, air pollution, congestion, and collisions, which fall heaviest on the poorest. Transport in cities contributes significantly to all these externalities. Many global cities (such as New York, Paris, London, Zurich, and Barcelona) see sustainable transport as part of the solution and have already started to give more space and priority to walking and cycling, sometimes combined with more space and priority for public transport. This has accelerated since the emergence of Covid-19 in 2020 with cities across the world rapidly creating separated cycle lanes and extending footways into the carriageway using easily installed temporary infrastructure (Law, Azzali and Conejos, 2021; Cannatella, 2020).

1.2.2 The contested nature of urban space

Human activity requires movement, and outside the home much of that movement occurs along the street network. People seek easy, attractive, and safe journeys, but movement by different methods of travel creates conflict and risk. The focus of the research is on three influencing factors: design, regulation, and behaviour.

In the latter half of the 20th century, there was little recognition of the contested nature of streets, with cars being allowed to dominate. Jacobs (2000, p.13) suggests that *"the destructive effects of automobiles are much less a cause than a symptom of our incompetence at city building"*. The inference is that it is in the gift of city planners to determine the future nature of urban mobility. In the 21st century perceptions are beginning to change, assumptions are being challenged, and some streets are now being re-designed and re-constructed to provide a fairer division of the space and priority to allow for a wider range of mobility options (Prytherch, 2018).

Chris Boardman, National Commissioner of Active Travel England, in a speech to the All-Party Parliamentary Cycling Group (2018) stated that people are marginalised on streets if walking and cycling is not an easy, attractive, and safe option for local journeys. Boardman proposed two simple tests: the buggy test and the cycle test. Are streets conducive to a parent with a double buggy and a competent 12-year-old cyclist to use and want to use? These tests are supported by others – Hammond and Kockelkeren (2018) proposed a stroller test that measures how close essential services are to where people live and how easy it is to reach there on foot with a pushchair, while van de Kloof (2018) demonstrates the role of cycle infrastructure and calm streets if children are going to 'bike to independence'. Boardman believes that when these tests are met, behaviour change will follow, with people exchanging their cars for other modes for local journeys. Boardman is therefore allying himself with the school of thought that says, 'build it and they will come' (Adam, Jones and te Brömmelstroet, 2020), or perhaps more accurately, adapt and regulate it and they will come. The premise is that when the tests are met everyone will have a viable choice to walk or cycle. Cycle design guidance in the UK is derived from Dutch guidance (CROW, 2016) and expands the concept of 'easy' as defined by Boardman, to include coherent, direct, and comfortable (Department for Transport, 2020b). Transport for London (2020a) applies the same terms for walking (safe, comfortable, direct, and attractive), but defines 'coherent' to mean legible and connected. The toolkit also adds inclusive as a concept that walking is expanded to all, including those using wheelchairs and mobility scooters, or who push prams and buggies. All these concepts could be summarised as the elements that make streets that are conducive to walking and cycling.

Modes of transport range from active human-scale modes to motorised modes. Active modes may be described as walking, running, cycling and different forms of rolling, such as using a wheelchair, kick scooter, skateboard, or rollerblades. The term rolling is used explicitly throughout this thesis so that the specific needs of people who roll are neither overlooked nor merged with the sometimes-competing requirements of other street users. Alternative terms such as wheeling could be used (Transport Scotland, 2020; Sustrans, 2022). The State of California (2021) have extended the definition of pedestrian to include people who roll: *"a person on foot or who uses a conveyance such as roller skates, skateboard… can also be a person with a disability using a tricycle, quadricycle, or wheelchair for transportation."* When used for full journeys, or in combination with public transport active human-scale modes can be described as active travel, which are in themselves healthy activities, but when they displace car journeys, they deliver significant benefits for the health and well-being of the wider population (Welsh Government 2021). Motorised modes range from mobility scooters to different forms of public transport and private motor vehicles.

Boardman's perspective on streets aligns with The Social Model of Disability (Oliver, 2013) which focuses on removing disabling barriers from the environment rather than 'fixing' the impairments of individuals. Applying this model more widely would mean that the most marginalised street users are those that are most disabled by the street environment, which may include people pushing double buggies and 12-year-old cyclists as well as visually impaired pedestrians and people riding in mobility scooters.

More active travel at the population level enhances health and reduces impact on the environment (Chapman *et al.*, 2018). There is evidence (Šťastná *et al.*, 2018) that some people are motivated to be more active by the health benefits, but others are deterred by the potential risks, particularly of collisions.

As already noted, transport involves movement, which creates conflict and thereby risk. Unless that conflict is suitably mitigated, it can result in collisions, the most serious of which cause injury or death. Most countries keep records of the numbers killed or seriously injured (Utriainen, Pöllänen and Liimatainen, 2018). Urban road networks inevitably consist of many road junctions. In the UK three quarters of all collisions occur in urban areas, and, of these collisions, two-thirds occur at or close to junctions, with people on foot or cycle disproportionally represented among the seriously injured (Department for Transport, 2018d). In New York 74% of collisions that kill or seriously injure pedestrians, occur at junctions (Viola, Roe and Shin, 2010). In some countries there is under reporting of injuries of people who walk or cycle, which is particularly evident in the South-East Asian region (WHO, 2018).

1.2.3 The interplay of design, regulation, and behaviour

Smeed (1949) in his consideration of road safety research noted that road engineers tend to hold the view that collisions can largely be avoided by improvements in road surfaces and the ***design*** of the roads; the police take the view that ***regulation*** and the enforcement of the law is what is required; and motorists believe that the ***behaviour*** of certain people is the problem as they cannot or will not drive, cycle or walk appropriately. Smeed concludes that the likely solution lies in how street design, regulation, and street user behaviour combine. Smeed was a peer of Buchanan who also considered the problem of traffic in towns. Based on some mathematical assumptions for theoretical towns, Smeed (1963) concluded that the ground space required for moving and parking for driving (especially when used inefficiently with single occupancy) is many more times for driving private motor vehicles than any other modes. In terms of required space, Smeed determines that buses require significantly less space than private cars, that walking is even better, and that urban rail would be the best space solution. Interestingly, he does not consider the space requirements of cycling. Whereas Buchanan's response to traffic in towns was design focused, Smeed (1964) additionally proposed regulation and behaviour-based solutions: road charging and car sharing which requires less space and could improve traffic flows (Ministry of Transport,1964). Building on Smeed, the focus in this research is on these same three factors, not just for safety and improving traffic flow, but also as ways to address the wider street environment. The factors can be thought of as contributing to (or detracting from) easy, safe, and attractive movement along urban corridors. That movement should consider everyone, particularly those walking and cycling, and this is a shift in emphasis away from the one that has dominated since Smeed's day: the flow of motorised traffic.

By the end of the twentieth century a shift had occurred in academic transport studies from a focus on infrastructure design solutions to a more interdisciplinary approach that also recognised the analysis of human behaviour as important. Dudley and Preston (2013) mapped the evolution of transport studies in the UK. Their interviews with 20 senior figures involved in the development of the field, also pointed to public policy and regulation as a third element alongside design and behaviour, that together characterise transport studies.

Design

Current typical street designs are often inappropriate to satisfy the needs of all users, and changes in the design of the layout may be needed. In the UK context the Design Manual for Roads and Bridges (Highways England, 2019) provides standards for the principal inter-urban road network. However, many designers also use it as a reference source for urban areas, which leads to designs that are not always appropriate for people who walk or cycle. This is changing, with the use of the more appropriate Manual for Streets (Department for Transport, 2007a; Young and Jones, 2010), which provides design guidance especially for streets where 'place' is more important than 'movement', but its principles are more generally applicable across the whole street network. Additionally, many cities are developing their own design guidance to address the needs of all street users. For example, to ensure the consistency and quality of the Bee (walking and cycling) Network, Transport for Greater Manchester (2020) is developing its own Streets for All design guide.

This shift in approach to design is increasingly evident in transport policy and city street and network design. 'Complete streets' is a term used for transport policy and design, particularly in North America (Hui *et al.*, 2018). They are streets that are easy, attractive, and safe for movement for people of all ages and abilities, to use, while retaining access for motorised vehicles as appropriate. In Europe and elsewhere similar street design changes have been described using the terms 'liveable streets' (Appleyard 1980; Dumbaugh and King, 2018) or 'healthy streets' (Ede and Morley, 2020).

It is important that individual junctions, or a single street, are not treated in isolation. This is because providing sustainable transport infrastructure along a whole corridor is required to promote an increase in active travel, such as providing walking and cycling facilities alongside enhanced bus routes (Panter *et al.*, 2016). There are several environmental attributes at a network level that contribute to the uptake of walking or cycling: Kerr *et al.* (2016) highlight residential density, land use mix, street connectivity, pedestrian infrastructure, aesthetics, distance to destinations and traffic safety.

Regulation

Highway laws and regulations grant rights, responsibilities, and restrictions on different road user types. Often, laws seek to protect, but there can be trade-offs between users of different modes, and between safety and convenience. They are supported by a series of regulations and standards that stipulate the parameters for signs and road markings as well as the form and geometry of infrastructure. The five types of signs as defined by law makers in the UK are: orders (prohibitions usually have red circles), warnings (mostly triangular), directions (mostly rectangular), information (all rectangular) and temporary road works signs (Department for Transport, 2019b). This combination of rules, standards and design at times enforces, and sometimes instructs and often nudges street users to behaviour in certain ways (Prytherch, 2018). As the way streets are conceptualised by planners and policy makers changes, so do the rules that regulate them.

Regulations, such as the Highway Code (Driving Standards Agency (Great Britain), 2007) in the UK were reviewed (Department for Transport, 2018a), with a revised highway code being published on 28th January 2022 (Department for Transport, 2022). The revisions were partly in order to help promote and protect walking and cycling, with an expectation that future revisions will seek to accommodate new technology including electric vehicles, automated vehicles and other human-scale modes such as e-scooters. The changes in the new Highway Code included introducing a hierarchy of road users which ensures that those road users who can do the greatest harm have the greatest responsibility to reduce the danger or threat they may pose to others. The street use codes in Belgium, Switzerland, France and Luxembourg have already taken steps in this regard (Murard *et al.*, 2011), by reorienting from a focus on facilitating the throughput of motorised traffic to one where the needs of all street users are prioritised.

Behaviour

This study investigates the behaviour of all road users navigating streets, especially within or adjacent to walking and cycling infrastructure in the context of the regulations that shape the use of that infrastructure. A better understanding of these interrelations will be essential to help politicians and policy-makers better balance efforts and resources between changing travel behaviour, amending laws and regulations and building infrastructure.

Changing travel behaviours have profoundly changed the street environment as they have evolved and transitioned from one dominant mode to another. Governments and local authorities have sought to modify that behaviour through design and engineering, as illustrated by Traffic in Towns (Buchanan, 1963) where design was used to encourage and accommodate a growth in driving. In parallel, methods for controlling that growth were being suggested, such as Smeed's (1964) proposed road user charge. The cycle of changing travel behaviour leading to changes in design and regulations aimed at modifying behaviour, which again leads to changing travel behaviour has not ended.

The relationship of three elements

The three elements of regulation, design and behaviour resonate with the long established three E's of road safety, a relationship of enforcement (regulation), engineering (design) and education (behaviour) interventions (McIlroy *et al.*, 2019), which when combined seek to ensure that no-one is harmed on roads. Flower and Parkin (2019) have already found that there is a consistency of opinion across all groups of road users that the lack of alignment between design and regulation, and lack of compliance with the regulations are not acceptable.

Figure 1 shows a conceptualisation of a three-way relationship between regulation, behaviour, and design. Individually and collectively, regulation, behaviour and design create the street environment and its culture. Regulation determines how street design is controlled and managed. In return, the nature of street design can determine the need for regulation (for example, a speed limit on a tight bend). Regulation also influences street user behaviour. In return, the characteristics of street user behaviour may require certain regulations to be put in place. Finally, behaviour is controlled by street design, and again in return, the nature of street design may be influenced by known ways of use of street infrastructure.

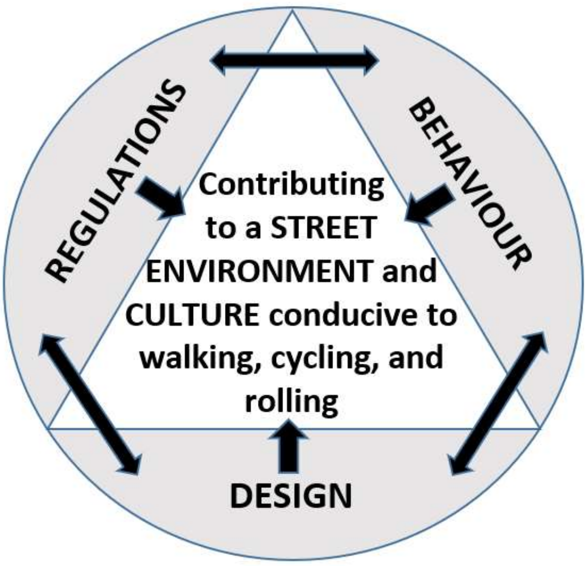

Figure 1 - Illustration of inter-relationships between the research elements

A street environment and culture that is *conducive* to walking, cycling and rolling, is one that is safe, comfortable, direct, attractive, coherent, legible, connected and inclusive (Department for Transport, 2020b; Transport for London, 2020a; CROW, 2016). Streets or routes that are not conducive, that are unsafe, uncomfortable, indirect, unattractive, incoherent, illegible, unconnected, and inaccessible, may be described as hostile.

The Cambridge dictionary defines conducive as: *"providing the right conditions for something good to happen or exist"*. This definition could be understood to be about both enabling and encouraging people, in the case of this research, to travel actively. Following on from that, it could be argued that this suggests that walking, cycling, and rolling are not neutral alternatives to driving, but they are seen as 'good' or better. Creating streets that are safe, comfortable, direct, attractive coherent, legible, connected, and inclusive for walking cycling and rolling is not neutral, as it will have an impact on other modes, especially private motor vehicles. So, providing the right conditions for walking, cycling, and rolling to happen or exist, will both encourage and enable it, but will only be delivered at the expense of the current car-centric status quo.

1.3 Aim and research questions

The starting point for this research is streets in their current form and function, and a consideration of those street users that are marginalised by streets. Past consideration of streets is now dated because a new era of urban transport has begun that requires that attention is given to street user behaviour with an elevation of the needs of marginalised street users. Previous policy agendas emanating from Buchanan's Traffic in Towns (1963) have increasingly created streets that are car dominated and have marginalised some people who walk, cycle or roll. Highlighting the needs of marginalised street users is key as the thesis is that if these are met then streets will be conducive to all who choose to walk, cycle or roll. Behaviour of other street users (and in some cases other actors such as policy makers) is a critical component of how conducive a street is to these marginalised people. Prior to the study it was unclear how important the behaviour of others was relative to street regulation and design. So, it was considered important to ensure that aspects of behaviour that shape regulation and design were included in the research questions.

The aim of the research is to understand how street user behaviour, design and regulation, and the interactions between them, shape street environments and culture and the implications for walking, cycling, and rolling.

The aim is supported by the following research questions:

1. What are the aspects of street user behaviour, design and regulation that are most important to the most marginalised people on foot, cycle or rolling?
2. What is the relative importance of behaviour, design and regulation to a street environment and culture that is conducive to walking, cycling, and rolling?
3. What are the interactions of street user behaviour, design and regulation that create a network of streets that is conducive to walking, cycling, and rolling?

For the purposes of this research the *most marginalised* street users are those that are most disabled by the street environment. The most marginalised street users on foot include visually impaired pedestrians, older pedestrians (aged 65 and over) and younger pedestrians (aged 18-24), particularly women who walk alone, but may at times be deterred by personal safety concerns. Marginalised cyclists can be typified by child cyclists, including competent riders who may be deterred by personal safety concerns. People who roll include users of prams or pushchairs (particularly double buggies, due to the additional footway width that these require) and users of wheelchairs, mobility scooters and other mobility aids.

When seeking to improve walking and cycling facilities on streets, a lot of focus, both in research and practice, is on crossings, both at major intersections and mid-block. Far less focus is given to the crossing of side roads and the quality of the links between the larger junctions. For the purposes of the research a *typical street environment* is taken to mean urban road networks with speed limits of no more than 30 mph (50 km/h), on which it would be reasonable to expect mixed traffic (people on foot, cycle or rolling, as well as motorised traffic). The concern of the research is for the movement along such roads between primary junctions. While the primary focus is on UK streets frequent reference is made to the northern European context given the geographical, social, and cultural similarities.

This research comes at a time when cities are in transition. Mobility within most cities has been dominated by the private car and increasing car dependency (Wiersma, Bertolini and Straatemeier, 2017) for more than half a century, but other options are being considered that could address the combined challenges of climate change, air pollution, congestion, and collisions. In response to these challenges, politicians and policy makers are increasingly turning to sustainable transport, or technological developments such electric vehicles, connected and automated vehicles, and different forms of shared on-demand services. In some cases, approaches are being combined, seeking to make cities both sustainable and smart (Bamwesigye and Hlavackova, 2019).

There are two expected contributions of this research:

1. Firstly, a better understanding from the users' perspective of the nature and functioning of a typical street environment necessary to promote more sustainable travel, and
2. Secondly, and important from a policy point of view, the ability to make recommendations for improvements to regulation, design guidance, and design and implementation practice in relation to creating street environments that are safe, comfortable, direct, attractive coherent, legible, connected, and inclusive for walking, cycling, and rolling.

The research reviewed theories relevant to street use. In particular, the Social Ecological Model (Bronfenbrenner, 1974) and the Social Model of Disability (Oliver, 2013). Neither of these two theories was able individually to account for all the relevant considerations, and as a result these two theories were combined into a new theory, the Social Ecological Model of Ability (SEMA). The SEMA is a way to understand street use and promote more inclusive sustainable travel in a way not done before in transport studies. The research is important given the emergence of (electric) micromobility and connected and automated vehicles in urban areas, the development of which is reviewed in Chapter 2.

1.4 Structure of the thesis

Figure 2 illustrates the research design and maps out the flow of the thesis from the literature review to its concluding chapter.

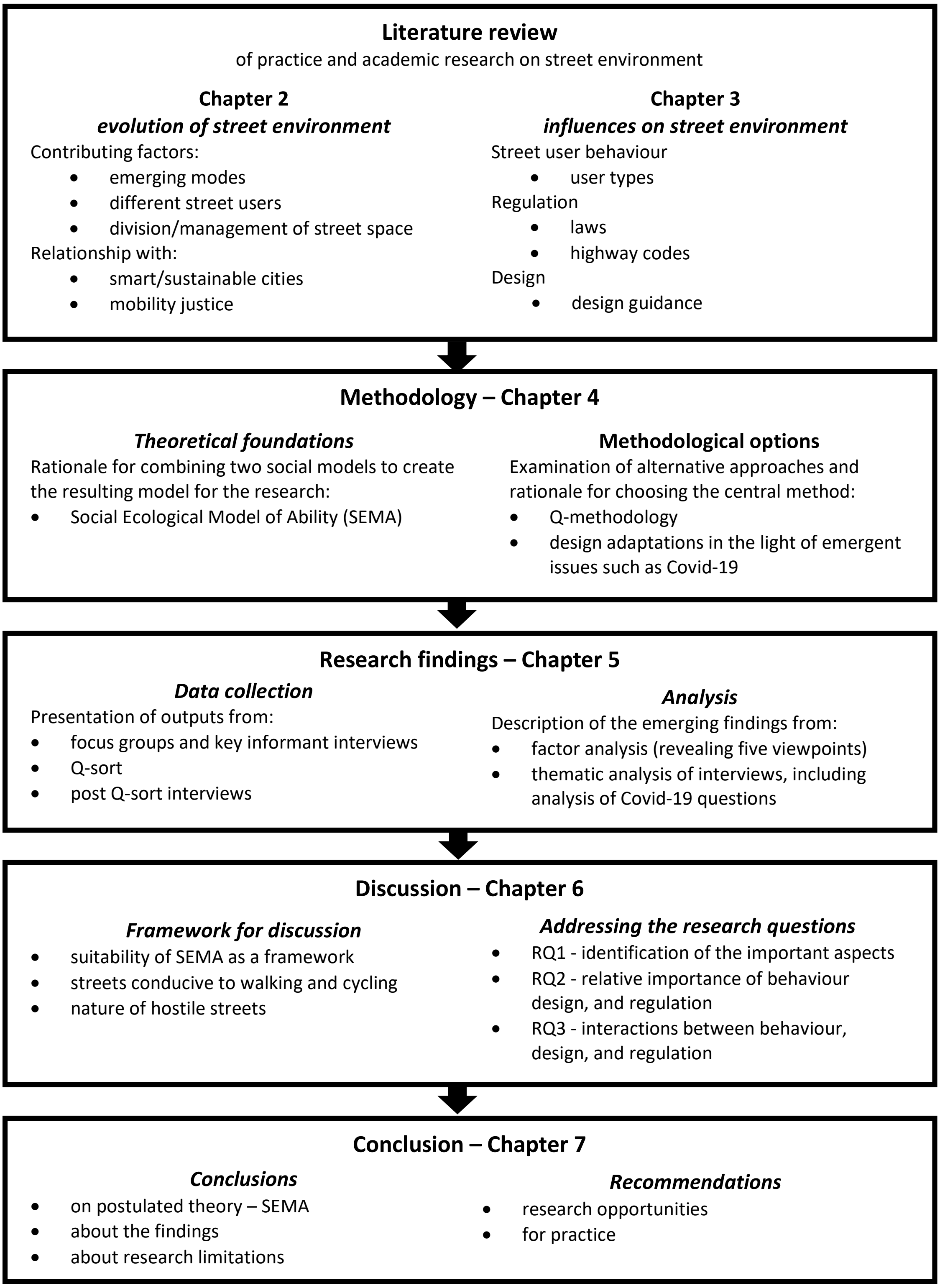

Figure 2 - Map showing the flow of the thesis

Chapters 2 and 3 provide a critical understanding of the current state of knowledge from practice and academic research on the street environment. Chapter 2 describes the evolution of the street environment. It introduces how emerging modes, different street users, and the division and management of street space all contribute to the contemporary street environment and its culture. Additionally, it considers how this relates to smart and sustainable cities of the future and examines the literature on mobility justice. Chapter 3 focuses on what the research tells us about the influences of street user behaviour, regulation, and design on street environment and culture.

Having established the context of the street, Chapter **Error! Reference source not found.** describes the research methodology and provides the rationale for the two social models which have been combined to create a framework for the research, the SEMA. The methodology includes an examination of alternative approaches that were not deemed able to address the research questions as fully as the chosen method. The central method, Q-methodology, incorporates focus groups, key informant interviews, a Q-sort, and post-Q-sort interviews with participants for data collection. The project design needed to be adapted in the light of emergent issues and understandings, such as the Covid-19 pandemic.

In Chapter 5 the research findings are presented and analysed, and the five viewpoints which emerged from the analysis are presented. Chapter 6 provides a critical reflection on this study and discusses the findings in the light of what has been seen in the literature and in theory, before moving on to wider implications. The study findings are used to address the three research questions, including a discussion on the relative importance of regulation and design on behaviour in the street context. Chapter 7 provides conclusions, limitations, and recommendations. The recommendations are sub-divided into research opportunities and recommendations for practice.

2 THE STREET IN CONTEXT

2.1 Structure of the chapter

The purpose of this chapter is to situate streets in their social wider context, describe the evolution of street environments, and provide a framing of the research problem, which is to better understand how streets work, and how they could work better. After placing streets in the context of urban areas, it describes their nature, the users that inhabit them, and the political perspectives, ideologies and policies that shape them. Section 2.2 describes how urban form has evolved in response to developments in vehicles and culminates in a discussion of the form of contemporary sustainable urban areas. Section 2.3 describes the evolution of street space, highlighting the inefficiencies of some transport modes in constricted and limited space, and the environmental impacts of motor traffic. Section 2.4 considers the political perspectives that have shaped street space, and issues of mobility justice. Section 2.5 reviews UK policy development, especially in relation to emerging modes including micromobility and automated vehicles. Section 2.6 considers the way in which people travelling by different modes and at different speeds consume different quantities of time-space, and the consequences of the disparities that result. Finally, section 2.7 summarises what has been learnt in this chapter.

2.2 Urban form and its evolution

The context of streets is urban areas, principally towns and cities. How people behave and use urban streets has evolved over time. Walking, transit, and automobile cities are explored in this section, explaining how urban form has followed the development of vehicle technology. Understanding the wider urban context is key to understanding street space which is the focus of the two sections that follow.

Newman and Kenworthy (1999) link the evolution of cities, particularly in North America, to the development of specific modes of travel; for example, the ‘Walking City’ (up until approximately the 1850s), the ‘Transit City’ (1850s to 1950s) and the ‘Automobile City’ (from the 1950s). Urban areas in the UK and across the world have followed a similar pattern, but at a different pace and with a larger number of stages. Based on commuting journeys, Figure 3 illustrates those eras that could be described as ‘walking and cycling dominated’ (1890-1919), ‘transition to public transport’ (1920s and 1930s), ‘public transport dominated’ (1940s and 1950s), ‘transition to the private motor vehicle’ (1960s), and ‘private motor vehicle dominated’ (1970-present).

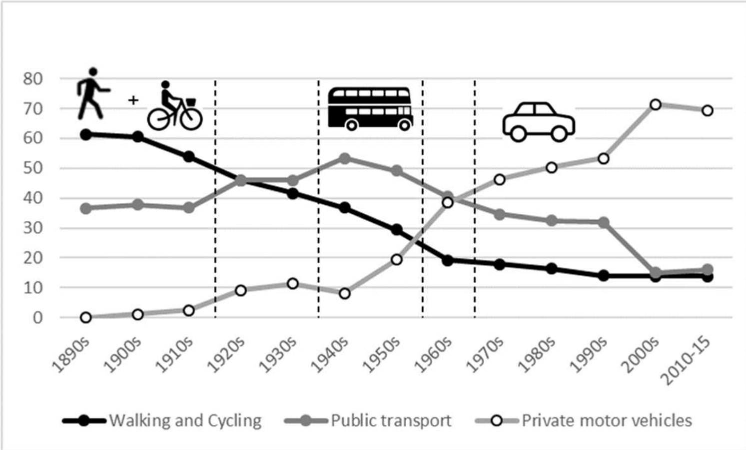

Figure 3 - Journey to work modal choices in the UK

Note. Produced using data from two different data sources, up to 2000 (Pooley and Turnbull, 2000) and after 2000 (Department for Transport, 2017a), see Table 1, p11 from Flower (2018).

It is important to recognise and identify transition phases rather than being focussed on only the periods of different mode dominance. This provides evidence about how a change occurs, which could be useful in attempting to create future changes that may be needed to re-balance current patterns of use to reduce risk and impacts on the environment. The slight apparent downturn in car use since about the year 2000 hints that a further transition period away from private motor vehicle dominance may lie ahead, but at this aggregate level the gap to other modes is still very large. At a city-wide level, the pattern can be different as illustrated in Figure 4 which shows trends in London and the sub-set of data for Inner London.

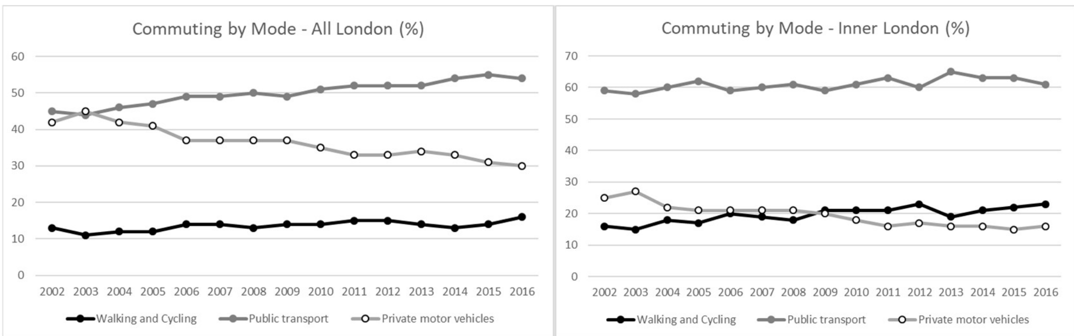

Figure 4 - Journey to work modal choices (London)

Note. Produced using data from Department for Transport (2018b).

A fall in numbers commuting by car is evident in the All London and Inner London data (a fall of 15 and 11 percentage points respectively from the high of 2003). The data for commuting by public transport in All London shows a rise of ten percentage points over the same period. Walking and cycling has grown in All London, overtaking the private vehicle mode share in Inner London in 2010. Perhaps the most dramatic change has been a doubling of cycling rates from three to six percent in all London and four to ten in inner London.

Sub-sections 2.2.1 to 2.2.3 illustrate in more detail the historical evolution of cities described by Newman and Kenworthy (1999). Understanding this evolution is important as it has left a legacy in some of the infrastructure and forms still imprinted on the streets of modern cities.

2.2.1 The walking city

Streets in many cities still reveal medieval patterns and widths that reflect the technology and scale of people walking or a horse and cart. These can still be seen in medieval streets such as the Shambles in York, or the souks and medinas of North African cities like Fes, which is reported to be the world's largest car-free zone (Laker, 2017), where work, shops and accommodation all lie in very close proximity. From the 1850s this began to change as city streets no longer revolved around walking. The scale began to change too, as the distances required to travel from home to work, shops and entertainment, and the width of the streets all expanded.

Turton (1961) describes a particular type of walking city or town that had some prominence in the 19th century, urban developments that became home to a population that were largely employed by a single industry. Examples include the South Wales mining towns and the mill towns across northern England.

Railway towns are of particular interest as although they had walking as their main internal mode, the focus of their industry would help to usher in the age of the transit city. A good example of such a town was Wolverton, now part of Milton Keynes and in 2022 still home to the Royal Train (Marsh, 2013). Its original name was Wolverton Station around which a town grew to house, at its peak, more than 5,000 employees for the railway works which initially built engines and later railway coaches. The Victorian town had a grid street system of terraced houses and all the necessary amenities. The railway works provided shops, services, churches, and entertainment in the form of a park, cinema, a football ground, and a velodrome. Nothing, including the gates of The Works, were more than an 800m walk from each home. For decades, a siren would sound to mark the beginning of each shift and the streets would fill with hundreds of workers walking to and from their place of employment. A rump of The Works is still operational in 2022, 183 years after first opening, now employing only a few hundred to renovate railway carriages. Some still walk from their nearby homes, but walking is no longer the main way of getting around. Many decades ago, like other towns in the UK, Wolverton transitioned to public transport, termed transit in North America, and then to the private car.

2.2.2 The transit city

Urban sprawl, with its associated low density living, particularly in North America, and dispersed amenities is sometimes associated with the growth of road building and transition to the private motorcar as the dominant mode of choice. However, Wachs (1984) explains that even in archetypal low-density, dispersed cities such as Los Angeles, the roots for these developments can be traced to an earlier period of dispersed growth between 1880 and 1910, when interurban trams enabled people to move beyond the city centres, in pursuit of low-density living. After 1910, the author draws links with the planning policies and political decisions that followed and the massive road building programme that continued the dispersion trend. This came at the expense of developing a regional rapid transit system and people began to switch from trams to cars.

Transit cities developed urban corridors and suburbs along public transport routes, where people chose to live. However, the street environment that lies between these transit corridors, and between the stops on the transit route, is somewhat different. This difference continued with the advent of the privately-owned car as people made decisions about where to live and where, and how, to travel. Henderson (2009) describes these 'in-between' streets as areas of urban blight not inhabited by those that can distance themselves from poor schools and urban crime, and the sort of streets that people would avoid on foot, especially at night.

Los Angeles provides an example of transit-oriented development that has its roots in the 19th and early 20th centuries. Manchester's Altrincham and South Junction Railway, now part of the Metrolink tram system, and New York's underground railway in the US, were both funded at least in part by land value capture. The first encouraged the development of housing for workers from Manchester's expanding city centre. The second encouraged people living in overcrowded districts like lower Manhattan to move out to the suburbs (Knowles, 2012). Public transport development by way of electric trams spread faster, further, and earlier in US cities compared to the UK, hastening the transition from the walking city to the transit city (Ward, 1964). The technology changed land use patterns, but also left its imprint on the streets themselves with the introduction of tram tracks. Knowles suggests Copenhagen's 'finger plan' as an exemplar of planned transit-oriented development after the Second World War. This has been revived in the 21st century with the Ørestad new town extension. Unlike its predecessors this is part of an intentional policy move to encourage living without cars and includes extensive high-quality cycle provision.

2.2.3 The automobile city

The urban development along corridors that started in some transit cities continued and was accelerated in automobile cities. The private car has meant that people are not limited to living in the suburbs or communities on public transport corridors, but as Root, Boardman and Fielding (1996) report, from the latter part of the 20th century people increasingly chose to live in rural villages in the commuter belts and still work in city centres such as Oxford and London. This led to streets hostile to people on foot and cycles with further decentralisation of services, growing suburbs, and zoning of uses by planners. Falcocchio, Levinson and Herbert (2015) describe an 'automobility' where neighbourhoods and services are only accessible by car. It creates a car dependency and segregation, as those that do not have access to a car are unable to live in certain areas or even to visit.

Luckin and Sheen (2009) used the language of conflict as they explored the needs of non-drivers in the urban context of automobility. Even the fact that people on foot and cycle are framed in relation to the car illustrates streets that are not designed for them. In their view it is not only infrastructure, but also the regulatory system which is heavily skewed towards driving and pays little regard to the rights and needs of people on foot. During the Second World War UK road collision fatalities peaked at over 7,000 a year and more than 200,000 injuries (Luckin and Sheen, *ibid.*). The main casualties were people on foot and two-wheels, and many were directly attributable to the behaviour and inexperience of young drivers of heavy military vehicles.

Mayers and Glover (2019) describe the experience of people cycling in car-centric cities as one of poor infrastructure that inhibits a conducive and safe space, citing examples where cyclists must re-join traffic when cycle lanes end suddenly, carriageway edges that are poorly maintained, and parked cars that are frequent obstacles. One solution is separate cycle lanes, but these have always been contested spaces (Oldenziel and Albert de la Bruhèze, 2011). Initially separated cycle space was seen as a way to control cyclists and subordinate cycles to the car, but more latterly they have been resurrected to provide safer provision as a way of enabling cycling for all. Some, such as Forester (2001), have promoted 'vehicular cycling' within the carriageway claiming that it is safer than cycling on bikeways. Pucher (2001) rebuffed such claims with European evidence suggesting separated infrastructure leads to 10 times higher mode share and 10 times lower fatality rate than the USA. De Vos *et al.* (2021) demonstrated in their study that when the design of hostile car-centric residential environments are changed in cities such as Ghent, street design can have a direct effect to stimulate walking and cycling and discourage car use, for example by providing wide, well-lit footways, separating cycling lanes, introducing car-free or car-reduced areas, and limiting car parking.

By the 21st century, cities had changed from ones characterised by densely populated city centres that were walkable and mixed use. The city dominated by pedestrians at the turn of the 20th century had become one dominated by cars. In the 1960s Buchanan illustrated this change in his Traffic in Towns report (Buchanan, 1963) showing footways given over to parked cars, the street clutter of road signs, and even carcasses of abandoned cars. The latter may have gone, but the dominance of cars has become even greater

2.2.4 Sustainable cities

The evolution of urban forms characterised by the walking, transit and automobile cities brings us to the modern era and the emergence of the sustainable city. Dematteis and Governa (2001) described the ribbon and ring patterns of transit and automobile cities, whereas the smart and sustainable cities of the future could be seen as almost coming full circle back to the historic city centres that were walkable, densely populated and had mixed use. Del Mistro, Proctor and Moyo (2017) theorised that sustainable cities, in order to accommodate increasing populations, economies and urban footprints, also needed to be multi-centred so that some parts of them remain walkable. Multi-centred sustainable cities are beginning to be characterised by various versions of Carlos Moreno's concept of the 15-minute city or neighbourhood, exemplified by Paris, where all amenities are within walking, cycling, and in some versions public transport, reach within this same limited timeframe (Moreno *et al.*, 2021). 15-minute cities, or in some adaptations 20-minute cities, may be attainable with a change of street environment and culture. Changing a city's focus from unfettered, often auto-mobility, to the ability to reach key facilities in a given period of time, sometimes referred to as accessibility (Capasso Da Silva, King and Lemar, 2020), could achieve this.

The importance of land use patterns, which are the progenitor of travel needs, is a key consideration in any move to more sustainable cities in the future. Another key consideration is a shift of focus in urban transport planning from providing for mobility to catering for accessibility. Bertolini, le Clercq and Kapoen (2005) define accessibility as what can be reached from a given point in space using different means. Their thesis is that, given the right land use conditions, the accessibility afforded by travel options such as walking and cycling can match, or even surpass that of less sustainable modes. Based on this thesis, the street environment and culture will need to be very different if accessibility is assumed to be predominantly on foot, cycle, or public transport, versus an assumption that it needs to be made by car.

McLeod and Curtis (2019) describe the notion of 'boulevardisation', introduced to the streets of Stockholm and Helsinki since the turn of the millennium. Boulevards were built into Paris as part of Housman's urban plans during the Napoleon III era (1853-1870), creating wide and straight streets that connected points, a style adopted in other cities around the world (Asl, Nouri and Sattarzadeh, 2014), which provides space and an attractive environment for walking. These wide boulevards have made it easier for Mayor Anne Hidalgo to retrofit more dedicated cycle space. Another French city, Lyon is in the process of transforming two urban motorways into boulevards, one of which runs along a riverbank (Prenveille, 2017). This involves declassifying the motorway, reducing the road capacity for private cars, creating dedicated public transport, cycle, and space for people on foot, as well as other changes such as plantings.

The notion of boulevardisation has also been seen in the UK, creating streets that are more conducive to the human scale. Leicester City Council dismantled a flyover in 2014, replacing traffic lanes with cycle lanes, creating new connections for pedestrians and cyclists. Additionally, two car parks have been transformed into public squares (Griffin, 2020). In South Bristol developers have described this process as humanising an arterial road to create a city boulevard (Harvie, 2019).

By increasing investment, and allocation of space and priority for walking and cycling, the culture and environment of streets in some urban contexts is changing. There are a growing number of adaptations of 15-minute cities globally, but they all share a common objective of reducing car use (Pozoukidou and Chatziyiannaki, 2021). Other approaches have also used different combinations of policy measures in order to limit dependence on the car and they include: liveable streets (Appleyard, 1980), superblocks in Barcelona (Rueda, 2019), and low traffic neighbourhoods (LTNs) in London (Aldred and Goodman, 2020).

Investment for these types of interventions has accelerated since the beginning of 2020 with the onset of Covid-19. The weaknesses of dispersed and zonal urban planning models that have separated where people live from the amenities that they need, have been exposed. Lockdowns, quarantines, social distancing, curfews and other measures to protect health, made the need for proximity to basic amenities very attractive. This has led policy makers to re-think the city, and some, of varying scale and geographies, have returned to the concept of “chrono-urbanism” (Moreno *et al.*, 2021). Moreno believes that many of the temporary infrastructures introduced by various cities in 2020 could equally be implemented in pursuit of 15-minute cities, such as: cycle lanes, walking zones, hyperlocal micro-markets, shipping container hospitals, pop-up shops, and outdoor restaurants. Restrictions on public transport services and capacity have led to conceptualisations of how to better link people on foot and cycle to local amenities using key urban routes (Palominos and Smith, 2020).

News outlets, including El País (Medina *et al.*, 2020) in Spain, have reported road space being taken away from parking and driving in cities around the world, to create hundreds of kilometres of temporary cycle lanes and widened footways, with plans to extend these and make many permanent. Paris and Bogotá stand out due to their ambition, the number of kilometres achieved and large increase in numbers cycling; 50 km (France 24, 2020) of temporary cycle lanes made permanent in Paris and a doubling of cycle journeys reported in the Colombian capital. Glaser and Krizek (2021) evaluated evidence from 55 US cities that made street-focused emergency responses. They found that six months on, 15 out of 30 cities that introduced ‘slow streets’ (similar to Low Traffic Neighbourhoods, LTNs) were still continuing, including six cities which had expanded or made the experimental changes permanent. Eltis, the Sustainable Mobility Observatory (Figg, 2021) has reported numerous initiatives across the British Isles. Modelling predicted 10 times as much cycling and five times as much walking in London as it moved out of lockdown. In response 30 km of temporary cycling lanes was created. The UK #BikeIsBest campaign used billboards to publicise percentage rises in cycling between May 2019 and May 2020: Liverpool (161%), Manchester (127%), London (54%) and Birmingham (55%).

Brighton, Bristol, and Sheffield all closed roads to general traffic to give more space to cyclists and pedestrians and after evaluation Bristol made some of these permanent in 2021. The borough of Lewisham repurposed parking bays as pavements to create extra space for pedestrians and London as a whole added 5,000 square metres of space for pedestrians.

The Scottish Government created a ‘Spaces for People’ fund for temporary walking and cycling improvements and the Welsh Government launched a £15.4M initiative to widen pavements and create more space for cyclists. Other cities have not gone so far, with some making insufficient or cosmetic changes.

Problems and issues with implementation

The re-appropriation of space for cycling has been met with a backlash from some quarters (Hill, 2017). This backlash is not only to the temporary infrastructure that appeared in response to Covid-19, but also to permanent infrastructure. Sadik-Khan and Solomonow (2021) argue that *bikelash* is a paradox as despite the vocal backlash and media storm, city mayors that invest heavily in quality cycling infrastructure and other projects that make cities more liveable get voted back into office with strong majorities. Across Europe in Milan, London, Oslo, Paris and Barcelona that has been the case.

In North America there is increasing consideration in urban design to walkability (Ewing *et al.*, 2006; Ewing and Handy, 2009; Speck, 2013), which has received muted criticism from people who perceive it in a negative light. Dong (2017) links walkability and neighbourhood safety, giving the example of Oregon where the quartile with the lowest level of walkability has significantly less burglary, but levels of robbery are not significantly different. Some like Cozens (2011) argue that walkability, especially where this creates greater permeability, undermines safety. However, Jacobs (2000) held the counter view that high footfall and pedestrian 'eyes on the street' serve as safety measures. Immergluck and Balan (2018) described the gentrification of neighbourhoods where increased walkability led to rises in land values and house prices. Su *et al*. (2019) have found significant social inequalities in street walkability, and report a correlation between walkability and socio-economic status, showing the disparities in China between the level of walkability, depending on the socio-economic make-up of the area.

After a long development in transport within cities over two centuries, the position now is one where many cities are testing different forms of more sustainable patterns in order to emerge from their car-dominated past. The forerunners could be seen as pilots that other cities might emulate if they prove to be successful in the eyes of street users and voters (we return to the issue of politics in Section 2.4).

2.3 The nature and evolution of streets

This section defines the street and then describes the challenges of urban transport inefficiency and environmental impacts. This leads to the major focus of the section, namely the evolution that has led to the street in its current form. Most people will be familiar with streets, but this section seeks to provide fresh insight and both a theoretical and practical explanation of street space.

2.3.1 Understanding the street

In the UK, a highway is a way over which the public has the right to pass and repass. Sauvain (2013). In urban contexts, roads are often known as streets and may include, firstly, footways (the part of the highway reserved for people travelling on foot), secondly, the carriageway (where wheeled vehicles are permitted, which is often at a slightly lower level than the footway), and, thirdly, sometimes a separated cycle track which may be at carriageway level or stepped between the carriageway and the footway.

The right of passage on a highway implies ‘movement’, and highway engineers tend to particularly consider engineering carriageway capacity for vehicle movement. Streets also have a ‘place’ function, associated with people choosing to dwell and not just to pass through. Place functions may be associated with shopping, resting, observing, socialising and other aspects of living that require time to stop (Mehta, 2013a). Urban planners are tasked with designing streets for ‘place’ as well as ‘movement’ (Jones, Marshall and Boujenko, 2008). Marshall *et al.* (2018) suggests that viewed broadly, streets, unlike roads, are not just linear conduits, but can also be containers of urban life, expressions of civic society, cultural interfaces, or even political acts, an echo of Jane Jacobs who saw streets as the lifeblood of cities, not mere traffic channels (Marshall, 2005). Southworth and Ben-Joseph (2003) describe streets as the public framework that structure neighbourhood and city life.

‘Street users’ could be considered as people who walk, cycle, and roll and are able to engage with their surroundings in a way that is difficult when in a motor vehicle. Street users can see, hear, smell and touch things around them and talk to other street users. By contrast those in motor vehicles have their senses dulled to the street environment. Figure 5 illustrates how driver perception can be impaired by speed, and so they can see the road ahead but miss much of the street activity. People in motor vehicles can hear little of their external surroundings and lose a sense of smell and touch beyond the interior of their cabin. Those in motorised vehicles could be referred to as road users rather than street users. For the rest of this thesis street user is used to mean people who walk, cycle and roll.

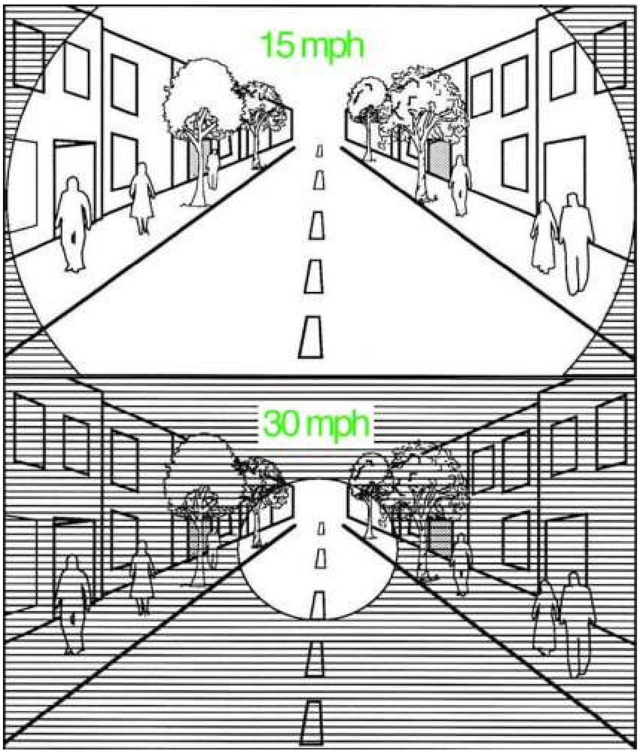

Figure 5 - Driver perception of the street decreases with speed

Note. Reproduced from Schmitt (2015).

2.3.2 Transport inefficiency

In the most congested cities, the mean speed of road traffic is reducing. Globally, of the 25 most congested cities, the inner-city last mile speeds range from 7-15 mph, and eight out of ten of the cities with the most hours lost to congestion are European (Reed and Kidd, 2019). Some car journeys in historic city centres built for pedestrians and horses, are no quicker today than they were when horse drawn carriages dominated more than a century ago (Trigg, 2015). In fact, in most cities it is already quicker to cycle than drive or take the bus at peak times. Inner-city last mile speeds in Dublin at 6 mph are slower than running, and in some city locations it is quicker to walk (Reid, 2018a).

Constrained European cities are responding by reallocating road space and changing priorities (Reed and Kidd, 2019). Zurich is an example where the city is managing vehicle speed through its urban areas by introducing a widespread 30 km/h speed limit to slow motor traffic through regulation and physical speed restraint in order to improve safety and promote walking and cycling. Other cities have adopted traffic management approaches to deter motor vehicles from entering their urban areas. Paris has eliminated motorised traffic from the banks of the River Seine Barcelona has created ‘superblocks’ which eliminate through traffic and London is allocating more road space for cycling, pedestrians and public transport

2.3.3 Environmental impacts

Motor traffic is a significant cause of airborne particulates consisting of fine particles with a diameter of 2.5 μm or less, known as $PM_{2.5}$ (Moreno *et al.*, 2015), that cause serious health issues, and mortality rates increase with exposure (Di *et al.*, 2017). Air pollution affects health, ecosystems, and the built environment, which is raising public concern amongst city policy makers globally (Marlier *et al.*, 2016). The response of most municipal administrations has been inadequate as demonstrated by the Obama administration's plan to cut greenhouse gas emissions from power plants being challenged in the Supreme Court in the US, and action taken by ClientEarth against the UK government and some local municipalities (Brugha, Edmondson and Davies, 2018). Bolder approaches like restricting certain vehicle types in Athens, London, Madrid, Mexico, Paris, and Rome perhaps suggests the dawn of a more coherent response. However, the issues around the creation, transmission and impacts of air pollution are complex and need to be tackled in a much more comprehensive way with national and international collaboration on policy and regulatory actions (Casares *et al.*, 2018).

Transport is the key sector where carbon dioxide emissions are proving challenging to reduce. Walking, cycling, public transport and cleaner electric modes are often put forward as a solution, but while fossil fuelled private cars remain the main mode of use, progress is very slow (Hickman and Banister, 2014).

2.3.4 The evolution of street space

The developments at the macro or city level have also been accompanied by an evolution at the micro or street level. This sub-section explores the evolution of streets and how society has grappled with their development and management.

Southworth and Ben-Joseph in their tome, *Streets and the Shaping of Towns and Cities* (2003) focused on the origins and design of residential streets and particularly the role that standards play. Southworth and Ben-Joseph traced street standards back to Emperor Augustus (15BC), who set standards that provided shade, adequately wide footways and kerb separation for pedestrians and carriageway width to accommodate a cart. These can be seen in the excavations in Herculaneum with its street scene preserved from AD79 as shown in Figure 6.

Figure 6 - A street in Herculaneum, Italy

Note. Photo reproduced from page 19, Southworth and Ben-Joseph (2003).

Southworth and Ben-Joseph (2003) question the car-centric standards applied in US metropolitan areas, which lead to streets and communities that are not cohesive, liveable or energy efficient. Often in the US fire departments resist people-centred street designs on the basis that their equipment requires wide streets. However, the city of Portland successfully worked with their fire department as part of a 'Skinny Streets' programme, to demonstrate that fire truck operation is not impaired in much narrower streets (Schwartz and Rosen, 2015). In the UK it is often refuse lorry swept path analysis and access for cars that trumps all else in residential street design which leads to dispersed, disconnected street patterns.

Marshall (2005) considered the evolution of street space through the lens of changing patterns. Prior to car domination, high streets were linked to residential streets like a fishbone, but modernist policy 'filleted' the city, leaving the circulatory system of the road network as something separate from living streets, where major traffic roads cease to be 'streets' at all. Figure 7 shows the street as the connecting point, the glue that brings together movement, provides a frontage for buildings, and forms a large part of public space for commercial and social activity. As urban forms have changed to serve the car, the role and focus of the street has also changed and new patterns have emerged. Urban centres have become appendages of the distributor roads and accessibility to amenities and residential areas has moved from the city centre streets to the urban periphery.

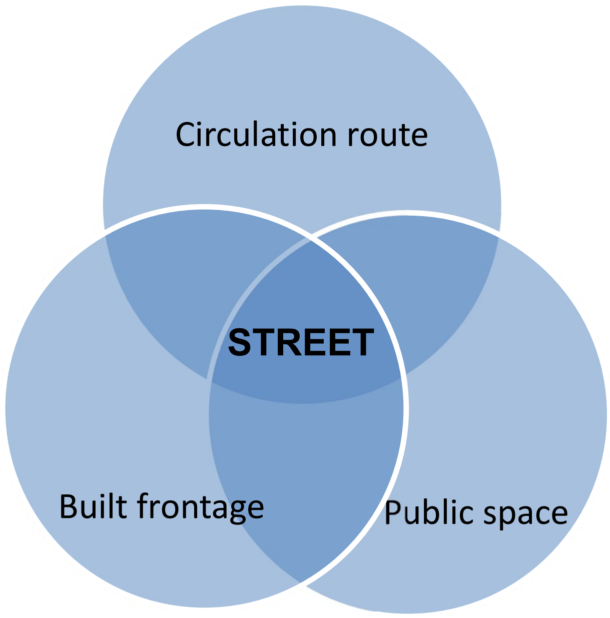

Figure 7 - The street as a connecting point

Note. Adapted from Marshall (2005).

Marshall (2005, p.8) describes the 'schism of Modernism' created by car dominated streets in almost spiritual language, *"the body of streets"* being *"dismembered, evacuating its soul".* Motorised traffic dictates everything: road design for peak hour flow replaces street design; the spatial form and aesthetics of architects and the public realm optic of planners is separated from the practise of highway engineers. The concept of the street environment as a place for people has been shattered.

Tripp (1942) while Assistant Commissioner of Police in London shared his thoughts on town planning and road traffic and introduced the notion of an urban pattern that turned streets inside out a bit like railway corridors with buildings having their backs to these vehicular corridors. This idea was too much for Buchanan (1958) who questioned whether creating grid roads was a price worth paying for the motor car. However, he seems to have come to terms with some of Tripp's ideas a decade later when he made the distinction between roads for movement and streets providing access to buildings (Buchanan, 1963). Tripp's phrase 'from the traffic point of view' and the dominant idea of traffic flow and circulation that emanates from it has been adopted by highway engineers and planners ever since. It has led to design, regulation and travel behaviour being seen primarily from a road user perspective. Interestingly, given that Tripp was a police officer, he held that road behaviour should be controlled by means of road design and not by regulations (J.S.M., 1943).

Traffic in Towns was a report commissioned by the UK Ministry of Transport (Buchanan, 1963) which was well received at the time (Proudlove, 1964) and its ideas of designing some streets for 'movement' and others for 'place' continue to be embraced by transport planners (Young and Jones 2010). It concluded in the words of Lord Chesham that *"cars are a boon, but they have now started to choke movement and, indeed, to threaten the quality of urban life"* (Hansard HL Deb., 27 November 1963). Buchanan (1983) believed the number of vehicles would continue to rise beyond the capacity of streets to cope, thereby reducing the door-to-door convenience that car-users seek and increasing the numerous disbenefits of driving for everyone (especially pedestrians), including safety, anxiety, noise, pollution, vibration, and visual intrusion. Solutions that seek to improve the door-to-door convenience of driving were seen as likely to be at odds with solutions to improve the street environment for everyone, when not in cars. The nature of streets with a 'place' function tends to limit their capacity for motor traffic. The report suggested that either traffic needed to be restricted to curtail the disbenefits of driving or those streets needed to be modified to both increase the capacity and mitigate against the disbenefits. Historic 'place' streets have an inherent low capacity for motor traffic with absolute limits, lower than future likely desired demands, that no amount of money could change. Buchanan proposed that most private car journeys would need to be replaced by other means, principally public transport.

The report received sharp criticism from some quarters. It failed to consider those that did not have access to a car and who relied on other modes, even though only 30% of households had cars at the time of writing (Leibling, 2008), the assumption being that almost everyone would want a car. Hillman (1983) claimed that Buchanan made two flawed assumptions which led to the report's conclusion that it was possible and desirable to redesign streets to accommodate cars if that could be afforded. Firstly, accessibility in the report equated to the ability to drive door to door and was assumed to be shortly within the grasp of most people. However, 20 years later only one third of adults had a car and 50% a driving licence, and almost no attention was given to the accessibility of people without cars. These assumptions created great inequalities and the solution of 'movement' corridors did not consider the effect of that environment for people living there or the severance that they would cause. Secondly, the concept of 'environment' was restricted to ‘a method of arranging buildings for motor traffic’ and overlooked the social aspects that would bring an end to children’s right to roam alone, the consequences of road traffic collisions - the highest peace time road death rate of 7,985 occurred in 1966 (Department for Transport 2008b, p.106 Table 2), the destruction of long-standing communities and the upheaval of years of construction. Additionally, the financial costs of achieving high private car accessibility were not properly evaluated and no low-cost mobility alternatives were considered. The resulting changes in urban forms included multi-storey car parks and pedestrianised shopping centres usually only accessible by car. Hillman (*ibid.*) suggests that the report engendered car-based living patterns and associated planning decisions resulted in more dispersal, and car mileage per person rose 50% in 20 years.

Marshall (2005) reflected on the urban forms that were imagined and could have emerged from the ‘Traffic in Towns’ report, including elevated motorways and grade separation between motorised vehicles and pedestrians (with little or no consideration for cycling). Extensive plans were developed for cities such as London, Glasgow, Manchester, and Birmingham, but very little was ever built beyond London’s A40 (M) Westway, Birmingham’s A4400 Inner Ring Road (now largely dismantled) and Bristol’s M32 (a low capacity and highly congested motorway with limited capacity due to constrictions in the city centre).

Jones, Marshall and Boujenko (2008) suggested that the Traffic for Towns report ushered in 50 years of traffic engineer led street design for car dominated streets that has created street environments hostile to people on foot, whether they are passing through or lingering. They saw Manual for Streets (Department for Transport, 2007a) as a reflection of a new enlightened attitude to streets where both movement and place functions are considered, which they refer to as link and place.

From the 1990s onwards, there were signs of change with movements like New Urbanism breathing life back into the concept of streets for people. It reimagined old urban forms as liveable, more sustainable neighbourhoods with amenities clustered close by in mixed-use localities (Hebbert, 2003), where walking and cycling, supported by public transport are catered for (Newman and Kenworthy, 1999) and seen as the future for streets in sustainable cities.

The concept of streets for people has given rise to the development of more contemporary street forms including shared space and low traffic neighbourhoods. Hamilton-Baillie (2008) advocated for shared space which he saw as a way of reconciling people, places and traffic.

Two of his more noteworthy projects were in Poynton in Greater Manchester and Exhibition Road in London shown in Figure 8.

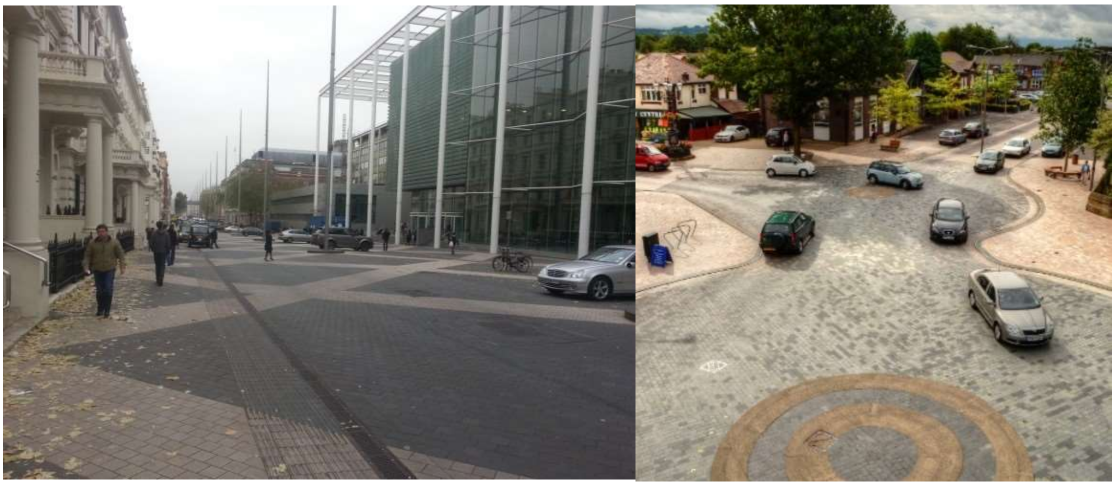

Figure 8 - Examples of shared space in the UK

Note. Photos of Exhibition Road (left) and Poynton (right) reproduced from Project for Public Spaces (2014).

However, an examination of an early shared space scheme in Ashford, Kent using video observation and a street survey of pedestrians, found that most pedestrians deviated from their desire lines, tended to give way to vehicles and generally felt safer with the original road layout. Moody and Melia (2014) conclude that some positive claims about shared space have been overstated, and caution is needed, especially when considering shared space schemes for environments of high traffic flows.

Low Traffic Neighbourhoods (LTNs) are a street form that stops motorised traffic passing though residential neighbourhood blocks, while retaining through cycle and pedestrian movements. They have been used at different scales from the Super Blocs of Barcelona to smaller schemes such as in Walthamstow in London. Goodman, Urban and Aldred (2020) used vehicle registration data to examine whether active travel interventions, including LTNs, can reduce motor-vehicle ownership. They found statistically significant reductions in car and van ownership in areas in areas where LTNs had been introduced. From a longitudinal survey Laverty, Goodman and Aldred (2021) found that with LTNs, residents increased their walking and cycling relative to people living elsewhere. Additional research (Goodman, Laverty and Aldred, 2020) found that emergency service response times did not increase, alongside an 18% reduction in street crime after three years, and a 75% reduction in the risk of injury in a road traffic collision, which corroborates evidence from similar schemes in The Netherlands. LTNs can also make residential streets safer for play, socialising, and exercise. LTNs were the most promising way to reallocate road space from cars to walking and cycling using the Covid-19 emergency active travel funding (Department for Transport, 2020h) and changes to regulations (Department for Transport, 2020d) meant that emergency traffic regulation orders could be implemented quickly by local authorities.

Such schemes are not without controversy and there have been several backlashes to LTNs, especially from car drivers that have been inconvenienced and required to change their route or routine. Councillor Holland of Lambeth, London said *“it is a culture war between those who want to drive wherever they want, whenever they want, at whatever speed they want – compared to the right of everybody else to get around peacefully and effectively,”* but, *“the truth is most of the people in this area don’t have a car, so driving is just not an option for them. This scheme is just about drivers sharing road space fairly with walkers and cyclists”* (Wall, 2020).

2.4 Political perspectives and mobility justice of street space

The urban street environment and culture is, in part, shaped by the ideologies or outlooks of citizens. Gössling *et al.* (2016) described why in constrained cities, public streets and the allocation of space are contested, due to the growing numbers of vehicles combined with traffic calming measures and the introduction of new infrastructure for more sustainable transport modes such as cycling. They used the German city of Freiburg as a case study and calculated the infrastructure space distribution by mode (personal motorised transport, public transport, cycling and walking). Street space is currently not distributed, prioritised, or used equitably as some people are privileged over others simply by their ability to access a particular mode. To help understand why that is the case, this issue will firstly be looked at from different political perspectives in Section 2.4.1 and then from the perspective of mobility justice in Section 2.4.2.

2.4.1 Political perspectives

In the context of San Francisco, Henderson (2013) identified three broad philosophical leanings that guide perspectives on the role of the street within the context of contested urban space, that he termed ‘street fights’ (see Table 1). Henderson and Gulsrud (2019) developed the concept of street fights further in the setting of Copenhagen.

Table 1 - Three political perspectives on street space

	Progressives (Liberals)	Neoliberals	Conservatives
San Francisco	• Seek to allocate street space to more sustainable modes, which tend to use space more efficiently • By giving space to more sustainable modes the capacity for trips in cities is increased • Allows citizens to move as they please	• Movement paid for by individuals should be unrestrained • If individuals had to pay the true cost, including externalities, for their journeys then the modal choices that people make might be very different, with the role of the car far less dominant • Where they are net contributors to local economy, pay people to walk or cycle or give them mobility credits	• Supportive of individual liberty and freedom and prepared to subsidise it • If they emphasised subsidising movement rather than the right to drive alone anywhere at any time, then a lot more resources and space would be allocated to sustainable modes
Copenhagen	• Car free city life is desirable • An approach to address climate emergency is needed • Citizens should have a right to green mobility in the city • Government should promote cycle space and car restraint	• Greener, safer traffic is needed • Families need cars • Economic growth remains important • Government should promote cycle space, but should not impede cars	• Freedom of choice, including freedom to park remains important • Cars are necessary and cycle space should not impede them • There should be no more car restraint • More car parking is required

Note. An elaboration of Henderson (2013) and Henderson and Gulsrud (2019).

Vanoutrive (2017) explains that progressives believe it is reasonable to charge drivers to achieve environmental and congestion reduction goals, whereas neoliberals conceptualise intelligent road user pricing in terms of a road transport market. There is an overriding belief that movement paid for by the individual should be unrestrained. This market-based approach can be destabilised by the actions of governments.

Paraphrasing the studies referred to in Table 1 the conservative view is mainly one where unfettered movement is seen as a pre-requisite of individual liberty and freedom, and this is something that government should support and subsidise, even if that comes at the expense of environmental and wider social constraints and goals. Conservative thinking usually has the car in mind as the mode that will be used by individuals for this unfettered movement. This could be seen as a quite simplistic representation as the social and economic is conflated. Another way of framing it would be to make a clear distinction between a market economy and a state interventionist planned economy as opposed to conflating social attitudes. For example, a Conservative might hold conservative views about conserving the city how it was prior to the advent of the motor vehicle, while a 'progressive' might argue for redistribution of access to cars.

An individual's political ideology is likely to influence their thinking and behaviour in relation to travel, but perhaps of more relevance to streets are the politicians that decide the shape of urban space (Hall, 2014). The policies that they create evolve over time which is addressed in Section 2.5.

2.4.2 Mobility justice

Justice is a key element of the three political ideologies discussed above. The progressive view espouses social justice, the neoliberal view is concerned with economic justice, and the conservative view relates to the justice of personal freedoms. However, when considering justice in mobility, its nature is rather different (Gössling *et al.*, 2016). Transport justice includes three factors, all relevant for streets:

1. Exposure (to traffic risks and pollution),
2. Distribution of space, and
3. Valuation of time.

As has already been shown, street space is contested, and this can be seen as a justice issue in relation to the freedoms to use space. According to Aldred (2015) the dominant policy paradigms promote a 'utility' model of transport which prioritises the destruction of distance and the minimisation of time spent travelling and gives it a monetary value. The assumption is that time spent travelling is wasted time, something that Lyons and Chatterjee (2008) contest. A utility model is traditionally weighted against active modes, although perhaps this could change in heavily congested cities where cycling can be the quickest mode for many journeys. Cupples and Ridley (2008) present a more progressive, more equitable policy paradigm that strives for sustainable cities and healthy communities and individuals. Within this context government policies promote cycling. How the three political ideologies relate to the three transport justice factors are explored in Table 2.

Table 2 - Relationship between mobility justice factors and political ideologies

	Progressive	**Neoliberal**	**Conservative**
Exposure	• Minimise traffic risks and pollution	• The market will determine exposure to traffic risks and pollution levels	• Tackling traffic risk and pollution levels must not restrain freedom to drive
Distribution of space	• Equity in distribution of space • Ensure walking, cycling and public transport are catered for	• Space distribution by mode and land use determined by the market	• Freedom to drive anywhere at any time will be protected • Adequate space will be allocated to parking
Valuation of time	• Seek equity in valuation of time • Journey types such as for education and shopping valued	• Some people's time is more valuable to the economy than others	• Accept the status quo where business and commuting trips are most highly valued

This difference in privilege displays itself in different ways, but two key measures of this inequity are the privileges given to higher speed modes and the inequity in the distribution of space amongst road users. Once speed limits are raised or removed, as by the Road Traffic Act, 1930 (20 & 21 Geo. 5, chapter 43), and vehicles are travelling at more than 15 mph, streets become dominated by motorised traffic to the detriment of other modes such as foot and cycle. Private cars also have the effect of privatising public space in a way that is not possible when using public transport, riding a cycle, or walking (Nello-Deakin, 2019).

Mobility justice (Mullen and Marsden, 2016) is an area of study that brings together different strands of philosophical thinking on both justice and mobility. It can contribute to a more progressive approach to making policies and decisions about urban street space and its environment. Maslow (1981) describes a set of basic needs (food, shelter, clothing, and safety) as the base of a hierarchy. Mobility is often required to access these basic needs. The need to be mobile is one strand of mobility justice. Mobility has different aspects from accessibility and inclusion to life-threatening risks and elements of sustaining life. Surviving and living well is conditional on these aspects of mobility. Accessibility and inclusion recognise that mobility enables engagement in social, economic political and personal activities. The focus on sustaining life and on physical risk recognises the role of mobility in provision of essential goods and services, and in threatening lives in multiple ways, such as collisions, poor air quality and through carbon emissions. Mullen and Marsden (*ibid.*) emphasise a need to consider these aspects together rather than as distinct elements.

For people to be mobile there is a need for distributive justice and equity in transportation. In that regard Pereira *et al*. (2017) concluded that opportunity to access transport and how mobility is distributed is key. In the Philadelphia context Sheller (2015) suggested that there is a stark lack of distributive justice, as access is freely available in the rich, predominately white suburbs, but lacking or inadequate in the poor, predominately black suburbs. Barriers to access take different forms. Access to cycling for instance requires physical strength, competence, ownership (or access) to a suitable cycle, perhaps a willingness to take risks, to interact with the elements and a shower or changing facilities at your destination (Cupples and Ridley 2008).

When thinking of distributive justice an alternative is to consider the distribution of space instead of access. Banister (1994) driven by the desire for a more efficient use of limited urban street space proposed the road network be sub-divided and allocated by user groups. A city centre might give 30% of roads to active modes, 30% to public transport and local access, and 40% to general use. He went on to posit that these proportions would vary determined by the dominant land use. He suggested a quarter of a century ago that such a scheme could be immediately implemented in UK cities, but there is little or no evidence that it has been. Banister saw this largely as a means of improving the capacity, speed, and quality of public transport.

Returning to Pereira *et al*. (2017), after comparing several theories of justice in their quest for transport equity they determined that Rawlsian Egalitarianism (Rawls, 1999) best serves mobility justice in the city. They argued that their emerging framework, which also takes on board some elements of Amartya Sen's Capabilities Approach, balances *"a universalist approach to justice and context sensitivity"* (p185). The universalist approach ensures that no-one is left behind, no matter how vulnerable. At the same time, it recognises that equitable solutions are context specific, a point that Sheller (2015) makes well in the context of a US cityscape, when comparing the poverty and racial makeup of different suburbs. However, Sheller (2018) critiqued how mobility justice has been approached in transport studies by the likes of Pereira, Schwanen and Banister (2017) as not going beyond transport justice. They considered distributive justice, including access to transport - Martens (2017) argues that a fair transport system is one that provides accessibility to all, or virtually all – and procedural justice, including access to information (access in its broadest sense is the major focus). Although she acknowledged that this is good in as far as it goes, Sheller (*ibid.*) felt that it missed other entangled dimensions of mobility justice as shown in Figure 9, such as deliberative justice, a feature of feminist theories that raises questions of recognition and exclusion. Looking at transport alone tends to act as if all individuals have the same experiences in similar bodies, not acknowledging that some may chose different routes or modes at night (gender), some may be smaller or slower (age), and others maybe put unnecessarily at risk due to missing dropped kerbs or tactile paving (impairment). Sheller's nested approaches to justice also includes the idea of reparations, for example from oil companies in the light of the profits that have made from products that contribute to climate change.

Figure 9 - Nested approaches to justice.

Note. Reproduced from Table 1 in Sheller (2018).

Sheller (*ibid.*) believes the whole world must answer the question of how we transition to more environmentally sustainable and socially just mobilities and described a triple mobility crisis as:

1. The climate crisis,
2. The urbanisation crisis, and
3. The refugee crisis.

The climate crisis is well rehearsed on the global stage and gets more airtime as it becomes more acute, effects more people and around times of global summits such as COP26 (Shaw, 2021). Addressing it will require many changes, including in the transport sector. The urbanisation crisis described by Sheller revolves around automobility, with possible signs that the tide has turned towards a new mobility paradigm with more shared transport and advocacy to support active modes with policies such as Vision Zero[1], congestion charging and other forms of demand management, and infrastructure changes. The refugee crisis involves mass movements of people and has occurred in a parallel with frequent terror attacks, both in war-torn countries and Western Europe, sometimes using motor vehicles as weapons against pedestrians in city streets. This in turn has caused a backlash, particularly on the right and a somewhat unwelcoming environment for migrants.

The ontology of mobility and mobility justice is far more than transport justice alone. It is therefore unfortunate that mobility is sometimes conflated with transport and even used as a synonym in terms like Mobility as a Service (MaaS). *"Mobility justice is as much about how, when and where we dwell as how, when and where we move"* (Sheller, 2018) which recognises that moving is not always a freedom as some are forced to move on (slaves, seasonal workers, van dwellers, etc.) or having little choice about where they dwell.

2.5 Policy for sustainable modes and emerging modes

This section addresses government policy development, largely from a UK context, to show both how policy has responded to evolving street environments and has contributed to further evolution. UK government policies on walking and cycling have changed over time. At times there has been a conflating of walking and cycling, despite their obvious differences in speed and nature, which continues to the present under the descriptor of active travel. Sometimes walking and cycling are considered as transport and at other times they are treated as something apart from transport. The term 'walking' is sometimes seen to be more inclusive than just the act of walking and can also include rolling (using a wheelchair or mobility scooter) when this is being used as an alternative to walking and inhabiting the same physical space. In contemporary policies and guidance, a similarly more inclusive view is given to cycling which recognises that cycles come in various shapes and sizes.

2.5.1 Policy development

The following timeline charts some of the UK policy developments in walking and cycling from 1949 to the present day:

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[1] A strategy, first implemented in Sweden in the 1990s, to eliminate all traffic fatalities and severe injuries, while increasing safe, healthy, equitable mobility for all

- 1949 – the Ministry of Transport collects data on cycling as part of its traffic statistics
- 2005 – six ‘Cycling Demonstration Towns’ established
- 2007 – ‘Towards a Sustainable Transport System Supporting Economic Growth in a Low Carbon World’
- 2008 – the ‘Cycling City and Towns’ programme launched
- 2008 – ‘Building Sustainable Transport into New Developments: A Menu of Options for Growth Points and Eco-towns’
- 2020 – ‘Gear Change – a bold new vision for cycling and walking’
- 2020 – ‘Active Travel Fund’ launched

Cycling data on or adjacent to roads has been collected since 1949 alongside traffic statistics for motorised modes. Figure 10 shows how cycling rates fell sharply during the 1950s and 1960s and reached an all-time low in the early 1970s at a time when private motor vehicles were becoming the dominant mode. Although cycling data continued to be collected, there appears to be a significant period during which there was no strong policy position on cycling as a mainstream form of transport. However, since the millennium cycling levels have risen steadily with a sudden increase in 2020 in the wake of Covid-19. 2020 had a 45.7% increase on 2019 levels to 5 billion cycle miles, numbers not seen on UK roads since the 1960s (Department for Transport, 2021e).

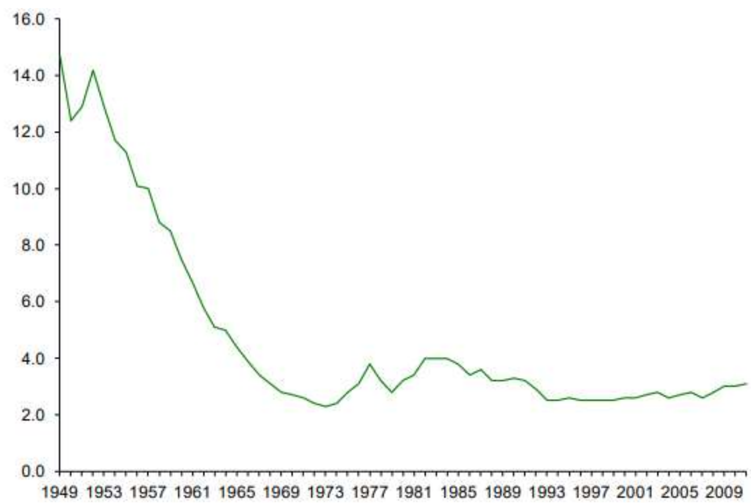

Figure 10 - Cycle usage in Great Britain, 1949-2011 (billion vehicle miles)

Note. Reproduced from Keep (2013).

Similar data has not been routinely and extensively collected for walking as transport from the thousands of roadside manual counts or automated counters. Not collecting such data suggests a policy direction that does not view walking as transport. However, the presence of people walking on or adjacent to roads is apparent in the STATS19 data that records the number of pedestrians that are killed or injured in road traffic collisions (Department for Transport, 2018d). Cycling on routes away from roads is not collected as part of the traffic statistics but is included in separate walking and cycling data that is produced using the National Travel Survey (Department for Transport, 2019c). Since 2017 an attempt has been made to avoid the underestimating of short walks, of less than one mile (Department for Transport, 2021f).

In 2005 six towns were selected as Cycling Demonstration Towns (CDT) with investments in physical infrastructure, promotion and other smart measures made through to 2011 to stimulate increased levels of cycling. After the first tranche of funding, in 2008, the Department for Transport launched the Cycling City and Towns (CCT) programme which built on the experience from the CDTs. 12 additional urban areas received funding and both programmes were evaluated by Sustrans and the University of the West of England (Sloman *et al.*, 2017). Findings were encouraging with automatic count data indicating an overall annual growth rate in cycling of 5.3% for the CDTs and 8.0% for the CCTs, comparable to rates of growth seen in international cities that have demonstrated long-term sustained commitments to cycling.

'Towards a Sustainable Transport System Supporting Economic Growth in a Low Carbon World' (Department for Transport, 2007b) portrayed the UK as a highly mobile society which did not need to choose between being 'rich and dirty' or 'poor and green'. Due to the financial and social consequences of catastrophic climate change 'rich and dirty' was not considered an option and being green did not need to mean being poor. The document sought to guide transport and other polices, accompanied by increasing investment, that would underpin a national transport system that supported the UK's economic prosperity while significantly reducing carbon emissions. At the time the UK government planned to support local authorities undertaking local measures to promote cycling and walking, recognising that small local schemes often represent excellent value for money.

The Department for Transport's (2008c) 'Building Sustainable Transport into New Developments: A Menu of Options for Growth Points and Eco-towns' took the Manual for Streets (Department for Transport, 2007a) approach of making provision for pedestrians and cyclists as part of the transport hierarchy. It also explicitly acknowledged that street design should be inclusive, providing for all people regardless of age or ability, part of the general duty to promote equality that public authorities have under the Equality Act 2010 (c.15). The document underlined the obligation on designers to ensure that disabled people play a full part in not only benefiting from, but also shaping an inclusive built environment.

In developments of up to 10,000 dwellings the policy expected that most local journeys would be feasible on foot or cycle and articulated the need to reduce car dependency.

Pooley *et al.* (2013) challenged the underlying assumption that if walking and cycling are made sufficiently easy and attractive then people will automatically shift from making short journeys by car to more active modes. They identify evidence that such approaches are rarely effective as they fail to fully consider the complexities that prevent people changing their travel behaviour. Pooley *et al.* (*ibid.*) conclude that without also making car use harder and less acceptable, significant modal shifts are unlikely to be achieved. Despite this, policy makers in the early part of the millennium were reluctant to adopt such interventionist approaches, rather they relied on gentle persuasion and promotion of active travel, predominantly on health grounds.

Gear Change (Department for Transport, 2020c) was a UK government policy to promote walking and cycling, but with a clear bias towards cycling as demonstrated by the title. Debates have been going on for some time about the difference between merely encouraging active travel as opposed to fulsomely enabling it (Panter *et al.* (2019). Governments and local authorities may encourage walking and cycling by providing small pots of funding, creating 'school streets' (closed to through motorised traffic around opening and closing times) or promoting schemes like 'take a stand' (providing cycle parking). While these are helpful, they rarely go far enough to enable everyone to walk, cycle or roll for the whole of their journey. This would need comprehensive walking and cycling networks that are safe, comfortable, direct, attractive coherent, legible, connected, and inclusive. The graphic shown in Figure 11 was used to promote the UK government's £2 billion package to create a new era for cycling and walking.

Figure 11 - UK government promotion to encourage walking and cycling

Note. Reproduced from Department for Transport (2020h).

Despite the graphic above suggesting that the funding for the policy would be used only to encourage, the fourth theme of Gear Change went beyond encourage, setting out to enable people to cycle and to protect them when they do. The policy emphasises the key design principle of separation between motor traffic and cyclists and between cyclists and pedestrians. There are clear efforts to be inclusive, both in cycling and walking, with an intention of putting walking and cycling at heart of transport place-making and health policies. To promote more inclusive streets, the policy proposes legal changes to protect vulnerable street users and launched a consultation on the Highway Code to improve safety for all users.

The Active Travel Fund (Department for Transport, 2020j) came in two tranches. The first tranche provided emergency grants to support local transport authorities install temporary cycling and walking facilities required because of the Covid-19 pandemic, to make it easier for people to choose alternatives to public transport. Cycling measures included:

- Pop up and permanent cycle lanes and reallocation of road space
- More cycle parking spaces at railway stations
- Reducing red tape to help councils get schemes up and running more quickly
- A grant scheme for individuals to get their bikes repaired

The second tranche was targeted at the creation of longer-term projects. A letter from Grant Shapps (2020), the Secretary of State for Transport made it clear that authorities that consulted communities and had well-conceived plans following sound design principles would receive all or in some cases more than they asked for, whereas those with schemes that were *"nowhere near good enough"* would not be funded to the same level. However, his words were diluted at the end of the letter where he added that the government would continue to provide support for motorists, and to assure them that once drivers made the switch to electric vehicles, they would be able to enjoy the same freedoms as before, secure in the knowledge that as a country we were tackling climate change. A follow up letter from the Department of Transport (Heaton-Harris, 2021) was sent to all combined, transport and highways authorities. It seemed to respond to a situation whereby some local authorities put temporary or trial walking or cycling schemes in place, only to remove them very quickly in response to either vocal politicians or members of the public. The letter made it clear that although pop up cycle lanes and LTNs are sometimes controversial, as well as being effective there is strong evidence of public support. The Minister of State for Transport urged local authorities to not remove schemes without justification and proper evidence, including objective tests such as professional polling and representative sampling to gauge local opinion.

2.5.2 Emerging modes

Means of moving along city streets are evolving. If a summer lunchtime was spent sitting in the centre of many cities, it would be reasonable to expect to see people walking, jogging, scooting (on kick scooters), using mobility scooters, and possibly even a Segway tour on the footway. On the cycle track, alongside conventional cycles, electric assist pedal cycles, e-scooters, people running, skateboarding and roller skating are likely to be present. As well as cars and vans in the carriageway there would typically also be cargo bikes and electric assist pedal delivery vehicles (for transporting people or goods). Emerging modes of transport are changing the street environment and the sections below explores how they could influence the future city.

Electric vehicles

Over the last half a century or more urban streets have been dominated by the motor car. In the 21st century the position of the car in transport and culture is changing. The internal combustion engine is being phased out to be replaced primarily by electric vehicles, and this will be aided by reaching peak oil (Sioshansi and Webb, 2019). It has been the subject of the Volkswagen 'diesel gate' emissions fraud (Boretti, 2017). Younger people are driving less, getting driving licences later, if at all, and seem to put more value on other consumer goods rather than cars (Chatterjee *et al.*, 2018). Since the turn of the millennium the majority of the people now live in cities, currently making up 55% of the world's population, expected to rise to 68% by 2050 according to the UN (Population Division, 2018). The transition to electric vehicles (EVs) is underway (Sioshansi and Webb, 2019) and it is likely that connected and automated vehicles (CAVs) will follow at some stage (Morgan *et al.*, 2018).

Connected and automated vehicles

The Centre for Connected and Autonomous Vehicles (2022) define CAVs as automated vehicles that are designed or adapted to be capable, in at least some circumstances or situations, of safely and legally driving themselves on public roads. They are connected when equipped with communications technology that enables data transfer with other vehicles, infrastructure or networks.

CAVs have been under development in the last decade, although it does not look like they will be ubiquitous any time soon (Nikitas, Njoya and Dani, 2019). The UK government is trying to accelerate their development and introduction (Gadd, 2016) by fully supporting this.

Car dependency (McIntosh *et al.*, 2014) could be defined as a reliance on private motor vehicles due to sprawling urban forms that include shopping centres with extensive parking. It, along with public transport with a higher generalised cost than driving, and a poor pedestrian environment, has been a major factor in the evolution of highway regulation and infrastructure and road user behaviour over the last half century. Peak car is the notion that the distance per capita travelled in private motor vehicles has peaked. Stapleton, Sorrell and Schwanen (2017) suggested that 'peak car' may have been reached and that we are in a period of transition which provides an opportunity for societies to consider a break with the recent model of private ownership of vehicles. That could mean more sharing of vehicles complemented by a rise of walking, cycling and more human-scale, both human powered and e-assist modes. Conversely, a transfer to privately owned electric CAVs could increase traffic levels by inducing more travel and vehicles running empty (Taiebat, Stolper and Xu, 2019). Whatever the future of cities, it is reasonable to think that these changes will affect how highway regulation and infrastructure and street user behaviour continues to evolve.

The behaviour of pedestrians and cyclists in the presence of CAVs needs considering, especially where CAVs are occupying space that has previously been unauthorised for motor vehicles such as footways, shared paths and public areas removed from the highway (Camara *et al.*, 2018; Merat *et al.*, 2018). Policy development and a series of consultations (Department for Transport, 2019a; Department for Transport, 2020b) have been undertaken to try and grapple with the questions as to whether city infrastructure and regulation such as the Highway Code should change to reduce possible conflicts between pedestrians or cyclists and CAVs, or whether the technology should adapt to accommodate the behaviour of the actively mobile. Shay, Khattak and Wali (2018) in a broad review of literature on CAVs and walkability concluded that CAVs will reshape the built environment, but it is not yet clear whether that will be for the benefit or detriment of walking and cycling. Civil society groups such as the Cycle Embassy of Denmark have made numerous recommendations to ensure that future technology adapts to accommodate active mobility and not the other way round (Weinreich, 2017).

Human-scale modes

While the much attention has been on larger electric vehicles, the big growth in recent years has been in vehicles such as e-scooters. The UK government has been slow to legalise their use and private e-scooters are only legal on private land with permission from the owner, but from the end of 2020 several UK cities began conducting trials. Members of the public who hire the trial e-scooters, who are over 16, hold at least a provisional driving licence and are insured via the scheme are legally permitted to use these vehicles in any location where cycling is permitted. Regulation limits the speed of these e-scooters to 15.5 mph, but some local authorities have limited them further and in certain geofenced areas they may be restricted to walking speed (Department for Transport, 2021a). UK sustainable transport charity, Sustrans (2020) suggests that they have little physical activity benefits and that evidence suggested that the journeys that they were replacing were largely from walking, cycling and public transport rather than cars. Initial European data supports this view, with rental company Lime reporting that 21% of e-scooter trips in Lisbon, Portugal are replacing a car journey and a much lower 8% in Paris, France (Vancluysen, 2019). Moran, Laa and Emberger (2020) provided a case study of six e-scooter share schemes in Vienna, Austria and concluded that, for the benefit of city streets and users, local authorities should be proactive in providing a clear framework on how the schemes should work, including transparency over geofencing, policies for parking, and, if necessary, incentives to ensure that socio-economic deprived areas are not excluded. Similar lessons can be learnt from and shared with floating and dockless cycle and e-bike schemes in other cities.

Hicks (2019) explores the importance of quality cycle infrastructure in streets with the present boom in what he calls “little vehicles”. Human-scale modes are proliferating and as well as personal mobility such as cycles, e-scooters and mobility scooters, companies such as Starship have been successfully using delivery robots for food and parcels in urban areas including Milton Keynes (Bogue, 2019). One challenge that arises is where these human-scale modes should be allowed to travel within the street cross-section. The Milton Keynes robots are operating at least in part on the footway. Hicks argues that if good, separated cycle infrastructure is available then it could be successfully shared with other human-scale modes that are operating at similar speeds. In earlier work he observed how Dutch cycle tracks have become an enabler of mobility for users of mobility scooters and other personal mobility devices (Hicks, 2015).

The International Transport Forum (ITF) (Santacreu *et al.*, 2020) have defined devices and vehicles weighing up to 350 kg for personal transportation, which if powered have their speed capped at 45 km/h, as micromobility. Figure 12 shows the definition and classification of micromobility proposed by ITF. Cycle tracks may be suitable for micromobility travelling at similar speeds as cycles. However, it is generally accepted by most experts that they should not accommodate the faster categories of vehicles and the

Netherlands for example has banned the use of speed-pedelecs (e-cycles restricted to 45 km/h) from using cycle infrastructure in urban areas, but like mopeds they are permitted on inter-urban cycle tracks.

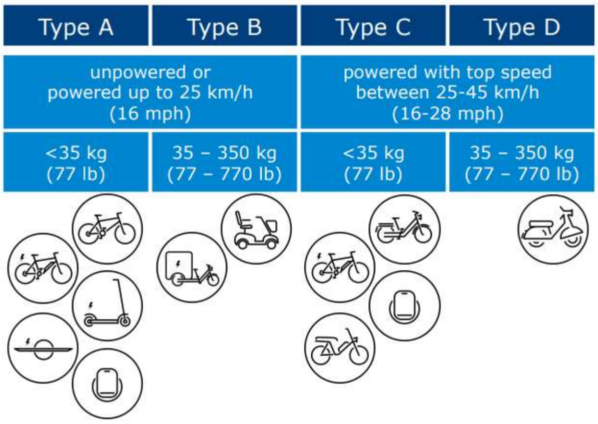

Figure 12 - Proposed ITF definition and classification of human-scale modes

Note. Reproduced from page 15, Santacreu *et al.* (2020).

The ITF definition also limits the kinetic energy of these vehicles to 27 kJ - a compact car travelling at top speed produces one hundred times more than this. The kinetic energy (a combination of mass and speed) produced by a vehicle correlates with the risk of serious or fatal injuries occurring (Khorasani-Zavareh *et al.*, 2017), which indicates that these human-scale modes are far less likely to cause personal injury to other street users than larger, faster road motorised vehicles. Oeschger, Carroll and Caulfield (2020) argue that the main potential of human-scale modes in cities is to address the first and last-mile links to public transport, and thereby offer real alternatives to car-centric urban mobility. That idea is explored further in Section 2.6 which provides answers for why that might be, by considering the way in which people travelling by different modes and at different speeds consume different quantities of time-space, and the consequences of the disparities that result.

2.6 Street users

As described earlier in Sub-section 2.3.1 a distinction could be made between street users as people who walk, cycle, or roll and who have more opportunity to use their senses to engage with the street environment, and road users in motorised vehicles who are more insulated as they pass through. Street users are concerned about place as well as movement. Road users, especially if not on a local journey, are predominantly interested in movement. Being stationary for road users is a problem as it usually signals congestion or delay to their journey, whereas street users may deliberately stop or are already going slow enough to appreciate their surroundings. Road users never visit streets as destinations unless they first leave their motor vehicle and become a street user who walks, cycles or rolls. People in their personal cars create mobile, personal, private enveloped space in the midst of the public space of the street (Merriman, 2009). In a sense they could be seen as removing space from the street, that could otherwise be shared and experienced by others.

Many contemporary cities were not designed for the volume of motor traffic that they now accommodate daily, and some have taken different travel demand management measures to reduce congestion and other disbenefits such as air pollution and carbon emissions. For example, London introduced a congestion charge, Singapore electronic road pricing (Batur and Koç, 2017) and Mexico City allows access to different vehicles each day based on whether they have an odd or an even plate (Farda and Balijepalli, 2018).

The street environment is influenced by design and infrastructure, behaviour of road users, and the speed of the different modes. The environment will in turn influence how street users use that space. The willingness and ability of people on foot to take priority is dependent on the relative volumes of pedestrians and motor vehicles. The images in Figure 13 illustrate that in the centre of Bristol, UK, in the 1900s people on foot had the freedom to roam, only giving way occasionally to passing carts and trams. In the 1930s people on foot were still outnumbering private motor vehicles and were prepared to take priority in the carriageway which served to slow cars down. By the 1960s the balance had changed and although there was still a lot of empty space on the carriageway, motor vehicles outnumbered people on foot and so pedestrians were more reluctant to step into the carriageway and vehicle speeds had increased. By the 21st century, at peak times the carriageway is congested, almost stationary at times, and motor vehicles dominate completely. People on foot will only venture onto the carriageway after they have received, for example, a green light to cross at a signal-controlled crossing, but as Speck (2018, p178) puts it: *“pedestrians shouldn’t have to ask for a light”*. The way of requesting this green light is by pressing a button, often called a ‘beg button’, and waiting at the designated signalised crossing points.

Figure 13 - Central Bristol (clockwise from top left): 1900s, 1930s, 1960s, 2020s

Note. Images reproduced from Vaughan postcards (1900; 1930) and Public Relations photographs (1965).

Table 3 summarises the changes seen in the streets around 'The (Tramway) Centre' in Bristol over the course of just over a century.

Table 3 - Evolution of 'The Centre', Bristol 1900s-2020s

Era	Role of street behaviour, design, and regulation	Other comments
1900s walking and cycling dominated	People on foot walk freely in the carriageway	Only need to give way to the occasional passing tram
1930s transition to public transport	People on foot and cycles still confident to take priority in the road, which slows down the motorised traffic	Buses beginning to emerge as a significant form of transport; a few private cars also present
1960s transition to the private car	Motor vehicles outnumber people on foot who are more reluctant to step into the carriageway; infrastructure - formal crossing points and footways more important than before for people on foot. More space has been given over to motor vehicles at the expense of people on foot.	The vehicle speed has increased with no people walking in the carriageway
2020s private motor vehicle dominated	People on foot will only venture onto the carriageway at the designated signalised crossing points. Emergence of separated walking and cycling provision to protect people on foot and cycle.	At peak times motorised traffic is almost stationary

In low-speed urban streets modern cars are required to operate sub-optimally and there can be a mismatch between operational speeds and design speeds. Wang *et al*. (2006) suggested that the roadway design process in the US that has been designed for high speed and rural roads does not work well in a low-speed urban context. Infrastructure design features that are intended to improve conditions for another mode may have unintended consequences - Dinh and Kubota's (2013) study of residential streets with a 30 km/h speed limit in Japan, suggested that the presence of footways on both sides tends to raise the average speed, compared with streets where people on foot might be expected in the carriageway due to the lack of footway. NACTO (2019) guidance demonstrates the importance of managing speed, especially for the most common vehicles (private cars and taxis). In contrast to drivers of motorised vehicles, city cyclists can travel at or close to their desired speed, especially if well-designed separated cycle tracks are available. The rest of the chapter considers two aspects of street users, relating to the modes that they choose: Sub-section 2.6.1 explores the different speeds of street users and Sub-section 2.6.2 the relative time-space and cost requirements that street users have. Speed and time-space are important concepts for understanding the relationships between street users.

2.6.1 The speed of street users

Figure *14* illustrates a range of different modes found on urban streets, from human-powered and e-assist human-scale modes to the more conventional motorised modes. The figure plots indicative urban speeds against ranges, with sources referenced in Table 4. Actual speeds will vary greatly according to location and time of day, but the figure gives a notion of relative speeds that could be expected. Some modes have a range of speed as their speed varies between, for example, in the city centre and city wide journeys.

Table 4 - Speed and range by mode

Mode	Speed	Speed and range notes
Walking	3mph	Crossing times at signalised crossings in the UK assume people walk at least 2.7mph (Asher *et al.*, 2012), but this disregards the fact that many older people walk considerably slower. There is no upper limit to how far people could walk, but urban journeys usually fall in the 0.5-3 mile range.
Class 1 manual wheelchairs	5mph	Wheelchairs can travel faster than pedestrians but are slower than pedestrians on uphill grades (Axelson *et al.*, 1999). As well as the terrain, speed also depends on the fitness of the user, the design of the chair and the infrastructure. Longer trips are possible, but typically used for quite short trips or combined with other modes.
Hoverboard	5mph	Different models capable of 5-12 mph (10 miles per charge), but most users feel comfortable and in control at a brisk walking pace (ScooterSA, 2018).
e-balance unicycles	5mph	More difficult to master than hoverboards, but with the right model and skill level it is possible to reach 16-25mph (Transportation Evolved, 2019). In a busy street environment brisk walking pass is more likely, but if they become more popular that may change.
(Kick) scooters	7mph	Manual scooters have a coasting speed of 5-8 mph (Levine, Platt and Foltin, 2001). Models with small wheels are most practical on well-maintained smooth surfaces. City-wide journeys possible with long downhill sections. When combined with public transport suitable for regional or inter-urban trips as light and easy to fold.
Running	7mph	Run commuters in Belfast average 6.9mph and TfL data predicts that running will be faster than the average car speed in London by 2020 (Reid, 2018b).
Class 2/3 mobility scooters	4/8mph	Class 2 limited to 4mph and use on the footway (where available); Class 3 limited to 8mph on the road and 4mph when used on the footway (UK Government, 2019). Battery range will vary by model.
Skateboard	10mph	Often used for recreational purposes to perform stunts rather than as a mode for journeys. Uncertainty as to what the speed would be for that purpose, but faster than walking (Rodier, Shaheen and Chung, 2003; Fang and Handy, 2019). Fang's observations report speeds of 6-13mph, with an average of 9.7mph.
Inline skates	10mph	Often used for sport and recreation rather than for regular urban trips, but a study in Florida measured a modal road speed of 10.5mph (Birriel *et al.*, 2001).
Local bus	12mph	Bus speeds have been declining faster than any other mode of transport between 1966-2016 (Begg, 2016). Some routes and corridors operate at significantly lower speeds, where it can almost be as quick to walk. Most services are aimed at urban areas, but particularly in multi-centred regions such as the West of England additionally there can be networks of regional services.
Taxi	12mph	Speed similar to private cars, but can use bus priority lanes in some places, if available. Can be used further afield, but generally serve shorter trips.
Private car	12mph	Inner city last mile mean speeds in London and Bristol are 7mph and 8mph respectively, comparable with other major historic European cities. Bristol averaged 12mph within a 5 miles radius of the centre in 2017 (Kidd, 2019; APH, 2017). Note that average speeds for city centres at peak are considerably slower, whereas average speeds for inter-urban trips could be expected to average above 30mph.
Cycle	15mph	At 15mph most cyclists travel almost six times the speed of a typical pedestrian. London commuters average 13.4mph (Allen *et al.*, 1998, p.30; Reid, 2018b). Some people are prepared to take longer trips, especially for recreation.
e-scooters	15mph	These vehicles are not legal in the UK on public footways or carriageways except as part of limited trials. In countries such as Spain they have been banned from the footway, but are permitted in separated cycle tracks where available, capable of 12-18mph (Valdivia, 2018). Battery range depends on model. Where permitted they are somewhat dependant on appropriate infrastructure being in place and a smooth surface.
e-cycles (EAPC)	15.5mph	Treated like pedal cycles in the UK. Can reach higher speeds, but electric assist cuts out at 15.5mph. Mean speeds are higher than pedal cycles, especially up hills (UK Government; Schleinitz *et al.*, 2017). Some used for longer regional journeys as it is easy to maintain 15mph, including uphill. Battery range depends on model.
BRT	20 mph	Data on journey speeds is limited and schemes in the UK vary greatly including the amount of priority and separation these services get. So, 20 mph is indicative that these services are significantly quicker and more reliable than local buses, but actual speeds are quite variable. The extent of BRT networks varies, but in some cases such as in Cambridgeshire they go well beyond urban centres and across the region.
Speed pedelec (L1e-B)	28 mph	As these vehicles are treated as mopeds in the UK and riders have to comply with all moped regulations they are rarely used legally. Battery range depends on model. In Germany where they are permitted a study found s-pedelecs 9km/h faster than cycles (Schleinitz *et al.*, 2017).
Coach	50 mph	Speed varies by road type, but free flow speed is 57mph on motorways and 46mph on national speed limit single carriageways (Department for Transport, 2016a).

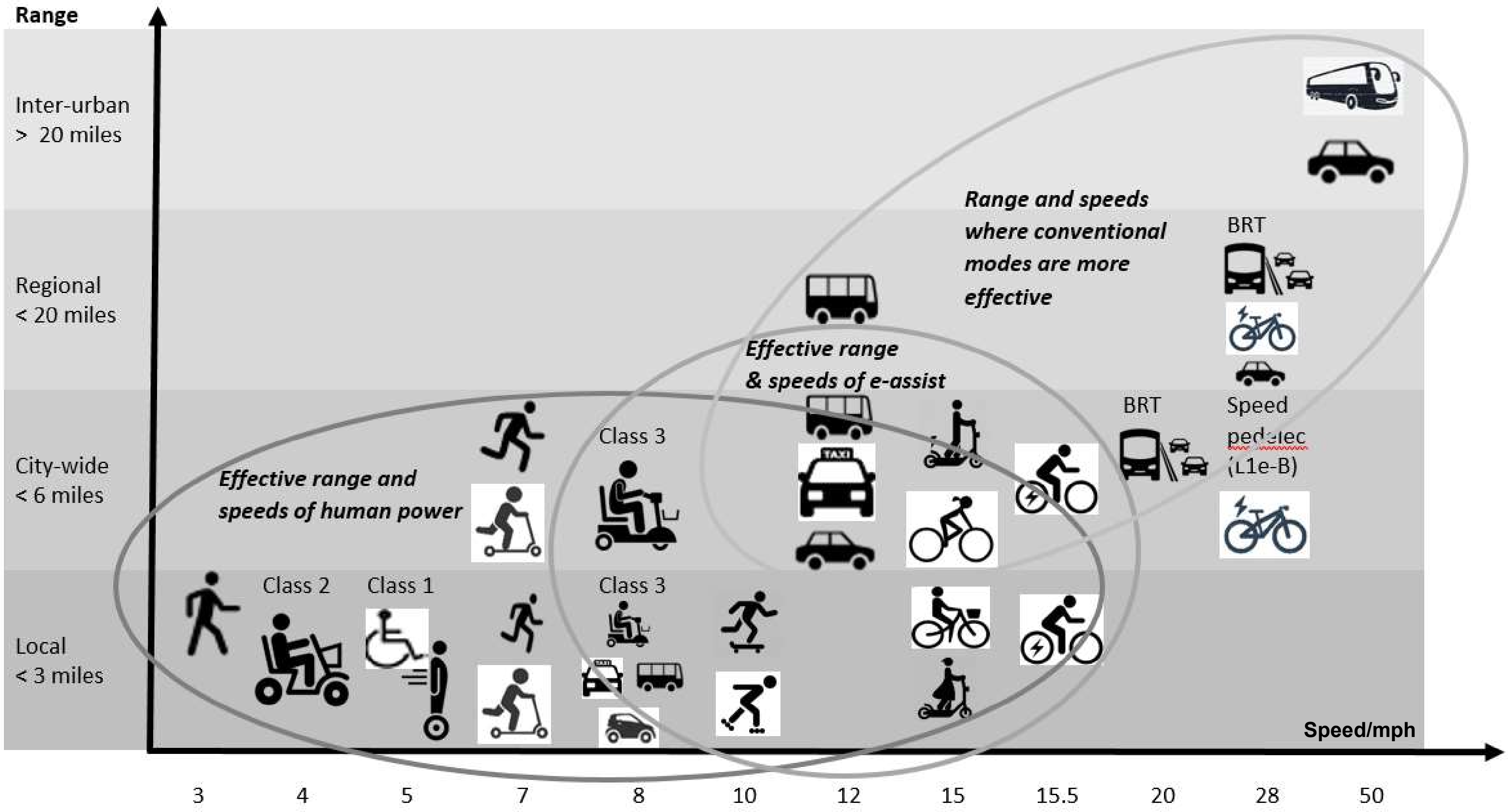

Figure 14 - Indicative urban street speeds (mph) by mode

The plot illustrates that human powered mobility is convenient and attractive in the city for many, especially for shorter, more local journeys, and is often the quickest option. E-assist can extend the accessibility, speed, and range of more active, healthy, and environmental ways of getting around. The potential speeds and actual speeds of human-scale modes in built up areas are close, meaning they are efficiently used. Motorised modes are far less effective for shorter journeys, unless there are no other options, as they are often no faster than a mobility scooter and half the speed of a cycle. Additionally, they come with many negative externalities. The difference between the potential speed and realised speed of conventional vehicles can be very wide, and as a result they are inefficiently used. On local journeys in city centres, vehicles having the potential to travel at more than 100mph can be limited to an average speed of 8mph in stop, start, congested traffic, increasing fuel consumption, carbon emissions and air pollution.

2.6.2 The time-space and cost requirements of street users

Mobility in urban contexts consumes space. One representation of this is the amount of land given over to streets. This varies around the world ranging from as low as 11.5% in Nairobi to 36% in Manhattan - London is between this range at 22% (UN-Habitat, 2013). Mehta (2013) goes even further and claims that some urban settings devote as much as 50% or more of their land to streets.

Consumption of time-area

The concept of time-area calculations is a way of comparing how much urban space different transport modes consume per person in terms of street space for safe movement, parking space when vehicles are not in use, and length of time that space is occupied. In Chapter 1 it was shown that Smeed (1963) had concluded that private motor vehicles require much more ground space for moving and parking than other modes. Time-area is thought of as the product of the time and area consumed by a vehicle and measured in terms of square metres consumed in an hour per person kilometre ($(m^2/h)/(prs.km)$). Bruun and Vuchic (1993) put bus and walking as consuming a similar level of time-area and private cars consuming eight times as much per person:

- On foot, 0.4 $(m^2/h)/(prs.km)$
- Cycle, 1.5 $(m^2/h)/(prs.km)$
- Car, 2.4 $(m^2/h)/(prs.km)$
- Bus, 0.3 $(m^2/h)/(prs.km)$

Other studies confirm high levels of disparity between modes, with cars requiring 30 times as much space for circulating and parking as buses and five times that of two-wheelers (Vivier, 1999). The low occupancy rates of privately-owned cars (Vivier assumed and average of 1.2[2]), their relatively large size, and their need for parking space when not in use, makes them the mode that consumes the most space. Pedestrians require relatively little space and no parking but are a little less space efficient than buses that require little storage space per person-kilometre, have very high capacities, and can pass through the road space relatively quickly, especially if they are given priority. Cycling does require significant space for circulation, especially if a network of secure, kerb separated tracks is established, although space requirements for parking are small compared with cars. When cycling volumes are relatively low, and they have dedicated space in the form of lanes or separated cycle tracks, their time-area value is relatively high. If cycling levels rise and more people use the same cycle infrastructure, the time-area consumption reduces, and cycling becomes more space efficient as a mode.

Urbinfo (2019), in a study in Manchester, concluded that private car commuters required 25 times as much surface area of infrastructure for driving and parking compared with each city centre cycle commuter. Each car commuter to central Manchester requires 11.71 m^2 to drive and park, compared with bus commuters that require 1.77 m^2, train users 1.21 m^2, tram users 0.74 m^2 and cyclists 0.46 m^2.

The time-space consumption concept has been applied using contemporary data from French cities. The work considers both dynamic (when travelling) and static (parking) consumption and like earlier studies finds that private cars are the most inefficient consumers of time-space. Drut (2018) cites Marchant (1993) who showed that when both static and dynamic consumption is combined, cars are 90 times more time-space consuming than the metro (largely underground railway). Taking the metro as a benchmark, walking is twice as consuming, the bus, without a dedicated bus lane, is three times more space consuming, and with dedicated bus lanes 12 times more space consuming. Two-wheelers are 21 times more space consuming than a metro system.

Drut (*ibid.*) critiqued these findings as over-simplified and developed a weighted approach that demonstrates time-space consumption advantages of shared modes such as car clubs, ride sharing, taxis and shared cycles, which all fare better than their privately used counterparts, as they spend less time parked and thereby unproductively consuming the

2 In the UK in 2019 the average car and van occupancy for communing was 1.1 and 1.6 for trips of all purposes (Department for Transport 2020e)

time-space resource. The approach assumes that private cars are the mode that provides the highest level of 'service', and so they receive the highest weighting; cycles (private and shared), car sharing, buses without dedicated bus lanes and walking are deemed to provide a lower level of service and therefore receive the lowest weighting (Table 5). The weighting for service or utility included ten factors, including the ability to cover the whole trip from origin to destination, carrying heavy loads and immediate availability.

Table 5 - Weighted time-space consumption/person for 10,000 commuting trips

Mode of transport		Weighted time-space consumption
Private modes	Cars	46.5
	Motorised two-wheelers	13.1
	Cycles	8.8
Shared modes	Car-sharing	37.5
	Car clubs	19.5
	Taxis	19.7
	Cycle-share schemes	4.3
Public transport	Bus (dedicated lanes)	8.6
	Bus (no lanes)	2.5
	Metro/underground	2.1
Other	Walking	1.7

The studies on time-area or time-space have all used slightly different approaches, assumptions, and contexts for their calculations. However, they all draw similar conclusions, that private cars consume multiple times more street space than any other mode, a conclusion also drawn by Smeed (1963). Different forms of sharing can make cars less resource intensive, but they remain the highest users of time-space. Public transport in the form of metro or bus, along with walking, consumes the least amount of time-space, and most of the studies agree that walking is slightly more efficient. Cycling is not quite as time-space efficient, but when part of a well-used cycle-share scheme the figures improve. Drut (2018) proposes the time-space concept as another tool that city planners and policy makers can use to better understand how each mode impacts the street environment.

The social costs of mobility

There are many negative externalities that need to be considered relating to city travel. In the UK the relative annual health costs associated with a diesel car have been calculated as £258, compared with £39 for a petrol and £13 for an electric vehicle (Hobbs, 2018). These health costs are those that are associated with outdoor air pollution. Dr Hunt of the University of Bath has calculated that emissions from cars and vans are accountable for a quarter of the total. Smith, Caulfield and Dey (2021) found that the total health costs from air pollution in Dublin could run into the billions of Euros a year, with cyclists being particularly exposed.

The costs imposed on other road users by a chosen mode are called marginal social costs (Maddison, 1996) and these become increasing significantly in heavy traffic. As all modes slow down, air pollution increases, carbon emissions increase, and these have negative implications for the physical and mental wellbeing of street users. While not limited to external costs, Poulos (2015) has calculated that in North America a bus ride may cost the passenger a $1 but it costs the city $1.50 in bus operations (including the infrastructure of lanes, real-time information, ticket machines and bus stops); drivers cost the city $9.20 in services like policing and ambulances for the same journey. By contrast for a cycle journey the cost is estimated to be $0.08 and pedestrians only cost the city $0.01 (Speck, 2018). So, for every $1 spent by the traveller, the cost to society varies widely by mode.

Negative externalities of travel can also be experienced by people not benefitting from the direct benefits of that travel. A Brazilian study suggested that the lowest social economic groups who tended to walk, cycle or use public transport, contributed between 8 and 15 times less towards transport related externalities than the two highest income groups, but suffered more of the disbenefits (de Vasconcellos, 2005). Gössling *et al.* (2019) reported results from an EU wide study which suggested that every kilometre driven by car incurs an external cost of €0.11, while cycling and walking represent net benefits of €0.18 and €0.37 respectively. If this is extrapolated across the EU to the total number of passenger kilometres driven, cycled, or walked, the cost of automobility is about €500 billion per year. In contrast, due to positive health effects, cycling has a net external benefit worth €24 billion and walking €66 billion annually across the EU.

In Chile, marginal external costs per person per kilometre in peak periods are estimated as being US$0.41 for petrol cars, $0.43 for diesel cars, and $0.04 for buses. These values reduce as congestion decreases for petrol ($0.12) and diesel ($0.13) cars, but with fewer passengers off peak on buses, the marginal external costs per person/km are slightly higher at $0.05. Externalities include congestion, road damage, road collisions, air pollution, and noise (Rizzi and De La Maza, 2017). Vu and Preston (2019) show the relative social costs in Hanoi of different modes (motorcycle, car, Uber, taxi, bus, BRT, monorail and metro) and demonstrate different costs depending on the number of passengers and whether dedicated lanes are provided. They found that in contexts with up to 50,000 passengers, dedicated car, Uber or taxi lanes are the least cost effective, with a cost to society being twice as high as the best modes, and the gap widens as the passenger demand grows, to four or more times. Bus is the most efficient mode until a point where there are enough passengers to make metro the most efficient mode (between 250,000 and 350,000 passengers per direction per day, depending on road space allocation to bus). All of the studies and localities concur that the car is multiple times worse than all other modes in terms of externalities. How much worse depends on factors such as the number of people travelling, whether it is peak or off peak, and the amount of space available. At the extreme, the car could cost US cities 920 times more than if the same journey was made on foot (Speck, 2018). The EU data (Gössling *et al.*, 2019) suggests that walking and cycling are net contributors while other modes cost societies.

Figure 16 draws on both the time-space and externalities data to illustrate the relative contribution made by, or burden of, different modes for the same journeys, at a city level. As well as the externalities shown in the figure, there are additionally costs to the individuals who use each mode in terms of sunk costs, running costs and health disbenefits (or benefits).

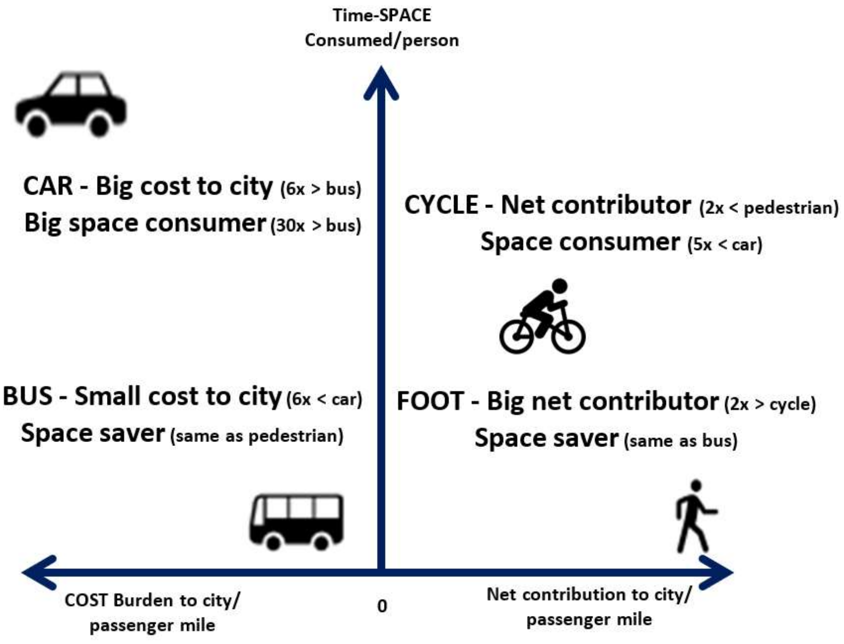

Figure 15 - Burden or benefit to city by mode

Street space allocations

Urban streets are typically sub-divided into footway and carriageway, with the latter often being divided further into lanes. Table 6 classifies different transport modes and clarifies where they can legally be used in the UK context. Figure 16 summarises this information. A black boarder around a mode indicates where modes are always permitted, and a dotted line boarder denotes where they are permitted under certain circumstances.

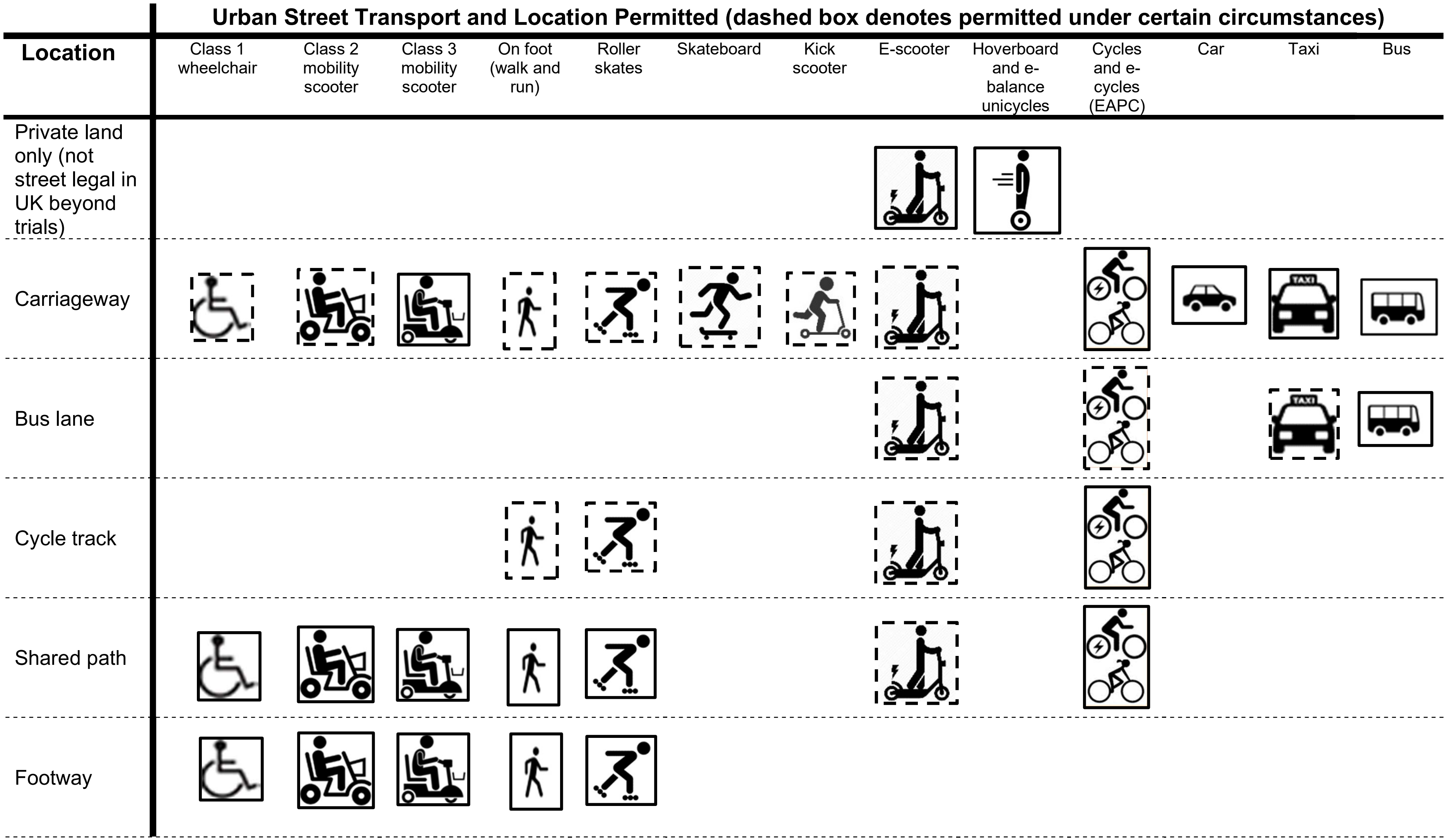

Figure 16 - Allocation of street space by mode

Table 6 - Modes and their street space allocations

Mode	Footway	Shared path	Cycle track	Bus lane	Carriageway	Comments
Walking	Yes	Yes	Sometimes	No	Sometimes	Should use footways if available. Can use cycle tracks if density of traffic permits. When pushing or carrying bulky objects, or when part of a group led by a person can walk on the carriageway (European Commission, 2019).
(Cl.2) Mobility scooter	Yes	Yes	No	No	Sometimes	Can be used on the carriageway if there is no footway (UK Government, 2019).
(Cl.1) Manual wheelchair	Yes	Yes	No	No	Sometimes	Should use footways if available.
Hoverboard	No	No	No	No	No	DfT bans from pavements via Highway Act of 1835; EU vehicle certification rules it off roads. Classed as a motor vehicle. Can only legally be ridden by someone in possession of a driver's licence, road tax and insurance, and also has to be registered and fitted with registration plates. Motor vehicles cannot normally be used on footways, footpaths or cycle tracks (BBC, 2006).
e-balance unicycle	No	No	No	No	No	Only legal on private land (see notes on hoverboards).
Skateboard	No	No	No	No	Sometimes	Skateboards cannot legally be used on footways or cycle tracks as they have no right of way. Local byelaws can be created banning them. The UK has fewer laws around these situations than, for example, Australia, where skateboards can be ridden during daylight hours on roads without a lane with a speed limit of less than 50km/h. The police have powers via some byelaws (Manchester City Council, 2019) to stop skating which is done: “in such a manner as to cause danger or nuisance or give reasonable grounds for annoyance to other persons”.
(Kick) scooter	No	No	No	No	Sometimes	Unpowered scooters cannot legally be used on footways or cycle tracks but can be banned from the carriageway via some byelaws (see notes on skateboards).
Running	Yes	Yes	Sometimes	No	Sometimes	Should use footways if available. Can use cycle tracks if density of traffic permits. When part of a group led by a person can run on the carriageway.
(Cl.3) Mobility scooter	Yes (max 4mph)	Yes	No	No	Yes (max 8mph)	Should be limited to 4mph on a footway of shared path. Must use a flashing orange light if on a dual carriageway (UK Government, 2019).
Inline skate	Maybe	Maybe	Maybe sometimes	No	Maybe sometimes	Rules concerning skates are not clear. It has not been established in case law whether these are classed as vehicles or not. Assuming they are not they can be used in the same locations and under the same conditions as pedestrians (BBC, 2006).
Local bus	No	No	No	Yes	Yes	
Taxi	No	No	No	Sometimes	Yes	Can use bus lines where indicated.
Private car	No	No	No	No	Yes	
Cycle	No	Yes	Yes	Sometimes	Yes	Can use bus lines where indicated.
e-scooter	No	Exceptionally	Exceptionally	Exceptionally	Exceptionally	Only legal on private land (see notes on hoverboards), unless hired as part of a designated trial.
e-cycle (EAPC)	No	yes	Yes	Sometimes	Yes	If a cycle meets the EAPC (e-assist pedal cycle) requirements it is classed as a normal pedal cycle and can be used in the same locations (UK Government).
Speed pedelec	No	No	No	Sometimes	Yes	Classed as a moped (L1e-B) and needs to be registered and taxed. Users need a driving licence to ride one and must wear a crash helmet (UK Government).
Coach	No	No	No	Sometimes	Yes	Can use bus lanes where indicated.

It can be seen from Figure 16 and Table 6 that the typical allocation of street space in streets can create potential conflicts from both large speed and size differentials. Shared space mixes pedestrians travelling at 3 mph with cycles and e-scooters travelling at 15 mph or more, and carriageways mix Class 3 mobility scooters limited to 8 mph with motorised vehicles permitted to travel at up to 70 mph. In terms of extremes of scale, double decker buses share bus lanes with cycles. On the basis of speed and scale it would seem reasonable that Class 3 mobility scooters and skateboards should be permitted to use cycle tracks.

2.7 Summary of the chapter

This chapter has considered streets and urban form, the nature and development of streets, political thought and policy and impacts on mobility justice, and the nature of street users. Urban form has evolved over time as vehicle technology and capability has developed. Different types of city form have risen to prominence and then waned: first walking cities, then transit cities and now automobile cities, using Newman and Kenworthy's (1999) nomenclature. These changing urban forms have been associated with different street environments that affect how people behave and use urban streets. The emerging notion of smart and sustainable cities is developing from a focus on 'traffic in towns' to 'people in streets'.

Street evolution has been closely linked with street function, and Marshall (2005) describes streets as the connecting point between circulation (i.e., movement), built frontage and public space. If a single street function and movement function is allowed to dominate because of local or national politics, there will be consequences. The fruit of politics is policy, and the outworking of policy is revealed in design, behaviour, and regulation.

Southworth and Ben-Joseph (2003) focused on the role that standards have played in street design and questioned the car-centric standards that have resulted in street environments that are not cohesive, liveable or energy efficient, which raises issues of (mobility) justice. Ideas of place and movement in streets are summed up by Sheller (2018) who describes mobility justice as being as much about how, when and where we dwell as it is about how, when and where we move.

In recent years in the UK there have been an increasing number of policy documents, funding, and initiatives to promote walking and cycling, which have an influence on the street context. Policy also plays a critical role in not only shaping streets, but then also how emerging travel modes and their enabling infrastructure can be used in streets.

Micromobility and connected and automated vehicles are two modes which are in the process of emerging as potentially being of important value in urban areas.

The people using street space and their behaviour are central to the street context, and it is their presence and the manner of their use of the street that helps create the street environment. People who walk, cycle, or roll have more opportunity to use their senses to engage with the street environment as they dwell on streets, i.e., use them as places, as well as moving along them. By contrast users in motorised vehicles are more insulated from the street environment and, if not on a local journey, are predominantly interested in movement. Merriman (2009) suggested that users of private cars could be seen as having the effect of removing street space that would otherwise be shared with and experienced by others. People take up less space than a person in a vehicle. Street user speeds also vary. Analysis of time and space requirements demonstrates that driving creates the largest economic, health and safety burdens on city streets. Smeed (1963) concluded that driving consumes the most space, in contrast to walking which, as well as contributing to the city's economy and health, also uses the least space.

Having reviewed the nature of the co-evolution of streets and urban form, the relevant political influences, and the nature of streets in their current form, the following chapter explores the three primary influences on street environment and culture introduced in Chapter 1, namely: street user behaviour, regulation, and design.

3 INFLUENCES ON STREET ENVIRONMENT AND CULTURE

3.1 Structure of the chapter

This chapter explores what is currently known about street user behaviour, regulation, and design, in relation to street environment and culture. However, their contribution does not happen in isolation of each other, and their interactions are addressed at the end of the chapter. Understanding these three influences on street environments and culture will help to better understand how streets work and how they could work better.

In the early days of the growth of motor car use, little redesign of the layout of cities and streets was undertaken, and regulations (red flags, speed limits, road markings and road signs) were introduced to attempt to influence the behaviour of drivers. It is questionable whether this was effective, and the collision and injury rates were very high, especially in the 1930s. With time, more streets were re-shaped to accommodate drivers of motor vehicles. Similarly, and more recently for pedestrians, Ishaque and Noland (2008) found that most pedestrians do not comply with the intentions of street design or regulation when crossing the road, even with high jaywalking penalties. This chapter presents the behaviour of street users first because it is an important influence on the street environment and culture. Interactions on the street are intrinsically human interactions and therefore it is the nature of these interactions which most influence street environment and culture. It also ensures that the perspectives of the most marginalised street users, especially people walking and cycling, are given primacy in the subsequent considerations of regulation and then design.

The first three sections discuss the way in which the street environment and culture is influenced by behaviour (Section 3.2), regulation (Section 3.3) and design (Section 3.4). Section 3.5 discusses the interactions between behaviour, regulation, and design. The penultimate section is a summary of this chapter (Section 3.6). Section 3.7 then presents the knowledge gaps and justification for the research.

3.2 Street user behaviour

3.2.1 Introduction

This section investigates the link between identity and travel mode and highlights that strong identity with a mode translates into how people behave on streets in several different ways. Henderson (2013) described the politics of urban mobility as a ‘street fight’ and how that battle plays out has an impact on how road user behaviour is evolving. One feature is the role of identity in shaping how people behave when using city streets. Henderson creates the idea of different street user identities, such as cyclists and motorists.

Identities are complicated and multi-layered. A cross-sectional study by Heinen (2016) on commute mode choice and intention to change, describes social identity as identifying with a social category or group, including those that identify with particular modes - a strong identity as a motorist or a public transport user for example, is associated with a propensity to use that mode. Social identity is sometimes thought of in terms of 'ingroup' and 'outgroup' (Hoekstra, Twisk and Hagenzieker, 2018), where the outgroup is not one that the individual identifies with.

According to Hoekstra, Twisk and Hagenzieker (*ibid.*) self-identifying drivers are more likely to drive to work and for other journeys and are less likely to use public transport to get to work or walk for other journeys, than people with other identities. Identifying with being a motorist was not associated with mode choice for escorting a child to school, but other identities were. People with a strong public transport user identity positively associated with public transport use for all trip purposes, and negatively associated with commuting to work by car.

These studies suggest that identity with a particular mode can be an important factor in how people might behaviour, but also raise questions about people who do not strongly associate with a particular mode, or street behaviours that are not obviously explained by identity. The sections that follow consider the behaviour of people using different modes, regardless of whether those people identify themselves strongly with a particular mode, or whether other people conceptualise them in that way. Given the study's emphasis on the most marginalised street users, people on foot (Section 3.2.2), people on cycles (Section 3.2.3) and people who roll (Section 3.2.4) are considered first. Section 3.2.5 then compares the behaviour of people who drive with these other modes.

3.2.2 People on foot

Pooley *et al*. (2014) suggested that although almost everyone walks on some occasions and sees walking in a positive light, however, the activity remains invisible within cities, and is often overlooked in street design. According to Demerath and Levinger (2003), if people are deprived of opportunities on foot, they are not only deprived of a way of getting around, but they also face a social problem due to a loss of opportunities for social interaction. This idea is reinforced by Hart and Parkhurst's (2011) report of a Bristol study that replicated an earlier San Francisco study (Appleyard, 1981). Both showed the link between the average number of friends and acquaintances that people have on their home street and the volume of motor traffic on that street. Higher volumes of traffic make the walking environment more unpleasant and dangerous, which leads to fewer social interactions with neighbours.

Although policy makers frequently conflate walking and cycling, there is a big difference between people on cycles and people on foot. The Department for Transport (2020) published a vision for walking and cycling in 2020. Like many such documents purportedly focussing on multiple active modes, the focus was actually on cycling as indicated by the title, ‘Gear Change’ (people on foot do not have gears), and the content was cycling heavy and walking light. Speed is one obvious difference that was addressed in Chapter 2, but there are others. People on foot are lightly regulated; have limited load carrying capacity; tend to move in a quite fluid fashion for example, passing others on the street on either side; usually have a more ‘local’ range, although everywhere is within walking distance if you have the time (Dorman, 2018). Stopping and starting requires little effort, but delays, such as those that occur at multi-stage crossings designed to cater for the flow of motor traffic, are a frequent frustration. In contrast cycles are vehicles, subject to regulations similar to other vehicles that use the carriageway; are able to carry substantial loads; are restricted in their movement, do not easily handle very sharp turns, and usually pass other cycles on the right (in the UK). They also have a more extended range and require concerted effort to start, with a restart after a stop within a journey requiring the same amount of energy as cycling 100m (CROW, 2016).

The most well-known pedestrian organisation the UK is the former Pedestrian Association, which rebranded in 2001 to become Living Streets (Living Streets, 2019). The organisation changed its name because of ‘pedestrian invisibility’ and to widen their agenda, positioning walking, so often taken for granted, at the intersection of some of society’s biggest challenges, from health to environment and social issues (Our Design Agency, 2016). Local civil society groups exist such as the Bristol Walking Alliance, that campaign for a better walking environment for everyone (BWA, 2019).

Where walking levels are still very high, such as in sub-Saharan Africa, the majority tend to be ‘captive’ to walking rather than walkers by ‘choice’. In situations where captive walkers are forced to make daily journeys in quite dangerous environments, safety concerns can be overlooked as people become habituated to the situation. Amoako-Sakyi (2016) found that routes to school in Ghana that were associated with serious injury outcomes were still perceived as safe by school children using them daily. Children should not be desensitised against the dangers on the street, rather as Casas (2018) points out their presence on streets should be symbolic that they are safe for all and have been designed with a child's perspective in mind.

Road users have different levels of responsibility for road collisions (Elliott and Baughan, 2004). Basch *et al*. (2015) observed that nearly half of people crossing at five busy intersections during the 'don't walk' signal were wearing headphones, talking on a phone, or looking down at a screen, suggesting that this distracted behaviour can be dangerous and may be a contributing factor to pedestrian injuries at crossings. Elliott and Baughan's study acknowledged that drivers have a role in collisions involving adolescents, but their paper argues that adolescents themselves have a larger role. The aim of the study was to provide a classification of aberrant road user behaviour in adolescent children. There is an element of blaming the (adolescent) victims in road collisions, rather than understanding why they act as they do. The assumption seems to be that streets are not a place for recreation and despite the freedom given under the law for pedestrians to cross roads at any convenient point, Elliot and Baughan demonstrated in their research tool (questionnaire) what they expected pedestrians to do, with one question asking: *"How often do you not bother walking to a nearby crossing to cross the road."* As can be seen from this example the identity of researchers and the framing of research evidently has a bearing on research findings.

While the presence of high levels of walking might be an indicator of an environment conducive to movement on foot, Sahlqvist *et al*. (2015) warn that high demand could demonstrate that the walking infrastructure needs improving to accommodate even higher flow rates. It is not always easy to demonstrate the causal links, but there is no denying that in some contexts the decline of walking has been dramatic and there is an association with safe environments. In the 1970s, 80% of children in the UK were walking to school alone by the time they were eight (Mackett, 2013) reducing to 9% by 1990, compared with only 3% of all primary aged children by 2018 (Evans *et al.*, 2018).

In their book, 'Ways of Walking', Ingold and Vergunst (2008) articulate some of the behavioural dichotomies of walking. There is a freedom in how we can walk, which is beautifully illustrated by a young child behaving with complete freedom, oblivious to their surroundings – they are unlikely to walk in a straight line, they may be looking at their feet, or following the patterns on the ground. By contrast anxious parents watch protectively over these children, and sometimes impose unwelcome restraints such as reins or strapping them into a pushchair, ensuring that they do not step inadvertently off the kerb and into harm's way. Older children and adults are more aware that there is some need to comply with rules (e.g. crossing the road), but on a footway, there is opportunity to allow your mind to wander. Christian *et al*. (2011) divide walking behaviour into two distinct categories, walking with purpose to specific destinations as a form of transport and recreational walking where the destination has less importance and enjoying the experience is more important. They link this to land use, which has echoes of how transport planners distinguish between streets for movement and streets for place.

Patterns of movement

Patterns of movement are most varied for people on foot. Road crossings can indicate a safe place for pedestrians and cyclists to cross a carriageway, or in countries that have jaywalking laws the same infrastructure indicates where pedestrians are obliged to cross. Railings and other barriers are often used as safety measures, but also prevent pedestrians following a particular desire line and corral them into limited spaces on the footway, Figure 17.

Figure 17 - Railings corralling people on foot at Birmingham Coach Station

Note. Image reproduced from Mappa Mercia (2021).

The behaviour of street users does not always follow the expected pattern considered by the designers as appropriate, or as indicated by the infrastructure. Figure 18 shows a pedestrian crossing at the junction of Broadway and Tramway Avenue, Stratford, London and the route intended by the designers for people on foot is shown by the yellow double-ended arrows.

Figure 18 - Route of pedestrians as intended by the design

Note. Image produced as a screen capture from a video shot on 21 January 2020.

Figure 19 shows the actual crossing routes used by people on foot (yellow lines), demonstrating that people follow their desire lines, usually the shortest route, rather than the lines intended by the designers and their designs. This illustrates that people may not conform to the intent of the design.

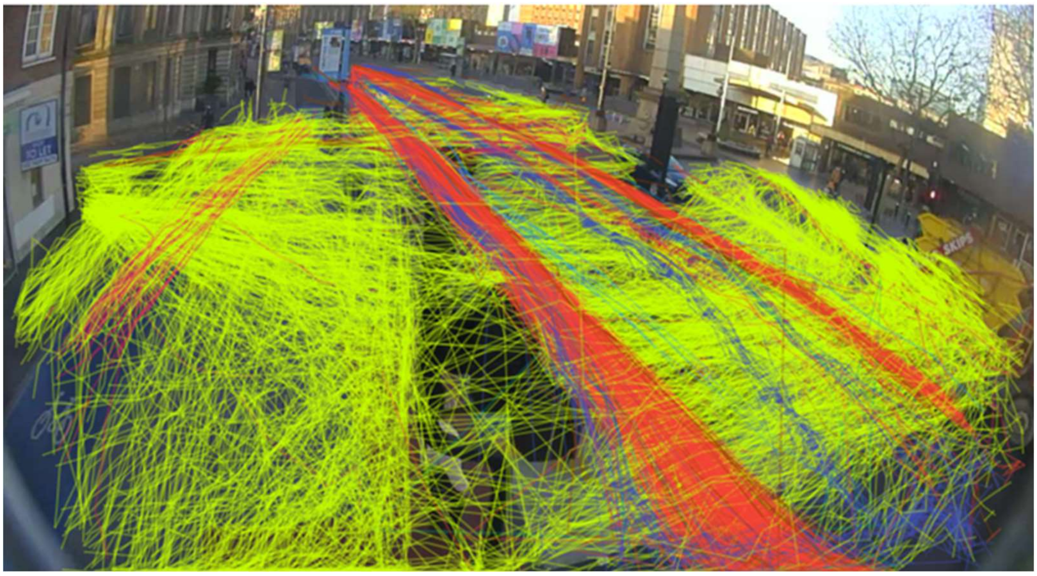

Figure 19 - Actual routes taken by pedestrians (in yellow)

Note. Red and blue lines in the carriageway represent the routes taken by cars and buses respectively; the pink lines in the cycle track on the left represent the routes taken by cycles. These traces were produced from the actual movements of pedestrians and vehicles in a 90-minute video shot on 21 January 2020.

3.2.3 People on cycles

Although, as was seen in Chapter 2, some cities such as London are seeing a revival in cycling levels, across Europe the number of people cycling fell significantly from the early 1950s to the early 1970s. This was followed by a brief renaissance in the mid-1970s in the UK followed by a gradual decline. 4% of secondary school children (aged 11-16) in England cycle to school and bicycle ownership is most prevalent among under 17s. In most countries cycling has the greatest share of trips for under 16s than any other age group, except The Netherlands where 16–25-year-olds cycle slightly more (Pucher and Buehler, 2008). In the UK twice as many under 16s cycle, compared with any other age category.

In contrast to walking, cycling interest and civil society groups abound. They lobby and promote cycling as sport, and they may bring together different types of cycling or different types of cyclist. These groups operate at local, national, and regional levels. There is also an academic network, Scientists for Cycling and annual global and regional Velo-city conferences (walking focused conferences do exist too, such as Walk21) that bring practitioners and academics together. Many who cycle have a certain affinity with cycling and a bond with other cyclists, that goes beyond just a means of getting around.

People who strongly identify as drivers and people who strongly identify as cyclists are more likely to feel animosity to the other group (Hoekstra, Twisk and Hagenzieker, 2018). Drivers who also cycle tend to have more positive attitudes towards cyclists than those who do not and are one and a half times more likely to drive safely when in the vicinity of cyclists (Johnson *et al.*, 2014). By contrast, pedestrian identity tends to be transient and does not remain with people as a strong identity (Gardner and Abraham, 2007). They adopt a persona in a given setting, rather than forming social groups that they feel they belong to (like cyclists). Although pedestrian identity is weakest and driver identity the strongest, one study found that there is little difference between pedestrians, public transport users and cyclists, in terms of their choice of mode defining who they are (Murtagh, Gatersleben and Uzzell, 2012). Aldred (2015) suggested that cyclists tend to be labelled as such in a pejorative manner by others in ways that users of other modes do not experience – it is not normal to describe people as ‘busists’ or ‘trainists’.

When assessing the role of active modes and cycling in particular, a utilitarian approach is sometimes considered (Aldred, 2015; Pereira *et al.*, 2017). This approach is illustrated by the Welsh Government (2021) which defines active travel as *“walking and cycling for purposeful journeys”*. Travel to work, school or the shops might be considered purposeful or utilitarian, whereas just going out for a stroll or a cycle may not be. Portraying cycling as a utilitarian activity can mean that cycling is taken more seriously as a mode of transport by urban planners and policy makers. However, the way cycling is conceptualised and treated is very different from other modes, particularly the car.

Aldred (*ibid.*) discusses how the dominant policy paradigms promote a model of utility cyclists that are expected to be faster than the average peak time motor traffic in most cities (10-15 mph), and regular all-weather commuters (or at least on real journeys with a purpose). Despite the inherent contradictions, there can be an expectation, even from cyclists themselves, that purposeful cyclists wear 'appropriate' clothes (helmets and high-visibility items). This is a contested point as cycling clothes made from materials such as lycra could indicate a sporting or leisure cyclist who is blocking the road space for purposeful (car) journeys that are contributing to the economy in some way (Aldred, *ibid.*). Alternatively, special clothing could be seen to represent 'fundamentalist' cyclists that pit "virtuous cyclists" against "vicious car drivers" (p263, Cupples and Ridley, 2008) and this 'othering' of non-cyclists can ultimately deter people who drive from cycling.

In countries like the Netherlands, where cycling is accepted as an everyday transport mode, no special clothing is expected. Some utility cyclists in the UK take a similar approach, but they may then be reproached by drivers for not wearing appropriate safety gear such as helmets and high visibility jackets, which some regular cyclists chose to wear, while others do not. Chatterjee *et al.* (2020) have found that people who cycle (or walk) their commute are more satisfied than those who travel by car or public transport. Riding two-abreast and chatting is not seen as acceptable as it indicates that this is not a purposeful journey and is blocking the carriageway for those making more important journeys (Aldred, and Jungnickel, 2012).

There are clearly several serious contradictions at play here. Aldred (2015) used data from a qualitative study of four urban areas in England where cycling rates were relatively high or rising. Although utility cyclists may ride with a purpose, this study, like others, concluded that most cyclists enjoy cycling and are personally gratified in many ways beyond simply getting from A to B. They are generally happy and feel that their transport choice contributes to improved health and general well-being. Secondly, riding two abreast does not actually block the carriageway for other users, but rather helps cyclists take a prominent road position so that others are aware of them and are more intentional about making an overtaking manoeuvre, which improves road safety. Thirdly, this way of considering cyclists is at odds with other road users, whose motives and behaviours are not scrutinised in the same way. Aldred (*ibid.*) suggests that few consider the journey purpose of car drivers, check whether the driver is socialising with a passenger or if they are blocking the carriageway when driving in a vehicle made for five with only one occupant. There is, hence, evident great disparity in the way people using different modes are seen and described.

Beyond utility cycling, riders of cycles are simply ‘people’ and are quite diverse in their backgrounds and nature. Where cycling takes place and the general local culture can have a significant influence on how cyclists are perceived. Aldred and Jungnickel (2014) looked at cycling in four locations and found that this perception can range from an assumption that a cyclist is predominantly ‘middle class’ in emerging cycling cities (Bristol and Hackney), to working class or even classless in established cycling communities (Hull and Cambridge). In some places cyclists were seen as ‘middle-aged men in lycra’ (MAMILs) on expensive touring cycles, elsewhere perhaps local eccentrics on shabby shopping cycles, fashionable young professionals on fixed-wheelers or low paid commuters on cheap mountain cycles. In Bristol and Hackney cycling is a sub-culture choice, in Cambridge a rational mainstream choice and in Hull it is suggested that people cycle through lack of choice. Many drivers are also cyclists and almost all of them are pedestrians, and this seems to influence the way they behave. Peschalidis *et al.* (2016) for example demonstrated that cyclists who have access to a car tend to blame pedestrians for collisions, compared to non-car using cyclists who do not.

Safety

Pre-release cycle signals are traffic signals with a cycle symbol that allow cyclists to pull away from traffic lights a few seconds before the general traffic (see inset box in Figure 20 which shows junction of Queen Street and Blossom Street, York) and were first introduced in the UK in York in 2010 in response to road user behaviour. The case study shows that drivers were wrongly using the right-hand lane to go straight on and colliding with cyclists correctly in the left-hand lane to turn right, as the left-hand lane was also available for vehicles that were turning right. So, sometimes design can be developed as a result of an understanding of behaviour.

Figure 20 - First cycle pre-release signals in the UK (York)

Note. Images reproduced from Department for Transport (2016b).

Using aggregate data sets from across Europe and North America, the concept of an enhancement in safety as a result of higher volumes of cyclists (‘safety in numbers’) was suggested. An analysis of both cross-sectional and time series studies showed that when more people walked and cycled the risk per distance travelled of individuals being involved in a collision decreased (Jacobsen, 2003). However, a lower rate coupled with higher volumes of cyclists can result in a higher number of collisions. While the studies show that the relationship is non-linear and the risk goes down as the number of cyclists increases, Jacobsen is sometimes contested because it does not describe the mechanism that links higher numbers with improved safety. Luukkonen and Vaismaa (2015) undertook a literature review to understand the mechanisms. This helped to establish the relationship between growth in cycling volume and improved cycling safety as shown in Figure 21.

Figure 21 - Connection between volume of cycling and safety of cycling

Note. Reproduced from Figure 4.3, p89 in Luukkonen and Vaismaa (2015).

It is apparent that improved cycling safety results from other factors and not just increased cycling volume. Of most significance are the quality of cycle infrastructure and land use and traffic network planning, as these factors relate to both safety and volume. Land use planning, traffic network planning and high-quality cycle infrastructure provision help to make conditions safe and competitive for cycling and tends to lead to both a growth in cycling and an improvement in safety. Increased cycling levels cause a moderate increase in the awareness of drivers to the presence of cyclists, which in turn leads to a moderate increase in the safety of cycling.

Safer prioritised junction crossings are more convenient and attract more people to cycle (Gårder, Leden and Pulkkinen, 1998). Casualties in Oslo among cyclists and pedestrians are lower over the summer months and Fyhri *et al.* (2017) suggest this is because drivers expect to encounter more pedestrians in the summer months.

Bringing the issue to one of UK research and understanding, a study in London found that driver behaviour changes when turning in and out of side roads that have continuous footways (Steer Davies Gleave, 2018): drivers are more likely to give way to pedestrians who are on or very near the continuous footway; drivers are more likely to give way when pedestrian volumes are higher; when turning out rather than when turning in; when turning left rather than when turning right. In the study, the number of interactions between drivers and cyclists were far more limited than the number of interactions with pedestrians, but in the sample most drivers gave way to cyclists using the main road. The focus of the research was not on safety in numbers, but on a specific design change, but the effect of safety in numbers was revealed, nonetheless.

3.2.4 People who roll

The term ‘rolling’ is an emerging term used in this study for people who use wheelchairs, mobility scooters, and also includes babies and toddlers in prams and pushchairs, as well as more diverse groups such as skateboarders. Stenberg *et al*. (2016) explained that the way people use electric wheelchairs needs to be considered in the context that their wheelchair is not something that they drive. Rather it can be regarded as an extension of that person like a prosthesis. That can be both liberating and create potential challenges if for example the street environment prevents access, and denying access to the wheelchair, automatically denies access to the person. According to Jang *et al*. (2019) the behaviour of people who use mobility scooters, and their experience of streets is somewhat different to those in (electric) wheelchairs. People who use mobility scooters often experience liminality with regards to their ambulatory status, which can also be poorly understood by other street users that they encounter, who sometimes perceive them in a negative manner. This liminality could be described as a kind of ‘no-man’s land’, with people caught somewhere between the world of walking and the world of rolling, without feeling fully part of either. A person who needs their scooter to travel from their home to the high street, may be able to park their scooter outside a café and walk in for a coffee. At its best, a mobility scooter can improve the sense of independence and quality of life, but like the experience of people in wheelchairs, social and physical barriers still exist. Negotiating limited space with people on foot can also be a challenge.

People who roll uses several distinct modes with relatively little linkage other than the fact that the wheel is used as the key part of locomotion. Some form quite niche groups, such as skateboarders. The primary use of a skateboard is sport and leisure and people on boards are most likely to be found in a skatepark. However, some people do use them as a form of transport, and they can also be seen on city streets. They tend to be from a certain demographic of young adults and teenagers. Borden (2020) describes how skateboarding has been seen as a sub-culture, but it has changed over time to something a little more mainstream, but it cannot easily be categorised. The skating sub-culture is often associated with a streetscape that includes street art, graffiti and tags, familiar in places like North Street in Bristol, UK, but linkages are not clear and Dinces (2011) points out that skateboarding identity is not limited to space and geography. Despite some marginalisation from other street users and infrastructure that is often designed to deter them, such as 'skatestopper' protrusions on benches, skateboarders do not experience the same level of discrimination and inaccessibility as other rollers on the street. Whereas rollers in electric wheelchairs can be denied access by a kerb or a step, these same barriers can provide challenges to overcome for the skateboarder (Borden, 2020).

3.2.5 Comparing behaviour of people who drive with other modes

The perspective of streets when driving is very different from the perspectives from a pedestrian, roller or cyclist viewpoint which has a bearing on their behaviour as road users, tempered by both highway regulation and infrastructure (Meng and Mikkelsen, 2015). Table 7 compares the behaviours of drivers, cyclists, rollers, and pedestrians.

Table 7 - Behaviour of different road users

People who…			
Drive	**Cycle**	**Walk**	**Roll**
• Fairly homogeneous group • Predictable behaviour • Trained • Tested • Defined space on the highway • Expectation that they will look out for the safety of other road user groups	• Not a homogeneous group • Less predictable • Not required to undertake formal training • Learn by doing • Usually lack a fixed space on the highway requiring movements between the main carriageways, cycle lanes, separated cycle tracks and shared space with pedestrians • How the traffic flows is more important than rules • Avoid having to come to a complete halt • Look to drivers to exercise a duty of care towards them	• Only subject to a few rules • Usually separated from other traffic • Low speed • Able to manoeuvre in complex ways • Do not expend a lot of extra energy when they start • Sense of self-preservation is high • Constantly take avoiding actions to prevent getting hurt	• A fairly diverse group • United by the limitation posed by the local infrastructure • Access is denied to this group if footways are not sufficiently wide, drop kerbs are missing, steps are present, or the surface is not smooth • Most people who roll (e.g. wheelchairs, children in prams) are akin to pedestrians • Class 3 mobility scooters may use the carriageway and be subject to general road regulations like a driver

Note. columns 1-3 derived from Meng and Mikkelsen (2015) and column 4 added by the author for comparison from observation and regulations.

To describe people who drive as a *"fairly homogeneous group"* on one level seems open to challenge given the seeming diversity of people that drive. However, on reflection there are more restrictive barriers to driving in terms of age, visual acuity, and physical ability, than exist for cycling, walking, and rolling. Dant (2004) goes further and suggests that people become more homogeneous when they learn to drive, by creating a new 'driver-car' entity. When people become assimilated into the driver-car they become oriented to a particular social order and actions, dictated by legal systems, driving conventions and traffic management which embeds a degree of coordinated habits not found in people when they use other modes.

King (2015) introduces the concept of pragmatic driving, which they define as: *"driving behaviours that achieve personal mobility aims while optimising perceived safety and enforcement risks, regardless of the legality of the behaviours involved."* They posit that this is a trait of low and middle-income countries but acknowledges that it is also demonstrated by drivers in wealthier nations (Figure 22).

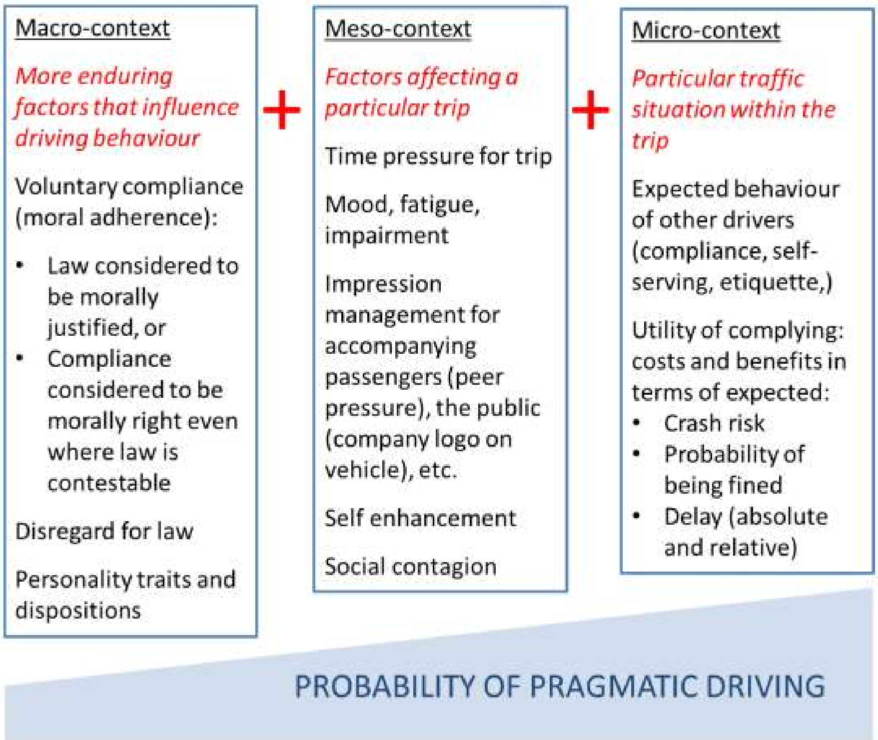

Figure 22 - Probability of pragmatic driving

Note. Reproduced from King (2015).

When King's model is extended to cyclists and pedestrians the same macro-, meso- and micro-context factors influencing compliant versus pragmatic driving apply. However, the outcomes are quite different. For pedestrians there are very few regulations and so compliance with the law is much less of a factor. People on foot or on a cycle are much more agile than those in cars and so may be less constrained by infrastructure; they can switch between the carriageway and footway easily or even climb over a barrier. Unlike drivers, journey times for pedestrians and cyclists are far more predictable and far less influenced by prevailing traffic conditions. At the micro-context the same crash risk assessment takes place for all modes, but the parameters are very different. Whereas a driver may calculate that the risk of serious injury or death in a 30mph collision is negligible, pedestrians and cyclists would calculate that their fatality is possible and serious injury highly likely. So, if they all used the same risk assessment approach, although the likelihood of a collision may be low, the consequences of that same incident would be rated high by the pedestrian and cyclist, but low by the driver.

3.2.6 Changes in behaviour due to Covid-19

Covid-19 resulted in significant changes in street user behaviour. The experience for many showed them that streets conducive to walking and cycling could be created immediately by removing motorised traffic (De Vos *et al*., 2021) from what would otherwise be hostile environments (Buchanan, 1963). This is borne out by the official travel data from the Department for Transport (2021d) for use of different transport modes during the pandemic, Table 8.

Table 8 - Use of transport modes in Great Britain during Covid-19 pandemic

Dates covered	Cars	All motor vehicles	National Rail	TfL Tube	TfL Bus	Bus (excl. London)	Cycling
28/3/20 to 26/4/20	32%	35%	5%	5%	17%	11%	172%
24/3/20 to 23/3/21	68%	72%	21%	21%	43%	34%	124%

Note: Figures are percentages of an equivalent period in 2019 and based on data from the Department for Transport (2021d).

During the days in the first national lockdown when general traffic was at its lowest, car use can be seen to be down by 68% on average and cycle use up 72%. Over the whole year from the day after former Prime Minister Boris Johnson's first *"stay at home"* message on 23 March 2020, all motorised traffic was down on average by 28% and cycle use was up 24%. All forms of public transport use were down considerably over the whole year. Walking data is less readily available, but like cycling, walking levels have also risen substantially. Transport for London (2020, p.187) data reports that the walking and cycling mode share in London grew from 27.4% in 2019 to 46.4% for quarter two 2020 (April to June) and was still at 37.3% in quarter three (July to September).

The necessity of transforming streets and normalising walking, cycling, and rolling has been highlighted in Goel *et al.*'s (2021) paper. It demonstrates that only when cycling reaches 7% mode share are women fully represented among cyclists. Similarly, children under 16 years old are often overrepresented in areas with higher levels of cycling. Over 60s are underrepresented everywhere, but fair better in contexts where rates of cycling are high. So, when streets are transformed and walking and cycling are normalised, then the full diversity of the population can take part.

3.3 Regulation of street use

The transition to car dominated streets began in the 1960s in the UK as discussed in Section 2.2. The government's response was to consider regulations to control rising demand, and commissioned Reuben Smeed to develop a proposal for road pricing (Ministry of Transport, 1964). However, neither road pricing, nor any other large-scale forms of demand management, have been put in place.

Regulations are laws and rules enacted by national or local government. All laws are regulations, but not all regulations are laws. However, there is a more technical use of the term, 'regulation' in the context of secondary legislation, that is addressed below.

Both criminal and civil law are relevant to transport. Criminal law relates to offences that negatively affect society and are defined by what Acts of Parliament articulate as acceptable or unacceptable behaviour in the UK. Under the Road Traffic Act 1988 (c.52) dangerous driving (Section 2) or cycling (Section 28) and leaving a vehicle in a dangerous position (Section 22) are all criminal acts. Civil law considers disputes which are usually settled by compensation, rather than custodial sentences; personal injury cases resulting from road traffic collisions are an example. The UK government has decriminalised several offences in the highway domain to allow highway authorities to enforce them. Decriminalised parking enforcement is the name given in the United Kingdom to the civil enforcement of car parking regulations, carried out by civil enforcement officers, operating on behalf of a local authority. The Road Traffic Act 1991 (c.40) decriminalised parking contraventions in zones administered by local councils, enabling local authorities to enforce parking restrictions instead of the police. Similarly, The Transport Act 2000 (c.38) decriminalised bus lane offences, so infringements can now also be enforced by agents of local authorities.

There are two pathways for making law: act and common law. An Act of Parliament, such as the Road Traffic Act 1988 (c.38) creates a law, or amends an existing law, and is called primary legislation. There is also common law, or customary law, that is based upon precedents set by decisions of the courts. As well the primary legislation of Acts of Parliament, government ministers have powers to create secondary legislation, Statutory Instruments, in powers given by primary legislation. There are three main types of statutory instruments: orders, rules, and regulations. ‘Orders’ include traffic regulation orders required to support a range of measures that govern or restrict the use of streets, including double yellow lines, banned turns and bus lanes.

Legislation is also delegated to bodies such as local authorities and operators of transport systems who can then make byelaws, which are usually limited to a particular local area. For example, the Local Government Act 1972 (c.70) allows local authorities to create bylaws against causing damage to road signs.

This section starts by outlining the legal and regulatory evolution in the street environment (3.3.1), with a particular focus on highway codes in both the UK and other European contexts (3.3.2). This analysis of highway codes leads to the suggestion that the relationship between law and design should be one of alignment and mutual support. It then considers what causes people to obey or disobey the law (3.3.3). After considering enforcement (3.3.4), it closes by reviewing punishments for offences (3.3.5).

3.3.1 Legal and regulatory evolution

In this section the methods for developing laws are established. This is followed by the different evolutionary routes that have been taken in the UK, Europe and North America. Regulation created to accommodate motorised vehicles in streets, compared regulation built on the assumption that streets are intended for these vehicles. Laws that affect the rights of people on foot or cycle, compared with laws that affect their safety. Legal systems that embrace strict liability, versus those that do not. Repurposing old laws compared with creating new ones. The section ends by looking at emerging street use codes in some countries.

Methods for developing laws

Ideas for laws come from a variety of sources including pressure groups, constituents, and political party policy, Figure 23. Sometimes laws are made in response to road user behaviour. For example, in the Netherlands people on foot frequently flouted restrictions on where they could cross the road which eventually led to the Dutch ‘cross anywhere’ rule. Similarly, cyclists in Ontario, Canada, would regularly use flashing lights on their cycles, which led to them being permitted (Ontario Ministry of Transportation, 2018b).

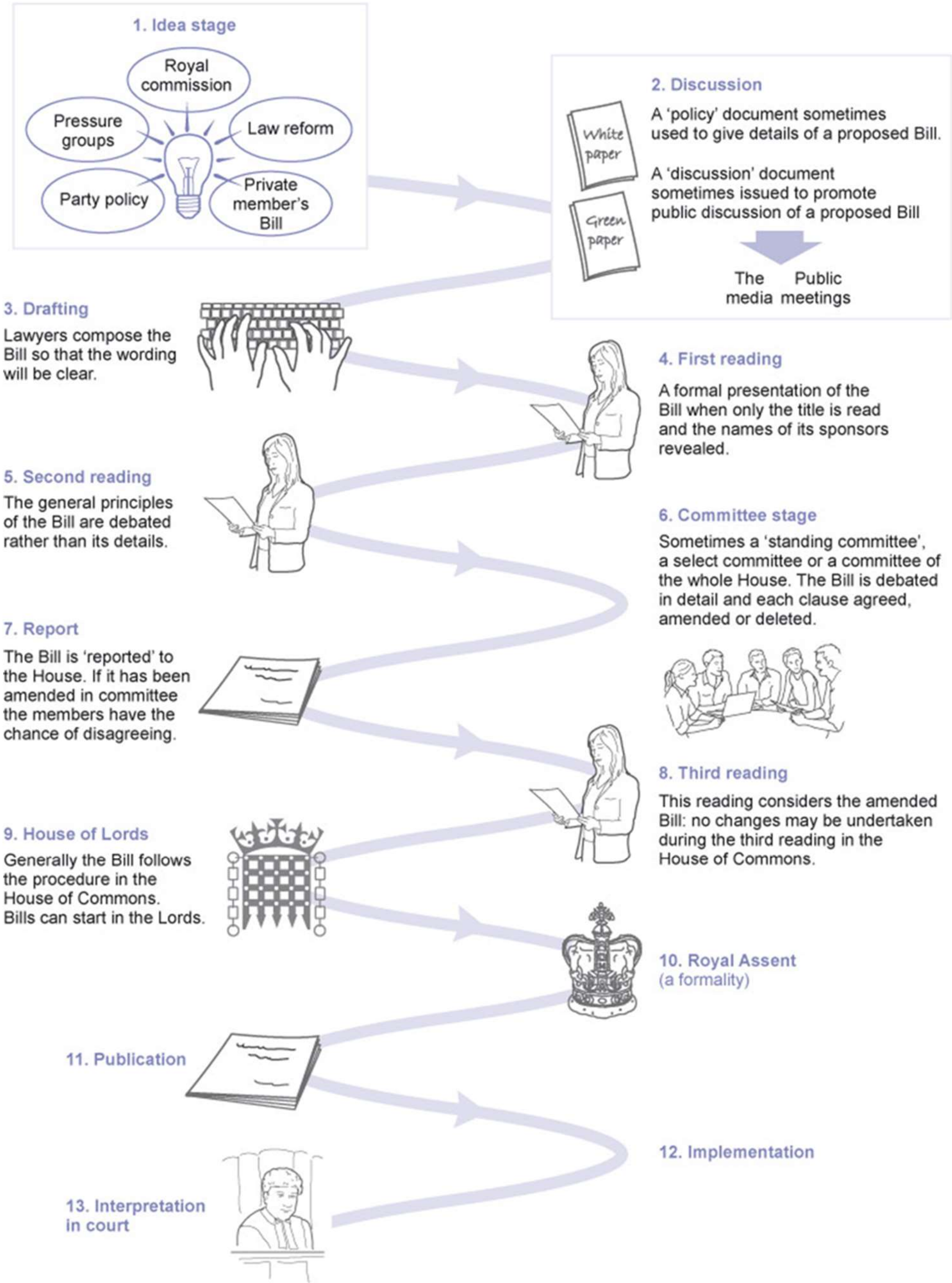

Figure 23 - The law-making process in England and Wales

Note. Reproduced from Open University (2020).

Evolution of laws in the UK and around the world

The legal and regulatory evolution and developments that have led to the current use of street space have taken different paths in different countries. Table 9 provides examples of how regulations have evolved in the UK and around the world.

Table 9 - Effects of evolving laws on pedestrian/cyclist rights and safety

	[Examples beyond UK shaded – dark, global; medium, N. America; light, Europe]		**Improves**	
Year	**Country**	**Law/Regulation**	**Rights**	**Safety**
1835 1878 1878	UK UK UK	Highway Act 1835 gave cyclists a legal right on the carriageway; The act was amended to ban cycling on footways; and to protect pedestrians from cyclists on footways	✓ X	 ✓
1861 1896	UK UK	Locomotion Act (1861-98) introduced requirement for a person carrying a red flag to walk in front of a car, with speed limit of 2mph in towns; Act amended to increase limits to 8-16mph at discretion of local authority		✓ ✓
1903	UK	Motor Car Act 1903 increased speed limit to 20mph, introduced offence of reckless driving and classed cars as carriages		✓
1930	UK	Road Traffic Act 1930 removed speed limit; Introduced offence of dangerous, reckless & careless driving & driving whilst being unfit & under the influence of drink or drugs; Highway Code introduced		X ✓ ✓
1930s	North America	Jaywalking laws introduced in different states that restrict where pedestrians can cross the carriageway	X	
1949	UK	The Special Roads Act 1949 allow the building of roads that could prohibit pedestrians and other forms of traffic like cycles	X	
1956	UK	Road Traffic Act 1956 introduces causing death by dangerous driving		✓
1967	UK	Criminal Justice Act 1967 introduced the offence of driving with excess alcohol		✓
1968	Global	Vienna Convention Road Traffic 1968 grants cyclists the right to use the road	✓	
1973	North America	Wisconsin became the first US state to enact a minimum (cycle) passing distance law; other US and Canadian states have followed and some have also introduced fines for 'dooring'		✓ ✓
1977	UK	Criminal Law Act (1977) changes dangerous driving to reckless driving.		X
1984	UK	Cycle Tracks Act 1984 enables former footways to be shared by cyclists Road Traffic Regulation Act 1984 makes it illegal to park in a mandatory cycle lane	✓	* ✓
1986	Denmark/ Europe	Drivers are automatically liable for collisions with people on foot or cycles unless they can prove that the accident was unavoidable and not due to the negligence on their part. By 2021 the UK, Cyprus, Malta, Romania and Ireland are the only European countries, which have not adopted the presumed liability system.	✓	
1988	UK	Road Traffic Act 1988 dangerous driving replaced the former offence of reckless driving		✓
1994	Canada (Ontario)	Highway Traffic Act, R.S.O. 1990, c. H.8 amendments sought to protect pedestrians with fines, points and imprisonment for cyclists & drivers who break rules, e.g., at crossings and school bus stops		✓
1995	Netherlands	Dutch Road Law 2.19 amended so pedestrians have right to cross roads anywhere	✓	
2000s	Ontario	Allow flashing lights on cycles	✓	
2000s	Belgium, L, F and CH	Principle of prudence especially towards the most threatened road users introduced in new 'Street Use Codes'	✓	
2006	UK	Road Safety Act 2006 introduces the new (lesser compared with dangerous driving) offence of causing death by careless driving; And careless driving while driving unlicensed, disqualified or uninsured Highway Act 1835 used to ban emerging modes such as segways	 X	 X ✓
2006	Global	Article 8.6 of the Vienna Convention on Road Traffic, 1968, was amended to include a ban on the use of mobile phones while driving		✓
2007	US Some US states	Washington first state to ban texting while driving; rose to 48 states by 2021, along with 25 states that ban making hand-held mobile calls Do not text & drive only considered as a secondary violation (so not a legitimate reason for police officers to stop offenders)		✓ X
2012	France	Cyclists can undertake & make turns prohibited for other road users if safe; they can use footpaths when the density of pedestrians is low	✓	
2013	NL	An update of Article 49 1990 Traffic Rules and Signs Regulations (RVV 1990) indicates that drivers must give priority at all times to visually pedestrians carrying a white cane and other disabled persons		✓
2020	UK	The Electric Scooter Trials and Traffic Signs (Coronavirus) Regulations and General Directions 2020 enabled e-scooters to be used in the same locations that cycles are legal, when hired as part of a trial		✓
2022	UK	In an update to the Highway Code pedestrians and cyclists crossing or waiting to cross a zebra/parallel crossing or side road have priority and other traffic should give way.	✓	✓

*Improves cyclists' safety (separating them from motor traffic) whilst making it less safe for pedestrians

Are streets intended for motorised vehicles?

During a 1903 UK parliamentary debate, MP Scott Montagu (Hansard HC Deb, 11 June 1903) said that *"roads were intended for vehicles"*, but MP Sir Ernest Soares (HC Deb, 04 August 1903) countered that *"the public has the use of the road by common law, whereas the motorists have only the right by statute."* Rights of Way: A Guide to Law and Practice, expressed it as *"A highway is not a thing; it is a right."* (Clayden and Trevelyan, 1983). The way both common law and statutes have evolved in the UK means that pedestrians, by common law, have the right of way on all of the highway, with exclusive use of the footway, whereas drivers of motor vehicles by statue have the right to share the carriageway. Cyclists can also use the carriageway and cycle tracks but are not permitted to use the footway. Highway authorities can create routes shared by both pedestrians and cyclists through the conversion of footways into cycle tracks[3].

This divergence of views on whether motor vehicles should be accommodated in streets, or that streets should be designed for these vehicles, has shaped the evolution of laws in different parts of the world. The advent of the age of the car from about the 1930s had a big influence that has led to the set of regulations that exist today. One significant divergence between countries is in relation to pedestrians. Jaywalking laws were introduced across North America in the 1930s, and some other countries have followed that lead, while others have continued to allow people on foot to legally use the carriageway unless specifically prohibited (for example, on a motorway). Dutch pedestrians were required to cross the carriageway only at designated crossing points until 1995 when that changed and people in towns are now free to cross the road anywhere. There has been no such change in North America where people are liable for jaywalking unless they cross at the crosswalks provided at the end of each block.

Decades before the car became the dominant mode (see Figure 3), it began to dominate the regulation of streets, perhaps reflecting that early adopters of the motor car were also those that were wealthier and wielded power. From the 1930s in the US, pedestrians in the street environment began to be restricted in their ability to freely move about and are now only allowed to enter the carriageway at designated points. In the UK, speed limits were

[3] A cycle track is a way over which the public has the right to pass and repass for the (usually exclusive) use of cycles; in the UK this is the legal term. As footways are for the exclusive use of pedestrians and therefore cycling is not permitted, in order to create a path to be shared between pedestrians and cyclists, in the UK it has to be designated a cycle track. In such circumstances the designated route for cyclists and pedestrians is sometimes indicated by using paint. Cycle tracks can also be kerb separated from pedestrians and motor vehicles. Cycle lanes are on the carriageway, indicated by paint. In the UK they can be advisory (motor vehicles are not prohibited from driving or parking in them) indicated by a dashed line, or mandatory (it is prohibited for motor vehicles to enter) indicated by a solid line.

removed in 1930 because so many drivers were breaking the speed limit, and the decision was taken to remove the regulation rather than to enforce it. These actions were designed to facilitate driving, not for pedestrian safety which was put at risk from raised speeds. Jaywalking laws promoted the unimpeded movement of motorised traffic. Removing speed limits showed disregard for pedestrian safety at a time when fatalities were already very high.

The degree of priority afforded to pedestrians also differs by country. In the Netherlands pedestrians have priority on the approach to zebra crossings, whereas in the UK before changes to the Highway Code (Department for Transport, 2022) they only received that priority when they put their foot in the carriageway (Rule 172 in the Highway Code, see Table 10). Dutch Road Law gives special protection to visually impaired and other disabled people, obliging drivers to always give way to them (Bicycle Dutch, 2017).

Laws that affect the movement rights of people walking, cycling, or rolling

The Equality Act 2010 (c.15) requires designers to promote equal access for people with disabilities and ensure that streets meet the requirements of all users. The Inclusive Transport Strategy underlines the government's commitment that disabled people must have the same access to transport as everyone else and be able to travel confidently, easily and without extra cost (Department for Transport, 2018c). However, Rye (2015) highlights from a case study of Edinburgh, that local authorities still often fail to make the reasonable adjustments that are required, and streets frequently remain inaccessible to many.

Some regulations have the effect of either enhancing or diminishing pedestrian and cyclist rights. Restricting movements for people on foot or cycle - 'no entry', 'cyclists dismount', or 'do not cross' signs - can create long diversions that deter people from using these modes. By contrast, removing barriers to movement enhances the rights of people who walk or cycle. Recent developments in standards, guidance and statutory instruments (Transport for London, 2014; Highways England, 2016; Welsh Assembly Government, 2014) have tended to have the effect of creating more direct routes on streets for people on foot and cycle, and separation from motorised vehicles. As can be seen from Table 9, regulations evolve. In 2016, 'except cycles' was allowed on no entry signs in the UK (Minister of Transport, 2016) permitting two-way running for cycles using minimal signing and street furniture. This created the appropriate legal permission at the entrance to the street, something that had been introduced successfully in other European countries such as Germany and Belgium[4]. Since 2017 Norwegian cyclists can undertake turns prohibited for other road users if it is safe to do so, and they can cycle on footpaths when the density of pedestrians is low enough (Norwegian Ministry of Transport, 2017). The latter enhancement of the rights of people on cycles could be seen as a potential diminishment to the exclusive rights of people on foot to use the footway.

Laws that affect the safety of people on foot or cycle

Some regulations have the effect of either enhancing or diminishing pedestrian and cyclist safety. This can be seen in a range of laws in the UK. An amendment to the Highway Act 1835 (5 & 6 Will. 4, chapter 50) in 1878 banned cycling on footways in order to protect pedestrians. The Road Traffic Regulation Act 1984 (c.27) made it illegal to park in a mandatory cycle lane, thereby improving safety for cyclists who were no longer forced back into the general traffic when using these lanes. By contrast the removal of speed limits in the Road Traffic Act 1930 (20 & 21 Geo. 5, chapter 43) served to diminish pedestrian and cyclist safety.

How safety is addressed differs by country or state. Sweden puts an emphasis on public awareness campaigns rather than on strict laws and regulations. So, it has resisted the need to specifically ban texting by law, but generally makes people aware of the dangers of driving while distracted and has some of the world's safest roads (Wallace, 2017).

The importance placed on safety by different societies and the relative importance of different road users, can often be seen in laws and how they are enforced. Canadian laws to protect pedestrians involve large fines, penalty points and imprisonment and cyclists are treated in the same way as drivers and subject to the same laws. Drivers and cyclists must wait at designated crossings until the pedestrians are back on the footway (Ontario Ministry of Transportation, 2018). Drivers in Ontario turning right at junctions (right hand rule of the road) have to yield to cyclists in cycle lanes who are proceeding straight on, but they often get confused (Tchir, 2017) especially at traffic signal-controlled junctions where they still have to give way even when they have a green signal aspect. Policies can sometimes send out mixed messages. While most municipal administrations promote walking and cycling, this can be undermined by other measures. In Montreal measures were introduced that were seen as deterring rather than promoting cycling, including heavy fines for violations

[4] An amendment to German Federal traffic law in 1997 allowed for the trial of contraflow cycle traffic in one-way streets with signage, and this was made permanent in 2000. In 2002 a ministerial decree enabled the highways authority to permit two-way cycling in one-way streets in Belgium based on the width of the streets (not permitted on streets less than 2.6m wide).

by cyclists; in addition, a promised change of priority for cyclists at junctions was never introduced (Valiante, 2018).

Laws that affect both the rights and safety of people on foot or cycle

The Special Roads Act 1949 (12 & 13 Geo 6, Chapter 32) was brought into force to introduce motorways in the UK, creating roads that are for the exclusive use of motor vehicles. Motorways ensure the safety of people on foot or cycle by removing them entirely from proximity with motor vehicles, but in so doing diminish the rights of pedestrians and cyclists by restricting access, hence the same act can simultaneously protect people while diminishing their rights. Over the years the Cycling UK has campaigned where access for cyclists and pedestrians has been revoked, usually on safety grounds, but without alternative provision being provided. One example was the closing of the Humber Bridge, which after campaigning was reopened to active travel in May 2021, albeit with restricted hours of operation (Cycling UK, 2021).

Strict liability

In all but five European countries in collisions involving a cyclist there is presumed liability for the driver of any motor vehicle involved. By contrast in countries like the UK that operate a fault-based system, when a cyclist is hit by a vehicle, they have to prove the driver was at fault in order to receive compensation. Some (Cycling UK, 2016; Department for Transport, 2018a) argue that no fault liability in the context of the highway develops a culture of mutual respect between road users. Others (Hembrow, 2012) suggest that clauses in the law are far less important than appropriate infrastructure provision. Cycling UK (2016) points to legal insufficiencies such as the absence of recognition that intimidating other road users is unacceptable, and the definitions of level of culpability ('dangerous' versus 'careless' driving). The Criminal Justice Joint Inspection (2015) found deficiencies in approach to offence investigation and recommended a prescription of minimum standards and a common model organisational structure for handling fatal road traffic cases. Parkin (2015) suggests there remains an unanswered question: to what extent does the law and the degree of its application affect behaviour in relation to cycling? A view from the legal profession (Kightly, 2017) is that compared with other European countries UK cyclists lack legal protection. For example, the presumed liability of motorists in collisions with pedestrians and cyclists in some European countries, also known as strict liability, provides compensations to these road users in most collisions and causes drivers to be more careful around walkers and cyclists, compared with the UK (see Table 9).

Repurposing old laws and creating new ones

There now exist many different laws which leads to 'types of behaviour' or 'types of society' in different countries. UK law has relatively little that is specifically designed for cycling and as a result some ancient laws have been repurposed. For example 'wanton or furious riding' was designed for horse riding, section 35 of the Offences Against the Persons Act, 1861 (24 & 25 Vict., chapter 100), and reinterpreted for cycling in the Justice Act 1948 (11 & 12 Geo. 6, chapter 58). This ancient law was invoked against Charlie Alliston, a young London cyclist who collided with a pedestrian on his fixed-wheeled cycle. The pedestrian died of her injuries and Alliston was subsequently found guilty of causing bodily harm by "wanton or furious driving" (BBC, 2017). Some Canadian laws do relate directly to cycling, including obligations for cyclists and drivers, with fines for offending. Examples are a minimum of one metre passing distance for vehicles overtaking cyclists and fines for 'dooring' (opening a parked car door in the path of a cyclist), something that is avoided in the Netherlands by teaching the 'Dutch reach' (when exiting a car, opening the doors using the furthest hand from the door) and has now been adopted in the UK (Department for Transport, 2022). US rules in traffic and environmental law, land use regulation, tax and tort, create large indirect subsidies to drive, sharing costs with non-drivers and society at large. Shill (2019) argues that this amounts to driving being subsidised by the law and that, at least in an American context, the law is a major cause of car dependent culture.

3.3.2 Highway codes

In its own words *"the Highway Code is essential reading for everyone"* and *"it is important that all road users are aware of the Code and are considerate towards each other. This applies to pedestrians as much as to drivers and riders"* (Department for Transport, 2015). So, it is relevant to all street users. This section considers the contents and development of The Highway Code and its relevance for streets, first in the UK and then in Europe.

In the UK

Britain introduced driving licences in the Motor Car Act, 1903 (3 Edw. 7, chapter 36) not initially as a road safety measure but as a way of identifying vehicles and their drivers. The introduction of the Road Traffic Act, 1930 (20 & 21 Geo. 5, chapter 43) prepared the way for the first edition of The Highway Code which was introduced in 1931 (The Ministry of Transport, 1931). This came at a time when road safety was firmly on the agenda as over 7,000 people were being killed in road collisions annually, at a time when there were only 2.3 million motor vehicles in Great Britain. By comparison the number of road related deaths in 2017 was 1,793 with more than 37.7 million vehicles on the road (Department for Transport, 2018e).

Some aspects of the Highway Code have not changed from the first edition to the 2021 online version (Department for Transport, 2021c). All road users are still encouraged to be careful and considerate towards others, putting safety first. In other respects, many elements have been evolved to reflect changes in technology and developments in traffic management and road safety. Back in 1931 mirrors were not mentioned and drivers were advised to sound their horn when overtaking (something that visitors to Cairo will notice is still practised in Egypt, a former British colony). The original 24-page booklet published in 1931 focused on motorised vehicles and featured adverts for car and motorcycle related products (Driver and Vehicle Standards Agency, 2019), but over time other users such as pedestrians, cyclists and horse riders began to feature. Only one paragraph was initially written about how to cross the road, and this has increased to a whole chapter of 29 paragraphs over time. More than a third of the first edition described the various hand signals that the police and road users should use, which by the early 2000s had been reduced to a single page.

The fundamental rules relating to streets have not changed significantly for decades. The 14 rules on turning in the Highway Code were an example of this, shown in Table 10, under the section on road junction use and behaviour (rules 170-183, Department for Transport, 2015), but some were updated when the Highway Code was amended in 2022 (Department for Transport, 2022).

Table 10 - Highway Code, rules on turning

Rule	Road users mentioned	Legal obligation	Suggestion	Ambiguous
170 – Take extra care at junctions. You should watch out for… cyclists, motorcyclists, powered wheelchairs, mobility scooters, pedestrians, long vehicles, horse riders	cyclists, motorcyclists, powered wheelchairs, mobility scooters, pedestrians, long vehicles, horse riders		✓	✓
171 - You MUST stop behind the line at a junction with a ‘Stop’ sign and a solid white line across the road. Wait for a safe gap in the traffic before you move off.	(general) traffic	✓		
172 - The approach to a junction may have a ‘Give Way’ sign or a triangle marked on the road. You MUST give way to traffic on the main road when emerging from a junction with broken white lines across the road.	(general) traffic	✓		
173 - Dual carriageways. When crossing or turning right, first assess whether the central reservation is deep enough to protect the full length of your vehicle.	(general) traffic		✓	
174 - Box junctions. These have criss-cross yellow lines painted on the road (see ‘Road markings’). You MUST NOT enter the box until your exit road or lane is clear. However, you may enter…	(general traffic – inferred by illustration)	✓		
[Junctions controlled by traffic lights] 175 - You MUST stop behind the white ‘Stop’ line across your side of the road unless the light is green. If the amber light appears you may go on only if you…		✓		
176 - You MUST NOT move forward over the white line when the red light is showing. Only go forward when the traffic lights are green if there is room for you to clear the junction safely…		✓		
177 - Green filter arrow. This indicates a filter lane only. Do not enter that lane unless you want to go in the direction of the arrow... Give other traffic, especially cyclists, time and room to move into the correct lane.	(general) traffic, cyclists		✓	
178 - Advanced stop lines. Some signal-controlled junctions have advanced stop lines to allow cycles to be positioned ahead of other traffic. Motorists, including motorcyclists, MUST stop at the first white line reached if the lights are amber or red and should…	cyclists, motorists, motorcyclists	✓		✓
[Turning right] 179 - Well before you turn right you should: use your mirrors to make sure you know the position and…	(general) traffic		✓	
180 - Wait until there is a safe gap between you and any oncoming vehicle. Watch out for… Check your mirrors and blind spot again to make sure you are not being overtaken, then make the turn. Do not cut the corner. Take great care when turning…	cyclists, motorcyclists, pedestrians, other users		✓	
181 - When turning right at crossroads where an oncoming vehicle is also turning right, there is a choice of two methods… Cyclists and motorcyclists in particular may be hidden from your view…	cyclists, motorcyclists		✓	
[Turning left] 182 - Use your mirrors and give a left-turn signal well before you turn left. Do not overtake just before you turn left and watch out for traffic coming up on your left before you make the turn, especially if driving a large vehicle… Do not cut in on cyclists.	cyclists, motorcyclists		✓	
183 - When turning: keep as close to the left as is safe and practicable. Give way to any vehicles using a bus lane, cycle lane or tramway from either direction.	buses, cyclists, trams		✓	

These rules leave a lot of ambiguity for turning vehicles, due to some common scenarios not explicitly being addressed, such as how drivers should treat cyclists crossing the mouth of a side road from a shared use path. Ambiguity also arises in these rules (and throughout the Highway Code) as “**MUST**” is only used for the rules that are supported by legislation, either the Road Traffic Act (1988) or the Traffic Signs Regulations (The Secretary of State for Transport, 2002). The effect is that the rules about the protection of the most vulnerable road users are worded as if they are suggestions whereas most rules that aim to stop motor vehicles colliding are clearly obligations. In turn this translates into road user behaviour that largely knows and follows the 'obligations' and ignores or is unaware of the suggestions.

Two of the rules in Table 10 are clearly ambiguous. In Rule 170 for example, drivers are asked to give way to pedestrians who have started to cross, but there is no reciprocal request that drivers should give way to users of powered wheelchairs or mobility scooters, neither to cyclists who have started to cross in situations where there is a shared path.

Rule 178 is about advanced stop lines (ASLs) which allow cycles to be positioned ahead of other traffic. Rule 178 is the only rule in the Highway Code that explicitly places a legal obligation on drivers to protect the welfare of people on foot, cycle or rolling; all other legal obligations, denoted by 'must', are primary directions to motorists for their own wellbeing or that of other motorists. *"Motorists, including motorcyclists, MUST stop at the first white line reached if the lights are amber or red"* is a clear obligation. Allen, Bygrave and Harper (2005) investigated 12 junctions with ASLs in London which showed that ASL reservoir (the area between the first stop line and the ASL) encroachment by car drivers is commonplace, but far less frequent among some professional driver groups, especially bus drivers. Collecting data at every fifth signal phase 7am to 6pm over two days, between 40 and 92% of car drivers were observed to encroach, compared with between 0 and 5% of bus and coach drivers.

Contradictions are not limited to the rules themselves, but there can also be contradictions between the rules and the street infrastructure. For example, much junction design fails to support the rules in the Highway Code, such as wide mouthed side roads that encourage drivers to turn in at speed and not to give way to pedestrians or cyclists in cycle lanes (Rules 170 and 183, Department for Transport, 2015).

The Highway Code in the UK and many other countries focuses on facilitating the passage of motorised traffic and assumes that the main audience is people preparing for their driving tests. The Paving the Way report (CABE *et al.*, 2002) proposed a revision of the Highway Code to address the needs of all road users, but this was not implemented until the 28/1/2022 when a new Highway Code came in, after consultation which amended a number of aspects. The three significant changes were:

1. To introduce a hierarchy of road users to ensure those who can do the greatest harm have the greatest responsibility to reduce the danger or threat they may pose to others,

2. To strengthen the rules on pedestrian priority when waiting or crossing the road,
3. To establish clearer guidance on safe passing of cyclists and their priority at junctions.

In Europe

The move to make highway code changes in the UK follows highway regulation reforms that started in Belgium and have now been adopted by other countries (Gaymard and Bordarie, 2015) that have involved re-orienting the focus of the highway code and creating a 'street code'. France followed Belgium by introducing a Street Use Code (Securité Routière, 2012; Murard *et al.*, 2011) in its highway code. This included a principle of prudence, the notion of sharing street space with the most vulnerable, thereby improving the safety of walkers and cyclists and prioritising 'soft mobility' (term used in French for active mobility). These street use codes broaden the focus from motorised traffic to the needs of all users of streets, and in the Luxembourgian version include rules specifically designed to protect cyclists (Komobile, 2018). These Luxembourgian cycle rules came out of a study of international best practice comparing traffic and infrastructure related laws and regulations that promoted cycling and walking for the Ministry of Transport (Cycle Competence Austria, 2017) and included laws that allow cyclists to turn right on red (right hand rule of the road). 187 million Europeans are already allowed to do this in six countries, and it is being piloted in several others.

The new French Highway Code requires the most powerful to demonstrate prudence in their interactions with others, particularly the most vulnerable (Sécurité Routière, 2008). Drivers of large lorries are placed at the top of this power hierarchy, followed by bus drivers, car drivers, motorcyclists, cyclists, pedestrians, with people with mobility difficulties seen as the most at risk. Another element introduced by Murard *et al*. (2011) is the way that street space is divided, and users are prioritised as illustrated in Figure 24, which is an official English translation of the one in the paper.

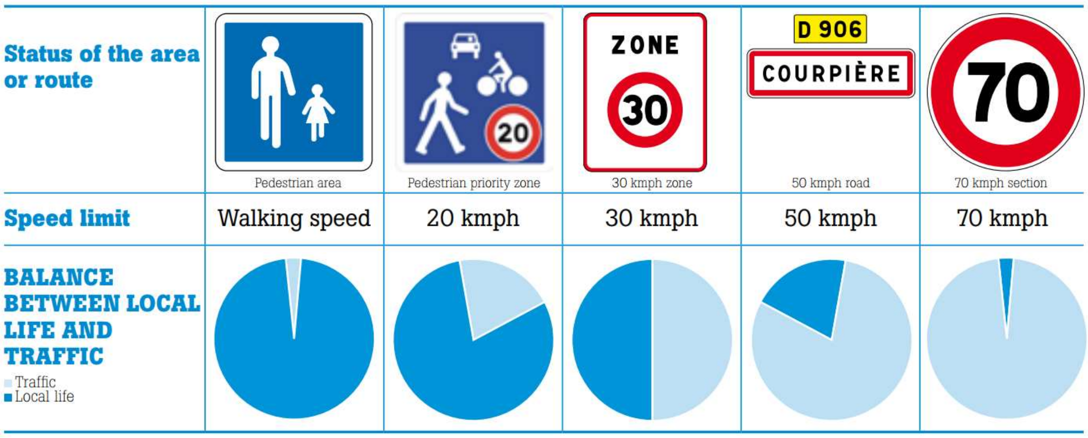

Figure 24 - Continuum of Street Use

Note. Reproduced from Sécurité Routière, (2008).

The continuum above illustrates areas at one extreme where pedestrians are prioritised, the accepted speed is 'walking pace' and emphasis is given to 'local functions' or place (98%) over 'motorised traffic' (2%). At the other extreme are roads with a 70 km/h speed limit where the emphasis is reversed. With lower speeds (20-30 km/h) road conditions conducive to encouraging cycling are achieved, but additionally other cycle promoting regulation changes have been introduced in the new codes such as two-way running in otherwise one-way streets, and the freedom for cyclists to turn right (or make other manoeuvres that are indicated, e.g., straight ahead) if it is safe to do so at red signal aspects.

3.3.3 Obeying and disobeying the law

This section considers law breaking based on road user type given that a use on sight system needs rules for engagement to prevent collision and injury. The most prevalent motoring offence is speeding in the UK and from Department for Transport (2020g) statistics we know that drivers of 54% of cars in free-flowing traffic break the speed limit on 30 mph streets, rising to 86% on 20 mph streets. Conceivably studies could count the number of offences coming to court by user type and scale that against vehicle kilometres travelled by different road user types. However, this would fail to pick up incidents that do not make it to court. So, as an alternative to considering rule breaking from the point of view of court cases, this section uses observational studies. Henni, Chong and Forbes (2016) suggest that reporting in the media fails to adequately convey the societal and economic consequences of speeding, which serves to normalise poor driving behaviours, and gives the impression that speed cameras and fines lack legitimacy and merely exist to raise revenue.

In addition, media portrayals of cyclists might suggest that they consider themselves above the law (Walker, 2019) and are always breaking the rules. However, two Danish studies report that few cyclists break traffic laws, while most drivers do break the law. The first study, carried out for the Danish government, showed that only 4.9% of cyclists broke traffic laws at the recorded junctions compared with 66% of drivers (Danish Road Directorate, 2019). Cycling on the footway is the most common offence by cyclists, which is twice as likely in smaller towns that have fewer cycle tracks, while drivers are most likely to speed. Reid (2019) cites an early study by the consultancy Copenhagenize that demonstrated similar results with only 5% of a sample of 80,000 cyclists breaking highway regulations. The Cycling Embassy of Denmark suggest that the law breaking of cyclists is more visible to other street users, whereas often drivers speeding or talking on the phone go unnoticed, which elevates the perception in people's minds, reinforced by presentations in the media that all cyclists break the law and drivers are mainly law abiding.

In the UK, a Transport for London study (Road Network Performance and Research Team, 2007) found that 16% of all cyclists at a sample of traffic signal controlled junctions in London (and 13% of female cyclists) rode through a red light. Lin *et al*. (2017) found in the US that cyclists were more compliant with traffic laws than drivers. The study followed 100 cyclists for 2,000 hours using mounted sensors, cameras, and GPS to record their interactions with motor vehicles, and showed 12% of cyclists breaking traffic regulations compared with 15% of drivers. According to Deegan (2018) rule breaking is a sign of poor rules or inadequate infrastructure, which can promote non-compliance. In the context of motonormative infrastructure[5] (Walker, Tapp and Davis, forthcoming) rule breaking is a strong indicator of the lack of appropriate design for cycle traffic.

There is data that runs counter to the above findings, which may illustrate how context specific rule-breaking is. A Germany study (Huemer, 2018) that looked at data from two online surveys concerned with the reasons, motives and likelihood for cycling on the wrong path or without lights in the dark, suggests higher levels of rule violations by cyclists in Germany than revealed by other studies elsewhere. This work also provides more insight into the context of German cyclists, whom it reported have a laissez-faire attitude towards

[5] Motonormative describes contexts such as the UK that have become so dominated by the car that many non-motorists have assimilated a motorist's perspective on streets in terms of how they function and what they are for. Motonormative infrastructure at a street level might accommodate all legal movements for motorised vehicles, but not consider all the legitimate manoeuvres that cycles might need to make.

rule-violating, are not greatly influenced by deterrents, and have a generally low knowledge of the rules. All this in a context where cycling is being carried out on designated cycle infrastructure. One of the biggest violations is cycling the wrong way on uni-directional separated cycle tracks or lanes.

On balance, from the evidence it is unjustified to say that cyclists are more prone to rule-breaking than drivers. The motivations for law breaking are varied. Sometimes it is out of self-preservation - for example, in un-protected situations it can feel safer to cycle on the footway than in the carriageway (Shaw *et al.*, 2015). A further example is cyclists anticipating the changing of traffic signal aspects from red to green and moving off early. This can enable cyclists to clear a junction from an advanced stop line before the motorised traffic behind sets off (Road Network Performance and Research Team, 2007). Not knowing the rules is another reason for violating them, with studies from Germany and Australia reporting that most cyclists were unaware of most rules (Johnson *et al.*, 2014; Huemer, 2018) which may be a by-product of not requiring testing and licencing for cyclists in most countries. Latham and Wood (2015) describe people's negotiation of cycle infrastructure in terms of rule following, rulemaking, and rule bending. Some of these practices are common to driving or walking, but others are unique to cyclists, especially where the highway engineer has created 'impossible' manoeuvres for cyclists in the street design. Figure 25 shows how a left turn is banned by regulation and physical design, thus preventing cyclists from making the manoeuvre, despite the presence of a contraflow cycle lane in the one-way side street behind the emerging orange bus.

Figure 25 - 'Impossible', but legitimate turn left cycle manoeuvre (Bristol)

Note. Photograph taken by Flower, 2021.

3.3.4 Enforcement

A safer environment where the actual and perceived risk of conflict with cars was significantly reduced or eliminated altogether would encourage people to walk and cycle. Governments tend to monitor collisions where people are injured or killed rather than collisions per se. When slight injuries are recorded, they are usually not acted on. The police collision record is incomplete because it does not record collisions where no-one was injured and there is an under-reporting of slight injuries, especially single vehicle collisions, particularly slight injuries to cyclists. Insurance data would provide a useful additional data source, but these are not readily available as they are viewed as commercially sensitive and kept by individual insurance companies.

Rezaour, Wulff and Ksaibati (2018) show that the number of people killed and injured on the roads decreases as police enforcement rises. They demonstrate that higher enforcement budgets, numbers of road traffic officers, and numbers of hours spend on traffic duty are preventive measures for fatality rate. Kyd and Cammiss (2019) found that cyclists can be ambivalent and fatalistic about the limited enforcement by the police of traffic laws to protect them, such as action taken to prosecute close passing motorists. This can lead to them feeling obliged to manage their own risk, through safety equipment and clothing, planning, and avoidance. As a consequence, it can lead to victim blaming by motorists who blame cyclists for incidents - such as it being the victim’s fault for not managing their own safety by wearing high visibility clothing, rather than the driver taking responsibility for not paying due care an attention.

Safety improvements in cars have been a development that has contributed a great deal to the reduction in casualties to people in these vehicles. This focus on making vehicles safer in a collision has consequences that are not positive for street users that are not in those vehicles. Traditionally, the design solutions for the safety of people outside of a vehicle has focused on the front bumper for impact protection. Occupant safety has been addressed separately by strengthening the crashworthiness of the structure of a car. People driving cars at speed feel increasingly safe with some justification, as the numbers killed and seriously injured inside cars has been falling for many years in the UK, more than halving between 2000 and 2017 to 9,681 (Havaei-Ahary, 2019). Over the same period the numbers killed, and seriously injured cycling has risen steadily and is beginning to rise again for pedestrians after a slight downward trend for the nine years to 2009. This anomaly may be an unintended consequence of successive governments’ targets to reduce road collision casualties since the UK introduced them in 1987 (Broughton and Knowles, 2010).

The targets can be achieved by improving safety for people in cars without also addressing the safety needs of people on foot or cycle.

A study reported by Srinivas *et al.* (2017) suggested that the safety of both people inside and outside of vehicles could be addressed simultaneously by reducing vehicle weight. Increased vehicle weight increases the likelihood of injury, with SUVs disproportionately likely to injure pedestrians, compared with cars (Monfort and Mueller, 2020). This is of concern as Tyndall (2020) reported that as SUVs are gaining a larger share of the automobile market, the average weight of vehicles involved in fatal crashes is increasing; while the number of fatalities among vehicle occupants fell in the US by 20% from 2000-2018, the number of pedestrians killed in road traffic collisions grew by 32%. Like people on foot, people cycling are also generally associated with much higher risks of death or serious injury than those who are travelling by car (Schepers *et al.*, 2014). These road users may benefit far more from measures to eliminate collisions, rather than measure to make collisions safer for occupants of cars.

Self-enforcing initiatives

A growing number of urban centres have introduced 20 mph speed limits, 30 km/h in the rest of Europe (Tapp, Nancarrow and Davis, 2015; Muelenaere, 2019) as part of wider transport packages aimed at improving road safety, promoting active travel and creating more pleasant communities with streets that are conducive to walking and cycling (Bristol City Council, 2019). Such schemes in the UK are expected to be self-enforcing, without the requirement of policing or other enforcement measures. These lower speed limits across a wide geographical area have been shown to lead to significant reductions in average traffic speeds (ROSPA, 2017), after controlling for other factors. They also reduce the number of injuries from road traffic collisions (Bornioli *et al.,* 2020), and contribute to increased numbers of people walking and cycling to school and work. While schemes retain majority support, concerns exist about compliance and the behaviour of some drivers (Pilkington *et al.*, 2018).

3.3.5 Punishment

Voelcker (2007) reviewed the penalties in the UK for drivers who kill cyclists or pedestrians. Since the introduction of the Road Traffic Act, 1956 (4 & 5 Eliz. 2, chapter 67) the killing of people involving a car has not usually been seen as homicide. The 1956 act introduced causing death by dangerous driving, thereby creating a separation between road traffic regulations and other criminal and civil laws, and it is generally accepted that this was created due to a reluctance of juries to convict drivers of motor-manslaughter (Williams, 1963). Dangerous driving requires two supposedly objective, but in practice, subjective tests to be met for a conviction:

1. *"A standard of driving which falls far below that expected of a competent and careful driver"*, and
2. *"… carry a potential or actual danger of physical injury or serious damage to property"*.

The Criminal Law Act 1977 (c.45) introduced reckless driving, which required foresight (*mens rea*, the intention to commit a crime). This was superseded by the Road Traffic Act 1988 (c.52) which replaced the offence of reckless driving with a new offence of dangerous driving. This was a change from the former law, in that unlike reckless driving, there is no *mens rea* required, and there was no definition of 'competent and careful'. The Road Traffic Act 1988 seeks to protect people from dangerous driving but fails because the justice system finds it hard to demonstrate that drivers meet the two tests above. Almost all police officers, judges and jurors are drivers, and most would consider themselves as 'competent and careful'. However, they are also aware that they, like most other people, have lapses and so it will always take a great deal of deviation from their experience to reach the threshold of 'falls far below'. By contrast other offences are completely objective to determine, such as excess drugs and alcohol in the blood stream and using a mobile phone (Voelcker, 2007).

According to Road Peace (2019) juries tend to be reticent to convict drivers who have killed someone and when they do, they are more inclined to employ lesser charges (e.g. careless driving instead of dangerous driving) and minimal penalties, rather than the maximum available to them. For example, a driver that killed a 15-year-old cyclist during a close pass, who was travelling at more than 50 mph in a 30 mph zone on a straight section of a well-lit road, who did not stop, who abandoned his vehicle, got a taxi home and went to bed without calling the emergency services, with eight previous convictions, received a 40 month sentence instead of the maximum 14 years (Wise, 2021). He was also disqualified from driving for three years from the date of his release, something Detective Chief Superintendent Andy Cox (2021), National Lead for Fatal Collision Investigation Reporting described as; *"deeply frustrating. Driving should not be seen as an entitlement but instead* *a privilege earned through safe driving records and a track record to prove it."* Often the principle of *'there but the grace of God go I'* applies.[6]

Many drivers know they are guilty of having driven carelessly or even dangerously at some point, but most do not get caught, often because there has been no detrimental consequence. Their shared injunctive norm is that they should not behave like this (e.g., drive in a manner that could cause death or serious injury, such as speeding and close passing a cyclist), but they observe the descriptive norm that everyone does it (breaking the speed limit is something that most drivers habitually do). Hirst (2008) writing following the introduction in the UK of the new offence of causing death by careless driving, acknowledged that motor vehicles are dangerous, and that deliberately bad, aggressive or irresponsible driving deserves serious punishment. Some drivers who kill are not prosecuted and of those that are some face *"downgraded charges",* such as careless driving, giving rise to the common complaint that such motorists ought to face charges of manslaughter, instead of the less serious offence of causing death by dangerous driving. However, Hirst argues that such complaints no longer have validity as both maximum and guideline penalties for death by driving offences have increased which means that motorists convicted of such offences are now punished more severely than most other involuntary killers.

Juries are more predisposed to convict, and judges readier to give harsher penalties to people seen as being 'real' criminals, as opposed to drivers perceived as having made an honest mistake. This includes people driving under the influence or driving a stolen vehicle. Voelker's (2007) review of court cases between 1996 and 2006 suggests that the driving offence may be the same (e.g., knocking down and killing a person), but in the case of the 'criminal' they are more likely to be both convicted of the driving offence and receive a penalty for the related offence such as driving a stolen vehicle.

Summary

This section has attempted to demonstrate that regulations shape the culture of streets in different ways. They can also be indicators of wider policy directions and who is considered as important in a particular society. Although it has been shown that some laws and rules make streets more conducive to walking, cycling, and rolling, the threshold of measures and their enforcement to encourage people to do so has not been established.

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[6] This is reminiscent of the story of Jesus and the woman caught in adultery. Jewish law required that she be stoned to death, but Jesus suggested that the person who was without sin cast the first stone. While Jesus wrote in the sand the crowd slipped away, starting with the oldest, many of whom had probably also committed adultery and just not got caught.

3.4 Street design

One of the responses of the UK government to the rising dominance of driving in the 1960s was to commission the Traffic in Towns report (Buchanan, 1963) which proposed an infrastructure design led change to address evolving behaviours. One of the prime aims in infrastructure design and traffic engineering is to improve traffic flow, without compromising the safety of street users. Design, construction, and maintenance also play an important role in determining whether streets are accessible to people on foot cycle or rolling. The aim of this section is to demonstrate from guidance and research how infrastructure design affects pedestrian and cycling traffic flows and safety. This section begins with an examination of relevant design guidance in the UK and elsewhere (3.4.1). It covers UK design guidance, especially issues to address safety and flow of pedestrians and cyclists at side roads. It then maps the evolution of UK design guidance for streets more generally, showing how the needs of walking, cycling, and rolling are increasingly catered for. A look at selected European design guidance turns to the Netherlands and Denmark due to their renown for championing active travel, as evidenced by the high mode share of active travel in their major cities. Guidance from North America and other countries is also reviewed briefly before looking at both effective design details that enhance the walking and cycling experience and design features that increase pedestrian and cyclist risk. The role of infrastructure design in creating a sense of place in streets (3.4.2) follows. The section ends with the relative importance of street design and regulation (3.4.3).

3.4.1 Design guidance

This section reviews UK national guidance, including guidance emanating from the devolved regions of the UK and local guidance. It then goes on to consider European guidance, especially Dutch guidance, and then other international, including North American guidance.

United Kingdom guidance

A key obstacle to traffic flow in streets comes at junctions and crossings. The majority of crossing points occur at the most prevalent junction types which are side road junctions, also known as priority junctions (yields, or T-junctions). Two thirds of all collisions in urban contexts occur at junctions (Department for Transport, 2017b). Traditionally the traffic engineering focus at these points has been motorised traffic flow and has come at the expense of both the flow and safety of walking and cycling traffic. This sub-section reviews the UK guidance documents that influence the way side road junctions are designed or redesigned in towns and cities. A range of options to enhance the ability to cross side roads safely and with minimum delay are increasingly being trialled in different parts of the United Kingdom. At a policy level these help to make walking and cycling the most natural and normal way of getting about, which in turn promotes healthy lifestyles and helps build liveable cities (Welsh Government, 2020). Options include: tightening junction geometry; providing continuous footways across side roads; using raised humps; marking the crossing for cycle traffic in various ways. Highway authorities are becoming increasingly creative in their approaches to designs, and some are wishing to push beyond what is currently allowed. For example, Transport for Greater Manchester has trialled non-prescribed zebra crossings (zebra markings only, with no zigzags, Belisha beacons or overhead lighting) across the mouth of side roads (Jones, Matyas and Jenkins, 2021).

The UK relies heavily on road markings to communicate who has priority, compared to other countries and states that have stronger give way on turning rules. In California (State of California, 2021) turning drivers have to yield to pedestrians on the main road who have the right-of-way and drivers are warned to check for cyclists that may be riding next to them; in the Netherlands (Ministry of Infrastructure and the Environment, 2013) drivers who wish to turn must give way to oncoming vehicles and also to all vehicles travelling behind them in the same direction. The UK's approach can lead to some very cluttered, and perhaps visually confusing, designs as illustrated by the 'marked priority' examples in Figure 26.

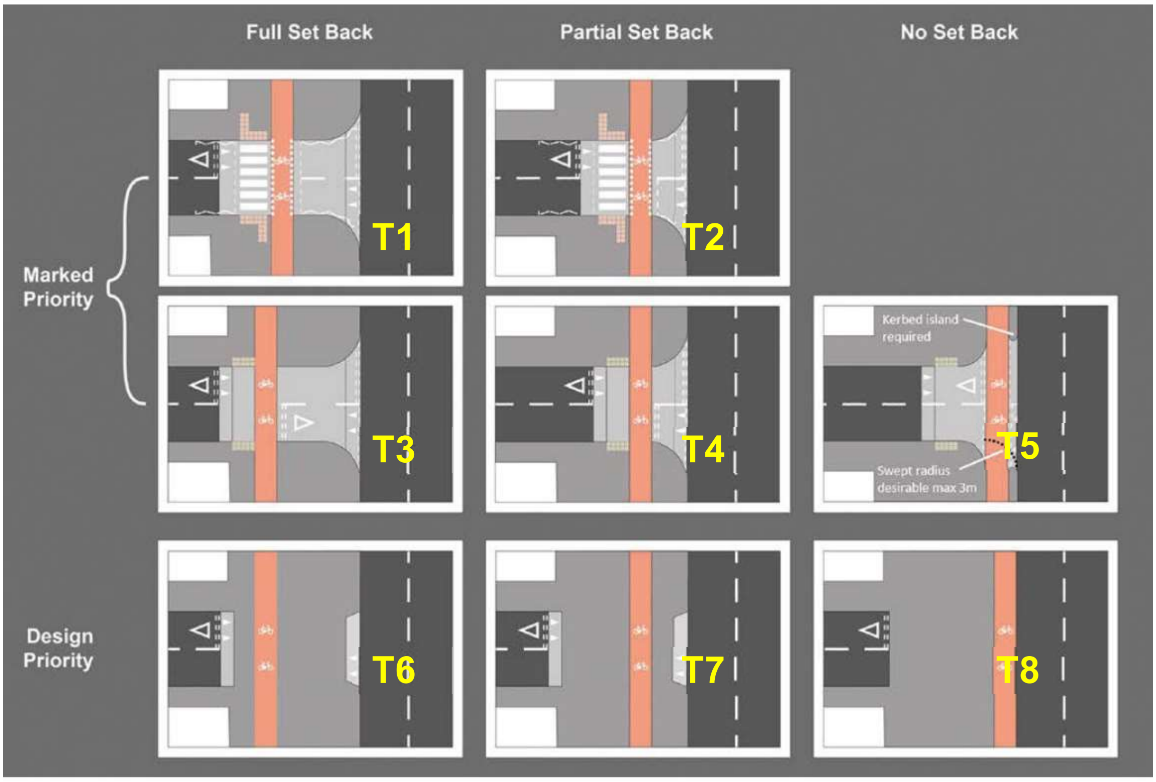

Figure 26 - Continuous pedestrian and cycle crossing priorities at side roads

Note. Reproduced form Figure 10.13 in Department for Transport (2020i).

The diagram shows two classifications of solution. Firstly, there are five images of full legal marked priority (T1-T5), and secondly three images where priority is provided by design (T6-T8). In the solutions created by design, there are changes in surfacing for the turning driver, but minimal road markings, to distinguish the footway and cycle crossing, from the carriageway. Where design is used to create priority, the result can be much simpler than when using road markings and signs. It should be noted that the idea of 'full set back', 'partial set back' and 'no set back' is from the perspective of the cyclist and can be different when viewed from the perspective of the crossing pedestrian. This may mean that the relative safety benefits of each design are different for pedestrians and cyclists.

Table 11 provides a summary of what some of the UK guidance documents say (or do not say) about continuous pedestrian and cycle crossing priorities at side roads.

Table 11 - Guidance that includes continuous pedestrian and/or cycle crossings

		Guidance for people on	
Reference	**Contribution**	**Foot**	**Cycle**
Manual for Streets 2 (Young and Jones, 2010)	• Advice for streets in built up areas, UK • Describes what it calls ‘footway crossovers’ pp64/5	✓	
Roads for All (Transport Scotland, 2013)	• For trunk road and motorway network, Scotland • Describes vehicle footway crossovers to provide access to domestic properties; can also be used for commercial properties	✓	
Cycling by Design (Transport Scotland, 2011)	• For Scotland • Section 7.2.2.2 describes a continuous cycle crossing at a minor private or commercial access, which should be ‘bent-out’ (away from the carriageway); gives conflicting messages as both drivers and cyclists encounter give way markings		✓
Active Travel Act Guidance (Welsh Government, 2021)	• For Wales • “On active travel routes, junctions and crossing design should favour priority for pedestrians and cyclists over vehicles” (p181) • Shared or separated pedestrian and cycle track crossing of side roads – “Footways and cycle tracks should give priority to users crossing the side road on the major arm unless this is unsafe. Giving users priority over the side road enables them to continue without loss of momentum and contributes to the directness of a route” (p187)	✓ ✓	✓ ✓
Making Space for Cycling (Cambridge Cycling Campaign, 2014)	• For Cambridge, with wider application • Cycle infrastructure that runs alongside a road needs to be continuous and maintain priority over every side road; cycle track and footway must not change height at the crossing location, and the adjacent footway should also provide continuity for pedestrians. • Uni-directional cycle tracks are better and safer than bi-directional tracks	✓	✓
Sustrans Design Manual (Sustrans, 2015)	• Describes bent out cycle priority at side roads • When cycle tracks are not set back: “priority to be determined from site conditions, visibility, speeds, flow” (p80)		✓
Waltham Forest Mini-Holland Design Guide (Waltham Forest Council, 2015)	• For Waltham Forest, London • Describes what it calls Copenhagen or blended crossings that can provide gateways into residential areas with continuous footways that can be combined with cycle tracks across side roads • A steep ramp to the cycle track for turning vehicles will slow vehicles down and warn drivers that they are crossing a cycle track and footway	✓	✓
London Cycle Design Standards (Transport for London, 2016)	• For London • Describes options for cycle tracks across side roads in Section 5.3.4. • Emphasis on good sight lines and speed reduction through raised tables, entry treatments and reduced corner radii, with highest level of service provided by a continuation of the cycle track without lateral deviation		✓
Streetscape Guidance (Transport for London, 2019b)	• For London • Continuous footways (p161) described as experimental in the UK	✓	
CD 195 Designing for Cycle Traffic (Highways England, 2019a)	• For strategic road network (trunk roads in Scotland, Wales, and NI) • Describes uni-directional stepped cycle tracks with priority over minor side roads by transitioning to a cycle lane across the junction • Both ‘bent-in’ (towards the main road carriageway) and ‘bent-out’ (away from the carriageway) solutions are described • For higher turning volumes of traffic (up to 8,000 annual average daily traffic) parallel pedestrian/cycle crossings are preferred	✓	✓ ✓ ✓
Edinburgh Street Design Guide (City of Edinburgh Council, 2019a)	• For Edinburgh • Recommends continuous footways, raised tables or buildouts to increase pedestrian priority at side roads, with continuous cycling facilities in accordance with the cycling design standards (see diagram, DWG Ref: CF-DR-C-0011)	✓	✓

The Design Manual for Roads and Bridges (Highways England, 2019) provides standards for the trunk road and motorway network. Despite that, many designers use it as a reference source for non-trunk roads in urban areas. The Sustrans Design Manual (Sustrans, 2015) draws heavily on UK examples, with a few European exemplars. The document tends to describe what currently exists, rather than to provide clear guidance on what to use and when. It is a cycling design manual and so provision for pedestrians is not always fully discussed.

The Welsh guidance (Welsh Government, 2021) supports the Active Travel (Wales) Act (National Assembly for Wales, 2013). When determining who has priority the following factors should be considered: location, vehicle speed, visibility, number of pedestrian and cycle movements, number of vehicle movements and accident statistics and the feasibility of providing similar priority at nearby side road crossings.

The ability to provide similar treatment to other nearby side road crossings is also important to create a continuous route for cyclists and so the approach used becomes familiar to drivers. Welsh guidance refers to continuous footways as blended crossings and contrasts them with an example from Hammersmith shown in Figure 27Figure 27. The crossing is described as a side road entry treatment which has a raised crossing, but there is not priority for pedestrians and the kerb line into the side road is maintained. In a study on the effect of side road raised entry treatments on road safety, Wood *et al*. (2006) identified that pedestrians appear to like the convenience such side road entry treatments afford, which provide a continuous level place to cross between the footways either side of the side road without the need to divert from their natural crossing line. Others have used the term 'blended crossing' to mean something less than a continuous footway, where priorities are ambiguous (Weetman, 2018).

Figure 27 - Side road entry treatment

Note. Reproduced from Welsh Assembly Government (2014).

Despite the great variety in the UK of standards and practice to create better conditions for crossing pedestrians, there is little evidence about approaches that are the most beneficial in terms of reducing the injury burden on pedestrians and cyclists. Three complementary projects have provided evidence about how people behave, including focus groups that reveal reasons as to why they behave in the way they do. The first evaluated the effectiveness of continuous side road crossings (Flower, Ricci and Parkin, 2020) and demonstrated that continuous footways can improve priority for people on foot and cycles. Specific design features assist, such as: continuity of kerb line along main road; no visible radii; continuity of mainline road markings; vertical upstands to slow traffic; continuity of materials and colours that are different for the different areas within the scheme (footway, cycle tracks and carriageway); having a wide continuous footway and cycleway extending at least from the main road kerb line to the building line. The interim results from the second study (Transport Research Laboratory, 2020) show that the UK-invented zebra crossing is nearly universally recognised by walkers and drivers alike, even without zig-zag markings and Belisha beacons which are currently required. Removal of Belisha beacons and zig-zag markings would simplify the zebra and provide a cost-efficient option to improve pedestrian priority at side roads. The third project commissioned by the Road Safety Trust is in progress at the time of writing and will examine design development of side road crossings for pedestrians and cyclists and evaluate the effectiveness of marked priority (Flower and Parkin, 2020).

Evolution of UK design guidance for streets

The ideas of movement and place were mooted in the Traffic in Towns report (Buchanan, 1963), but it was not until the arrival of Manual for Streets (Department for Transport, 2007a) more than 40 years later that the UK had design guidance where both of these functions were fully considered (Jones, Marshall and Boujenko, 2008). This subsection outlines the evolution of design guidance for streets.

The timeline shows some of the documents that led to the Manual for Streets guidance and evolutions beyond it, spanning thirty years:

- 1992 - the first edition of Design Manual for Roads and Bridges (DMRB) was published
- 1992 - Design Bulletin 32 (DB32)
- 1998 - Places, Streets and Movement
- 2007 - Manual for Streets (MfS1)
- 2008 - LTN 2/08
- 2010 - Manual for Streets 2 (MfS2)
- 2012 - LTN 1/12
- 2016 - IAN 195/16
- 2019 - CD 195
- 2020 – LTN 1/20
- 2022 - *Manual for Streets 3* expected to be published

The Design Manual for Roads and Bridges was first published in 1992 to provide design guidance for interurban roads, and it brought together a series of previous advice and guidance into one source document. The Department of the Environment (1992, cited by Department for Transport, 2007) published Design Bulletin 32 to address layout considerations for residential roads and footpaths. Baxter (1998, cited by Department for Transport, 2007) wrote a companion guide for DB32 called Places, Streets and Movement, which Marshall (2000) saw as an advance that brought planning, highway engineering and urban design together in housing developments, but also advocated the guidance be used in mixed-use developments, something not addressed in DB32.

Manual for Streets (Department for Transport, 2007) superseded DB32 and its companion guide, which were subsequently withdrawn. Like DB32 MfS1 focused on residential streets, but its principles are applicable to other types of streets, including high streets. The design requirements motorways and major A roads were set out in the DMRB (Highways England, 2019). Unfortunately, DMRB had been inappropriately applied to many residential streets, something that the publication of MfS1 sought to end (Davies and Huxford, 2009).

Manual for Streets 2 (Young and Jones, 2010) was introduced as a supplementary companion guide for MfS1. The focus of MfS1 was in its own words ‘lightly trafficked residential streets’ and it defined a street as a highway with an important public realm function, over and above just traffic movements. In the light of this MfS2 proposes that most urban highways could therefore be considered streets. MfS2 provides guidance on how to apply MfS principles to busier streets and non-trunk roads, filling a gap that many have perceived between MfS1 and DMRB.

Interim Advice Note 195/16 (Highways England, 2016) was introduced to be used alongside the DMRB for cycle traffic on the Strategic Road Network. Three years later the interim advice note was replaced by CD195 (Highways England, 2019a), entitled ‘Designing for cycle traffic’ which brought the document fully into the DMRB rather than being interim advice. It is worthy of note that the title of these documents contains the term ‘cycle traffic’ which recognises the cycle as a distinct mode of transport that is not motor traffic or walking traffic, which as Parkin (2018) says, "are vehicles capable of speed". The document is clearly for trunk roads and although it has been used for streets, much of the information is not applicable. However, CD195 contains a lot that is generally applicable, given that design speed, user requirements and the physical space needed for cycle traffic apply everywhere.

Cycling Infrastructure Design (Department for Transport, 2020i) also known as LTN 1/20, was introduced to provide design guidance and good practice for cycle infrastructure, to be used by local authorities responsible for setting design guidance for their streets. Although aimed specifically at cycling infrastructure it does have implications for walking infrastructure. For example, the document provides design options for continuous pedestrian and cycle crossing priority at side roads (see Figure 26). LTN 1/20 replaces previous guidance on cycle infrastructure design provided by LTN 2/08 (Department for Transport, 2008a), and LTN 1/12 (Department for Transport, 2012) which provided guidance for shared use routes for pedestrians and cyclists. The withdrawal of LTN 1/12 - which itself replaced LTN 2/86 (Department of Transport, 1986) - and its replacement with LTN 1/20 is an important development in the separation or segregation debate. The second guiding principle of LTN 1/20 (p9) is that *"Cycles must be treated as vehicles and not as pedestrians. On urban streets, cyclists must be physically separated from pedestrians and should not share space with pedestrians. Where cycle routes cross pavements, a physically segregated track should always be provided. At crossings and junctions, cyclists should not share the space used by pedestrians but should be provided with a separate parallel route."* This is a significant and major departure from previous guidance and practice which had led to a lot of shared provision between pedestrians and cyclists.

A new version of Manual for Streets is in production at time of writing and is expected to be published in 2022. The Chartered Institution of Highways and Transportation, CIHT (2020) is developing a new streets guidance document with the support of WSP which will update and merge MfS1 and MfS2 into a single tome expected to be called simply, 'Manual for Streets'. It will seek to provide guidance for local authorities on designing residential and busier urban streets and it is anticipated that LTN 1/20 will be incorporated and that this research will also contribute to the revision. CIHT have called on the government to strengthen the status of MfS by making it government policy, which the professional body feel would help better integration between planning and transport (Browne, 2021).

Selected European guidance

This section reviews Dutch and Danish guidance on providing priority for pedestrians and cyclists across side roads. The Dutch guidance assumes that cycle tracks, and cycle lanes alongside distributor roads, have continuous priority over junctions to ensure that there is no interruption to cycle traffic.

Dutch guidance

The Dutch have detailed guidance on designing for cycle traffic in the Design Manual for Bicycle Traffic (CROW, 2016). There are five guiding design principles, directness, safety, comfort, attractiveness and coherence. The first three of these are relevant to side road crossings. Earlier Dutch guidance (CROW, 1998) provides special mention of continuous footways and cycle tracks, which are omitted from later additions, perhaps because they are now widely assumed as the norm for side roads that provide a transition into residential areas.

Danish guidance

The City of Copenhagen, regarded by many as one of the world's foremost cycling cities (Copenhagen Design Company, 2019), has its own design manual called 'Design Manual for Urban Spaces and Parks'.

The city also has cycle specific guidance (The Bicycle Programme, 2013) which includes what it calls 'continuous pavement' over side streets. In the UK these are sometimes called Copenhagen or continuous crossings. It is the turning motor traffic that must change level to cross the cycle track (and footway) which helps to reinforce the priority for pedestrians and cyclists. Normally the stepped cycle track continues with priority across side roads alongside the continuous pavement as seen in Figure 28.

Figure 28 - 'Continuous pavement', Copenhagen

Note. Photo: Symons (2017).

Parkin (2018) reviews different treatments at priority junctions drawing on international principles and practice and proposes the Danish example as best practice for side roads with two-way annual average daily traffic of less than 2,000.

Other international and North American guidance

This section reviews the Organisation for Economic Co-operation and Development (OECD/International Transport Forum, 2013) guidance, and, from North America, National Association of City Transportation Officials (NACTO, 2019) guidance.

The OECD research report on cycling (OECD/International Transport Forum, 2013) included guidance on measures for priority junctions. It defined what it called ‘continuing bicycle tracks’ which can be used across side roads along minor or major roads, and states that they are usually combined with continuing sidewalks.

There is currently no provision for continuous footways in NACTO (2019) guidance, but it does provide guidance for continuous cycle tracks. The main features help indicate and facilitate priority for pedestrians and cyclists, as shown in Figure 29.

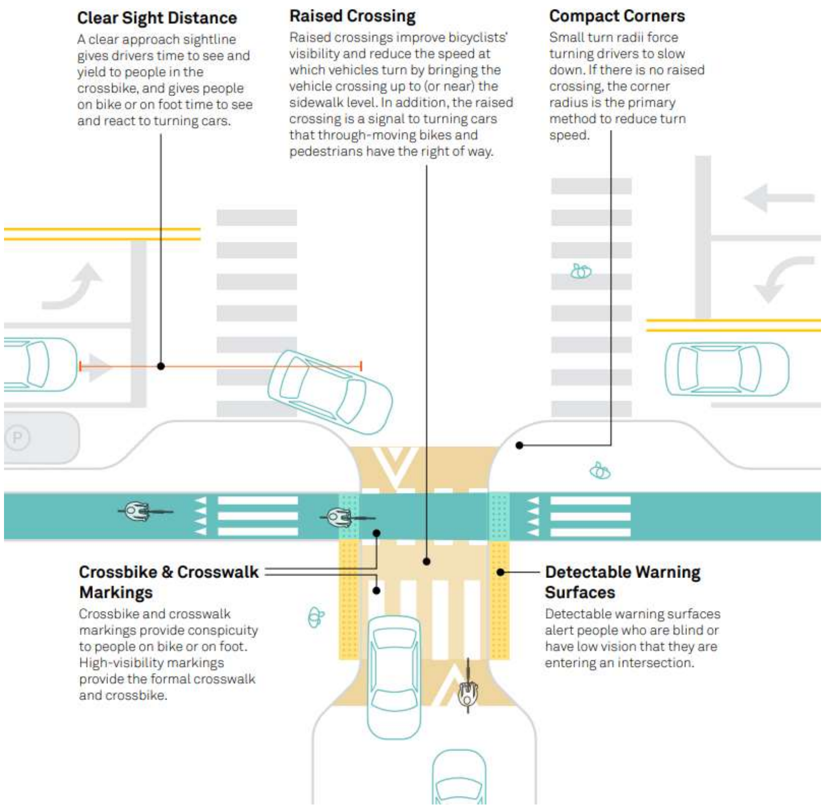

Figure 29 - NACTO guidance for treatment of minor side road crossings

Note. Reproduced from NACTO (2019).

Tactile paving is recommended across the width of the cycle track, at the point that the track crosses the carriageway. In contrast, in Europe, tactile paving is not used within cycle tracks. The idea of surfaces that are detectable to visually impaired people is to warn them that they are entering a live carriageway at points where the footway is flush with the carriageway. If the same principle is used when a footway encounters a cycle track, then there would be no need for detectable warning surfaces to be used when cycle tracks cross carriageways.

Further design detail considerations

Pedler and Davies (2000) compared different side road junction treatment designs at five UK locations, all of which provided some level of priority for cycle tracks, with varying degrees of provision for pedestrians. The study drew some interesting conclusions and raised some conundrums from the hundreds of interactions observed and more than 200 interviews with cyclists. They have been classified below as neutral, enhancing the walking and cycling experience, and increasing pedestrian and cyclist risk, summarised in Table 12, with more details below.

Table 12 - Junction design features that enhance the user experience or the risk

Observation:	Comments from Pedler and Davies (2000) study
Neutral	• Most interactions non-hazardous, but some cyclists cede priority to drivers • Only bent-out designs offered cyclist and pedestrians priority
Enhancing walking and cycling experience	• Humps • Contrast of colours and materials used for different modes • Continuous
Increasing pedestrian and cyclist risk	• Mixed priorities

Most interactions that cyclists had with other road users were not risky. Some of the observed failures to give way by drivers were due to cyclists ceding priority to drivers; the cyclist stopped and waited for the driver.

Enhancing the walking and cycling experience

None of the designs in the study (Pedler, Davies 2000) had continuous footways for pedestrians, but the researchers indicated that some design features (humps, coloured contrast tracks and set-back give way markings) all aided pedestrians crossing the road, as did good designs that attracted more people to cycle or walk. This corroborates and is corroborated by other international studies:

- **Humps** - Gårder *et al*. (1998) found in Sweden that raised priority cycle crossings improved safety for individual cyclists by at least 30% compared to a conventional cycle crossing, with safety benefits for pedestrians and drivers too; Li, Graham and Liu

(2017) observed in London that raised and separated side road cycle crossings have a safety benefit

- **Contrast** - Iasmin *et al*. (2016) showed in Japan that greater visual distinction from the carriageway provides the safest solution for pedestrians
- **Good design attracts numbers** - good design such as safer prioritised junction crossings attracts more people to walk and cycle because they are seen as safer and more convenient (Gårder *et al*., 1998)
- **Continuous** - it is uncomfortable for cyclists to get out of their saddles and endure the leg strain and associated forces required to get going again, hence cyclists avoid having to come to a complete halt (Meng and Mikkelsen, 2015)

Network importance

Continuity of priority needs to be also considered at a network level and not just for individual junctions. St Leonard's Street in Edinburgh has an attractive bi-directional kerb separated cycle track with priority crossing across two side roads, as shown in Figure 30.

Figure 30 - Cycle track, St Leonard's Street, Edinburgh

Note. Image reproduced from City of Edinburgh Council (2019b).

In delivering this route, the City of Edinburgh established several key principles new to the City or to Scotland, including cycle track kerb separation; road space reallocation; priority and direct desire lines over side roads and minor accesses; and direct major road crossings on desire lines.

However, this project is also illustrative of the constraints imposed on designers by national guidance and existing practice:

- The originally designed clear footway priority over side roads was diluted and removed during the delivery process due to a lack of national guidance in this area
- The location of one of the Toucan crossings, at the junction of St Leonards Street and Rankeillor Street in Edinburgh, shown in Figure 31 forces people cycling to undertake complex manoeuvres, ceding twice to motorised traffic and twice to pedestrians, whereas on-carriageway traffic can make the same manoeuvre (left turn into a side road) without having to yield
- The continuous priority established along this road does not continue at a network level

Figure 31 - Complex cycling manoeuvre

Note. Image reproduced from Rightmove (2021).

The purpose of outlining this is threefold:

1. Continuous priority at the network level as well as across individual junctions must be considered, otherwise some cyclists will opt to use the carriageway instead,
2. A continuity of approach across numerous junctions in a network also brings familiarity with the design which improves user understanding and compliance, ease of use and enhances safety for all users; and
3. Without clear and unambiguous guidance, debate will continue, and a variety of practice will be delivered.

This example, typical of the difficulties designers face, serves to illustrate the importance and applicability of this research to the design community and to users, but also to ensure that the site selection process is informed by both the micro-level junction site and the wider surrounding network environment.

Increasing pedestrian and cyclist risk

The Pedler and Davies (2000) study also identified features that can cause danger or deter cyclists:

- **Mixed priorities** - the side road treatments that conveyed mixed messages on priorities proved to be dangerous and confusing, especially those that appeared to give partial priority to both drivers and cyclists
- **Poor design suppresses use** - in the study some cyclists chose to remain on the road and were observed to have fewer problems at junctions, which was corroborated by Lawson *et al*. (2013) who found that if the design of cycle tracks is not good enough, confident riders will continue to use the carriageway

3.4.2 The role of infrastructure design in creating a sense of place in streets

This sub-section is about creating a sense of place in streets, but before addressing this it is helpful to note that from a highways' perspective, the two main aims of street infrastructure design are to provide capacity for motor traffic, and to provide it safely. The function of modifying behaviour is often a secondary aim. An example of this may be seen with the design of roundabouts. A compact roundabout has single lane entries and exits per arm and it is not possible for two cars to pass while circulating; it has less capacity than a normal roundabout but is more suitable for pedestrians or cyclists (Department for Transport, 2020a). By contrast a traditional roundabout design has greater capacity but also has higher speeds which create risk. Capacity has often trumped safety, and this helps explain why there are not more compact roundabouts in the UK (Parkin, 2018).

Turning from movement to the perspective of place, the street looks a little different. Figure 32 shows the idea of the characteristics of well-designed places. These include accessibility and movement, but focus on place, making streets that are beautiful, healthy, and sociable – places that people want to be.

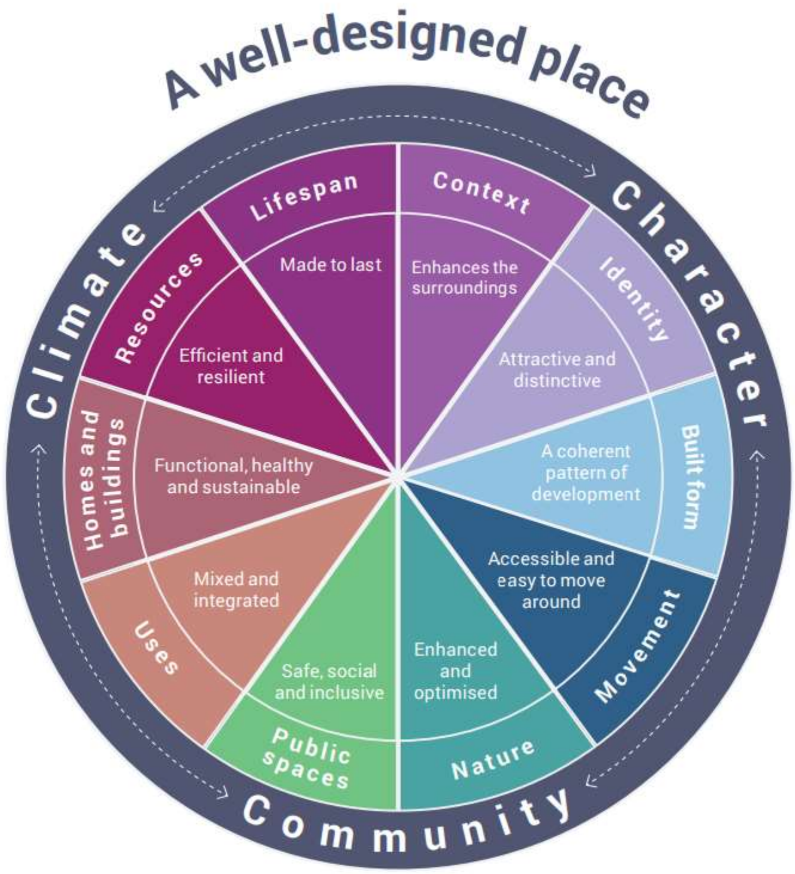

Figure 32 - 10 characteristics of well-designed places

Note. Image reproduced from: Ministry of Housing, Communities and Local Government (2021).

Creating a sense of place in streets often involves reducing car dominance and making more provision for walking and cycling. Many city authorities are no longer designing new large-scale highway schemes, typical of the 1960s and 1970s. Most of the raised urban motorways planned around the UK in the wake of the Buchanan report were never built. Some of the grade separated schemes that were built at that time have since been demolished, such as the inner ring road in Birmingham and freeways in San Francisco (Henderson, 2013). The reconstruction has usually included public realm improvements, creating more space and priority for walking and cycling. Bristol removed a dual carriageway from its centre that allowed for the Georgian Queens Square and College Green to be restored. London has redistributed street space to allow for its cycling superhighways and is re-engineering major junctions to provide more space and convenience for pedestrians and cyclists. Amsterdam and Copenhagen have taken many far-reaching actions that have turned these cities back from car domination to streets where cyclists, pedestrians and public transport are at the forefront.

In the UK alone there are numerous other examples, demonstrating that this is not just a one off, but part of a wider movement, for example: Churchill Way Flyover, approaching the Mersey tunnels in Liverpool was demolished in 2019 and pedestrian movements around the tunnel entrance have been improved; Leicester has been gradually dismantling its inner ring road and traffic lanes have been replaced by cycle lanes, and new connections created for pedestrians and cyclists (referenced in Section 2.2.4).

Substantial investments have been made across the UK in walking and cycling infrastructure (Song, Preston and Ogilvie, 2017), but this funding for active travel only represents 1.5% of total transport spending (Transport Committee, 2019). Bornioli, Parkhurst and Morgan (2018) identify characteristics of urban settings that encourage behaviour change and demonstrate the psychological wellbeing potential of walking in street environments, which would justify more investment. Khan *et al*. (2020) point out that the incidence of people on foot being involved in a road traffic collision is very unevenly distributed, depending on the city, age, sex and socio-demographics. In relation to age and gender for example, the cognitive development of children influences their safe decision-making ability, and adolescents and young men may actively seek risk taking. Some socioeconomic groups are far less likely to have access to a car than others, putting them more at risk of a road traffic collision. The amount of attention that city authorities give to people not in cars varies widely, both across countries and across the world. This is reflected in street design, which in turn may not consider the different behaviour patterns of different strata of the population.

The concept of smart cities is one where the deployment of different technologies combines to optimise different urban fabrics (Medina *et al.*, 2020) integrating information and communication technology, and physical networked devices to optimise city operations and services, including transport. Several have put this idea forward as an approach that can help cities to achieve sustainability and improve the liveability of residents (Allam and Dhunny, 2019; Allam and Newman, 2018). When the ideas of smart cities are combined with sustainable ideas, technology can be used for efficient low carbon distribution of goods (delivery), services (high speed broadband and mobile technology) and mobility (via walking, cycling and shared transport apps, as well as (e-)cycle, scooter and cargo bikes schemes).

3.4.3 The relative importance of street design and regulation

UK regulations on vehicular turning at side roads have been ambiguous and sometimes contradictory and there were 14 different rules on turning in the Highway Code (Flower and

Parkin, 2019). This has led to varied practice amongst road users at junctions, which can differ from the requirement of the regulation and guided more by the design of a junction than the regulation. So, for example, drivers may turn into a side road at speed, aided by large radii, without giving way to crossing pedestrians (rule 170), or crossing the path of cyclists who are going straight ahead (rule 182), or failing to give way to cyclists in a cycle lane (rule 183), travelling in either direction (Driving Standards Agency, 2007). On the other hand, rule 206, which specified that drivers should go carefully and slowly when needing to cross a pavement or cycle track to reach or leave a driveway and give way to pedestrians and cyclists on the pavement, seems to work well and suggests that this existing rule could be applied to the similar context of a continuous footway.

In Finland, regulations were changed in 1997 so that traffic on the carriageway no longer had to give way to crossing cycle traffic on a cycle track (unless signage indicated otherwise). This merely made legal what had already been custom and practice. The practice of drivers in terms of approach speed and their tendency not to yield remained unchanged before and after the law change (Räsänen, Koivisto and Summala, 1999). The authors of the research suggested that clear priority rules needed to be uniformly and rigidly enforced or reinforced by good design to be effective and have an impact on behaviour.

3.5 Interactions of behaviour, regulation, and design

This section discusses the interactions between behaviour, design and regulation. Since the turn of the millennium, a variety of policy interventions have been introduced to reduce car travel, including incentives for using walking, cycling and public transport (Graham-Rowe *et al.*, 2011). This chapter has presented what is currently known about how behaviour, regulation and design contribute to a conducive street environment and culture for walking cycling and rolling.

On the basis that individual contributions have now been made clear, the purpose of this section is to understand how they combine in either a complementary way, or a conflicting way in relation to make streets conducive to walking, cycling and rolling.

3.5.1 Behaviour as a product of street design and regulation

Social behaviours within the public realm are influenced by the law and regulation (Friedman, 2016; Björklund *et al.*, 2005), and by the design of infrastructure (such as the degree of mixing or separation of different user types), in the context of the wider environment (Gehl, 2011; Bassani *et al.*, 2014). Street infrastructure and regulation may or may not be mutually reinforcing. Figure 34 shows that some street user behaviour emerges as a result of street design and regulation. Some design features appear to alter driver behaviour such as tight corner radii and limited sight lines tend to cause drivers to slow when turning and make them more likely to give way(Steer Davies Gleave, 2018).

There have been significant development in standards, guidance (design) and statutory instruments (regulations) in relation to highway design for walking and cycling in the last few years in the UK as well as across Northern Europe and North America (Transport for London, 2014; Highways England, 2016; Welsh Assembly Government, 2014; National Association of City Transportation Officials, 2013; CROW, 2016). These developments inevitably create new and different designs which may not be familiar to users and so it requires time for them to adapt their behaviour to these changing environments.

The literature suggests that new walking and cycling infrastructure (Song, Preston and Ogilvie, 2017) encourages a change in behaviour in terms of a mode shift towards more active travel, especially when it is separated from general traffic (Marqués *et al.*, 2015; Hull and O'Holleran, 2014). While there is generally agreement that people on foot and cycle prefer to be segregated from other modes and that this separation encourages modal shift away from motor vehicles (Bellizzi, Eboli and Forciniti, 2019), Delaney, Parkhurst and Melia (2017) found that on a width restrained shared path, cyclists have a preference for non-segregation. Figure 33 illustrates these general findings, showing how infrastructure that promotes walking and cycling lies on a continuum of shared or separated space: grade separation (all modes), footways (pedestrians only), separated cycle lanes (cycles only), shared paths (pedestrians/cyclists), roads (cycles/motorised vehicles), shared space (pedestrians/cyclists/motorised vehicles).

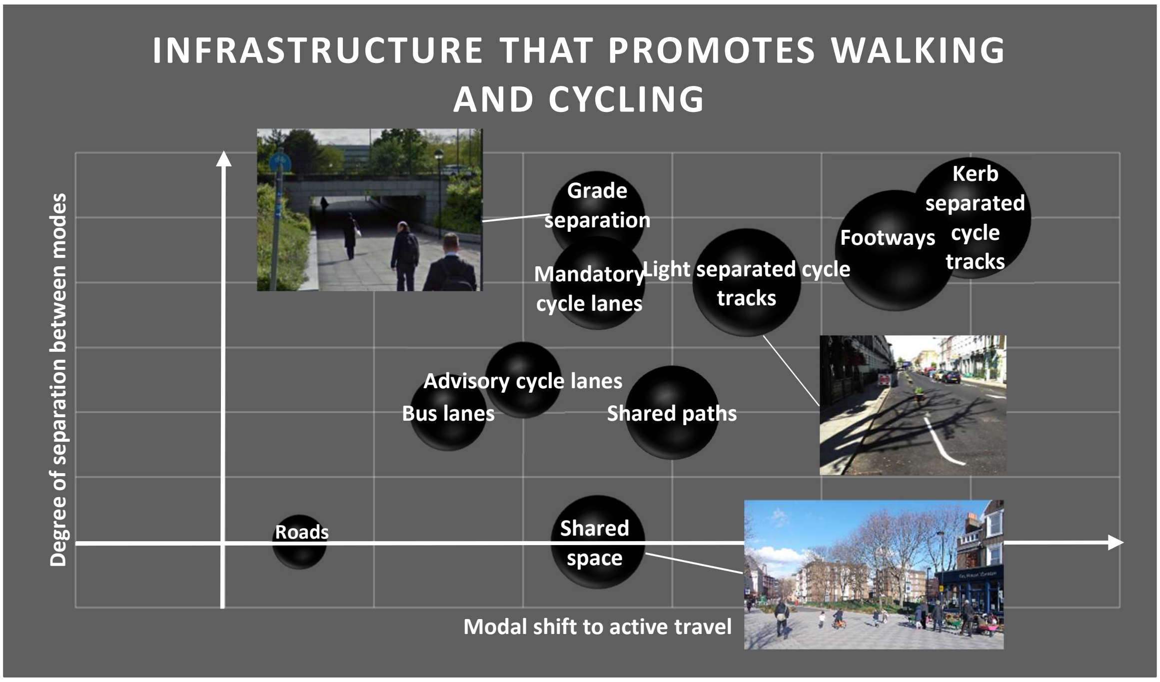

Figure 33 - Relationship between separation and modal shift to active travel

There has been an inconsistency in infrastructure design approaches to active modes in the UK. Design guidance has evolved to reflect policy changes to promote active travel (Department for Transport, 2007; Young and Jones, 2010), but these are largely implemented on new developments rather than retrospectively on existing streets. Even so, the approach on new housing developments often falls far short of best practice for people on foot or cycle (Evans, 2015; Transport for New Homes and FIT, 2018) and car-centric design can still trump infrastructure that works well for pedestrians (Calvert, 2015). Changes to highway infrastructure may on the one hand create more separation between cyclists and motor traffic, while other changes create more shared space between pedestrians and motor traffic. Even if the designers understand the intent, road users may be forgiven for sometimes being confused by seemingly contradictory developments.

3.5.2 Regulation as a product of street design and behaviour

The way that some regulation is developed is influenced by behaviour enacted within the context of the design environment, as shown in Figure 34**Error! Reference source not found.**. In the 1930s, disregard for the speed limit in the UK led to it being abolished with the introduction of the Road Traffic Act, 1930 (20 & 21 Geo. 5, chapter 43). To quote Lord Buckmaster: *"the reason why the speed limit was abolished was not that anybody thought the abolition would tend to the greater security of foot passengers, but that the existing speed limit was so universally disobeyed"* (Hansard HL Deb, 01 December 1932). Drivers at the time found that they could drive fast within the context of the design of the street environment. Sometimes the actual behaviour of road users (which may differ from rule following behaviour) and how they respond to infrastructure such as zebra crossings, can create new informal street rules (Bjørnskau, 2017) which may, or may not, later become formalised. In the UK context until 2022 a pedestrian only had priority at a zebra crossing once they placed their foot in the carriageway, with no obligation for drivers to stop for waiting pedestrians, but since the Highway Code was updated (Department for Transport, 2022) drivers are now required to give way to waiting pedestrians to cross.

3.5.3 Street design as a product of behaviour and regulation

A lot of street infrastructure is highly regulated but can also be influenced by the way people use streets. Some street design emerges as a result of behaviour and regulation as shown in Figure 34 which is a reprise of Figure 1.

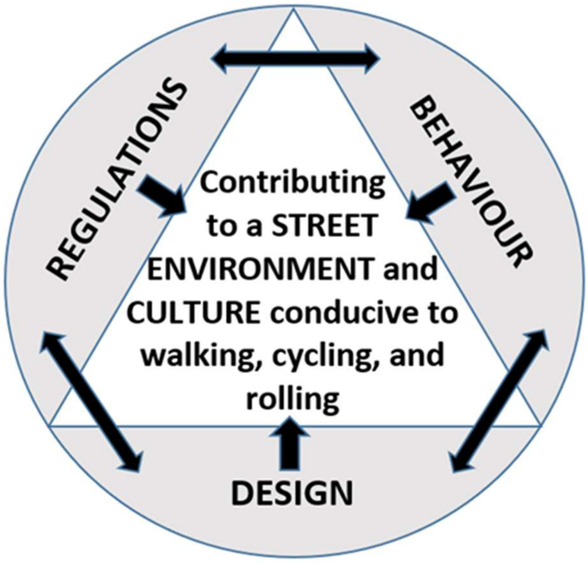

Figure 34 - Interactions of behaviour, regulation, and design

After years of cyclists not conforming with regulations, which required them to dismount to cross zebra crossings, parallel pedestrian and cyclist crossings were introduced in the UK in 2016 (Minister of Transport, 2016, diagram 1055.1). Parallel crossings place a cycle track adjacent to the zebra crossing for pedestrians and grants priority for crossing cyclists in a similar fashion to the priority afforded to crossing pedestrians. There is no longer a requirement for cyclists to dismount at these crossings. So, in this example, rather than changing the regulations so cyclists were permitted to cycle across zebra crossings, the permitted design was changed introducing a new design feature in the form of the parallel crossing (Department for Transport, 2022). Cyclists are still not permitted to cycle across a traditional zebra crossing that connects two footways.

3.5.4 Audit and assessment tools

There are different descriptors and indicators of streets that are conducive to walking and cycling. The notion of pedestrian levels of service (PLOS) or inclusive streets was developed in North America and has been taken up in other cities around the world (Asadi-Shekari *et al.*, 2019). The cycling equivalent is the bicycle level of service (BLOS), which is presented as an objective measure that can be used to evaluate the current cycling conditions across a city network of streets with different weightings to quantify comfort and safety levels of the street environment. However, Huff and Liggett (2014) are highly critical of the approach as the weightings and calculations used can produce some questionable results that do not adequately account for delays to people walking and cycling and ignore accessibility issues such as dropped kerbs and smooth surfaces.

The Healthy Streets indicators (Transport for London, 2017, pp. 12-13) focus on the human experience of the street environment culture rather than the inputs required to create this and have been used in London. At the highest level the indicators are qualitative and are presented in plain English rather than the usual language of street appraisal. They examine how suitable each street is for pedestrians, cyclists and those using public transport, and could equally apply to people using other human-scale modes as they are outcome orientated, but they do not explicitly mention people who roll (e.g. one indicator is ‘people choose to walk and cycle’, but ‘and roll’ could be added to be more explicitly inclusive). There is a Healthy Streets Check for Designers (Transport for London, 2019a) that provides a useful list of quantitative measures and enables planners to assess a street as it is and to determine how a redesign would improve the experience for those on foot or cycle. As with other indicators that rely on professional judgement, checks need to be undertaken to ensure inter-rater reliability and to avoid subjectivity.

Speck (2018) has penned 101 rules for a walkable city and one of the rules is that streets should be good for cyclists. In North America the Complete Streets approach (Marleau *et al.*, 2019) aims to promote sustainable transport, including walking, cycling and public transport. It embraces both policy and design seeking to create streets that are safe, accessible, and comfortable for all street users, regardless of capacity or mode. However, just because streets are walked it should not be assumed that those streets have any reasonable level of walkability. In many contexts socio-economic status means that large sectors of some societies lack choice and are effectively captive walkers, regardless of what the quality of the street environment might be (Amoako-Sakyi, 2016).

Street users behave in ways that either submit to the street culture and environment or push the boundaries in order to change and shape the culture and environment. Both the design of infrastructure and the way regulation is enforced for each mode will either make street users timid or emboldened to push the boundaries.

3.6 Summary of the chapter

This chapter has explored the influence on street environment and culture of behaviour, design and regulation, and the complex inter-relationships between them. It is difficult to control behaviour via infrastructure and regulation, but these factors do influence it. Regulation and design guidance in the UK has developed over time and is increasingly giving more consideration to walking, cycling, and rolling, evidenced in Highway Code revisions (Department for Transport, 2022) and more priority at crossings being given to pedestrians and cyclists by design and regulation (Department for Transport, 2020i).

Although these moves are positive, there is still a significant gap in practice compared to the good practice seen particularly in the Netherlands and Denmark, where separation between modes is normalised, walking, and cycling networks are complete, and cyclists are consistently treated as traffic. The experiences and behaviour of street users varies considerably by mode (Meng and Mikkelsen, 2015) and these street user experiences and perspectives could be better understood.

The rapid changes that took place on streets due to Covid-19 demonstrate that street user behaviour is mutable and streets conducive to walking and cycling could be created instantly by removing motorised traffic, because people will walk and cycle when it feels safe and comfortable to do so, and it is normalised by others doing the same. Behaviour has changed, with more active travel, less emphasis on peak time daily commutes and reduced use of public transport (Department for Transport, 2021d), but it is not clear what of the changes to streets will endure.

Luukkonen and Vaismaa (2015) illustrated some of the complex inter-relationships with the example of ‘safety in numbers’. Their cycling example showed that behaviours such as helmet use and related regulation, along with design factors like the quality of the cycle infrastructure, have both positive and negative influences on cyclist safety and the growth in cycling. This suggests that although streets conducive to walking and cycling could be observed, modelled, or imagined, how street user behaviour, design and regulation, and the interactions between them, shape street environment and culture remains something of a black box to be investigated.

3.7 The knowledge gaps and justification for the research

The literature reviews provided in Chapters 2 and 3 explored the evolution of street environment and culture, and the way they are influenced by behaviour, regulation, and design. The summaries to chapter 2 and 3 have indicated in short form what is known from the literature. This section considers the evidence from the perspective of what is missing in knowledge, or could be developed further, in the light of the research questions which are restated here:

1. What are the aspects of street user behaviour, design and regulation that are most important to the most marginalised people on foot, cycle or rolling?
2. What is the relative importance of behaviour, design and regulation to a street environment and culture that is conducive to walking, cycling, and rolling?
3. What are the interactions of street user behaviour, design and regulation that create a network of streets that is conducive to walking, cycling, and rolling?

The gaps in knowledge are described under the following three headings: i) Conditions needed to make streets conducive to walking, cycling, and rolling, ii) Developments needed for design guidance and practice, and iii) Methods to appropriately allocate space and priority.

The following three points describe the ways that the research will set out to investigate the conditions needed to make streets conducive to walking, cycling, and rolling. Firstly, it remains unclear as to the conditions that would allow the most marginalised street users to perceive that a street is conducive to use on foot, cycle or rolling. These conditions may be the same or different for a driver to perceive walking, cycling, or rolling as viable alternatives for local journeys. Aldred and Jungnickel (2014) articulated this knowledge gap well by pointing to the parallel gap between policies that seek to support active travel and cycling levels in the UK that remain stubbornly low (Section 3.2.3). There is mixed evidence about suitable interventions, and Research Question 2 addresses this gap.

Linked to this, much of the literature addresses single interventions, such as individual streets, or design and regulation approaches to individual junctions, including the study on the effect of side road raised entry treatments on road safety by Wood *et al*. (2006), and Pedler and Davies' (2000) study which compared different side road junction treatment designs at five UK locations (Section 3.4.1). The importance of the network of streets overall remains a gap and is addressed in Research Question 3.

Mobility justice (Sheller, 2018) would demand that the voices of those the most at risk of marginalisation by the future street environment should be heard in this contested space and Research Question 1 requires that those perspectives be identified (Section 2.4.2). This hence continues to fill a gap in knowledge.

Secondly, developments needed for design guidance and practice is an area of knowledge that requires further research. As shown in Section 3.4.1, design guidance is often not fully implemented due to missing or ambiguous guidance, and apparent conflicts with regulations, such as mixed priorities at some junctions creating increased risk for pedestrians and cyclists (Pedler and Davies, 2000). Recommendations to change design guidance and regulation to overcome deficiencies and create better alignment between them is one of the contributions of this research, and will be identified through Research Questions 1, 2 and 3.

Implementation of design guidance is often compromised because of a perceived lack of street space or the assumed greater needs of motor traffic. Recommendations to change practice in regard to dealing with compromise is one of the contributions of this research. A better understanding of what is wrong with practice emerges from the key informant interviews as part of Research Question 1.

With a focus on drivers and cyclists, Lin *et al*. (2017) noted that the extent to which the law is obeyed varies by user type (Section 3.3.3). However, there is a gap in knowledge in terms of how regulations and their enforcement affect behaviour in relation to cycling and walking. Research Question 2 addresses that.

Thirdly, the methods to appropriately allocating space and priority remains a gap in practice. Particularly since the onset of Covid-19 in early 2020, some cities have given more space and priority to walking, cycling, and rolling. It is unclear from the post-intervention studies such as Glaser and Krizek's (2021) evaluation of 55 US street-focused emergency responses, what changes will endure or how this trend might be expanded to other contexts (Section 2.2.4). A contribution of this research will be a better understanding of how space and priority contribute to a street environment necessary to promote more sustainable travel, and hence this gap will be filled.

In Section 2.6.2 it was seen that many cities do not allocate adequate space to human-scale modes even though the benefits are known (UN-Habitat, 2013). While this is not therefore a gap in knowledge, the thesis will contribute recommendations for practice that may assist in addressing any remaining practice knowledge gaps.

Chapter 2 proposed an urban typology that suggests that some societies may have entered a period of transition from the ‘automobile city’ to the ‘smart and sustainable city’. That then calls into question the street environment and culture; the balance of movement and place; and the role of streets as the nexus of circulation, built frontage and public space (Marshall, 2005).

Having reflected on what is missing in knowledge, or could be developed further, it is concluded that the research questions will help create new knowledge. We turn to these questions and address them in the next chapter. There is a need for a suitable theoretical model and research methodology, and this is also dealt with in Chapter 4.

4 METHODOLOGY

4.1 Structure of the chapter

With a knowledge of the gaps in the research, attention is now given to the appropriate theoretical framing and the selection and description of the methodology to be used in this study which aims to understand how street user behaviour, design and regulation, and the interactions between them, shape street environments and culture and the implications for walking, cycling, and rolling.

Candidate theoretical models are discussed in Section 4.2. However, no single model is shown to be appropriate and a new model, which combines elements of two other models is developed, and which has been called the Social Ecological Model of Ability (SEMA). It combines the Social Ecological Model (Bronfenbrenner, 1974) and the Social Model of Disability (Oliver, 2013).

Section 4.3 explores methodologies that may be used to develop a data set of subjective responses to complex concepts. As a result of that exploration, Q-methodology, a process of ranking statements about a subject, has been found to be the most appropriate method. Section 4.4 explains the seven steps of Q-methodology and the measures taken to ensure that the research was conducted ethically. The steps include a description of the process to develop the statements, which were generated from ideas by focus groups with street users, and key informant interviews with professionals and policy makers. The process adopted for ranking the statements is also described as is factor analysis, used to analyse the results from the ranking process. The section ends with a description of the methodological adaptations and innovations that were undertaken, including a Covid-19 statement. Section 4.5 provides a summary of the chapter.

4.2 Theoretical foundations

Unidisciplinarity, where the theories and methods of only one discipline are used, is a common approach to research. However, there is value in considering and potentially using theories and methods from other disciplines because this may produce deeper understanding, knowledge, and insight. The types of research involving more than one discipline are summarised in Figure 35.

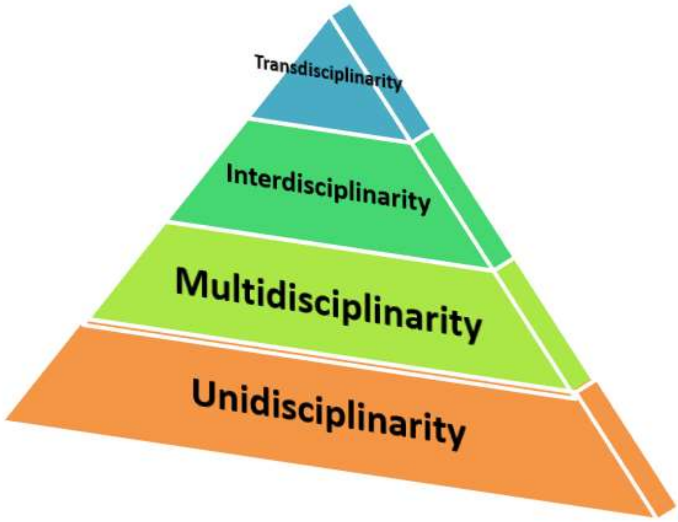

Figure 35 - From unidisciplinarity to transdisciplinarity

Stokols *et al*. (2008) describe interdisciplinarity as: *"an interactive process in which researchers work jointly, each drawing from their own discipline-specific perspective, to address a common research problem."* For this study, an interdisciplinary supervision team was formed that reflected the multifaceted nature of the research topic of the street environment. Transdisciplinarity goes beyond a coordinated input from multiple knowledge domains to solve a problem, which could be described as multidisciplinarity (McPhee, Bliemel and van der Bul-Brouwer, 2018).

The relevant academic disciplines for this study were transport engineering and planning (design), psychology (behaviour) and law (regulations). Given that in the area of this research psychology, planning and engineering often feature as key components within a collaborative team and that they have to have some familiarity with transport regulation, a decision was made not to have a legal member of the team. However, advice was sought as required form the University of Bristol and UWE Law Schools. Hence a team of a psychologist, engineer and transport planner were put in place (researcher and the supervisory group) who supported the work to analyse data and develop and use shared conceptual frameworks. A conceptual framework was developed that was suitable for the under-researched topic area from the perspective of all street users. It has been necessary to create new models and use appropriate language because the specific models and language of a single discipline have proved inadequate to cover the topic area. The thesis has been written by a transport planner and drafted generally in a manner linked with engineering and planning, rather than psychology.

With an interdisciplinary approach building on mobilities research and behavioural psychology, this has led to the availability of a number of theories that could have been used. Several theories which consider human behaviour and interactions with the environment have been considered. Two have been identified as candidate theories and these are Bronfenbrenner's (1974) Social Ecological Model, and Oliver's (2013) Social Model of Disability, that have been adapted to form a framework for this research. The three 'worlds' of Habermas (1984) were also used to guide the research as it sought to combine the multiple perspectives needed to generate a complete understanding of street environments. These are now discussed in turn.

4.2.1 Behaviourism and the Social Ecological Model

A Socio-Ecological Model (SEM) takes into consideration the individual, and their wider relationship to their context which includes other people, organisations, and their wider community. Watson's (1930) Behaviourism theory focused on the outward behaviours of people rather than their internal emotional and psychological conditions. A theory of learning that assumes behaviours are acquired through conditioning, and which result from interactions with the environment is a reasonable starting point for considering the issue of the relation between street design, regulation, and behaviour, because it provides a frame for people's behaviour within the legal and environmental context. Bronfenbrenner's (1974) SEM unpacks these 'environments' into multiple layers.

Individual street user behaviour is shaped by the social context in which individuals find themselves. Bronfenbrenner (1974) developed a SEM in the context of child development, which has been widely used and adapted in different fields including public health (Mandic *et al.*, 2016), agricultural health, safety (Kilanowski, 2017), walking and cycling (Pikora *et al.*, 2003) and active commuting (Feuillet *et al.*, 2015).

The work by Feuillet (*ibid.*) on active commuting demonstrated local variety in the impact of different levels of the social ecological model. It is highly applicable to streets and puts individual behaviours in a much broader social context. Jensen (2013) also uses the example of our daily journeys along city streets such as commuting, describing them as embodied practice influenced by our interactions with the built environment and other people in the streets that we interact with (our consociates), moderated by regulations, design and the behaviour of others. Individuals who make those journeys make a number of choices (route, mode, etc), but the moderating factors also form a critical part of the context in which the journey along a series of streets takes place. Jensen conceptualises undertaking journeys as a performance as if on a stage, and the nature of the stage is created both by top-down planning and by the nature of the performance of others. Figure 36 illustrates Jensen’s concept of journeys as being staged from above and below.

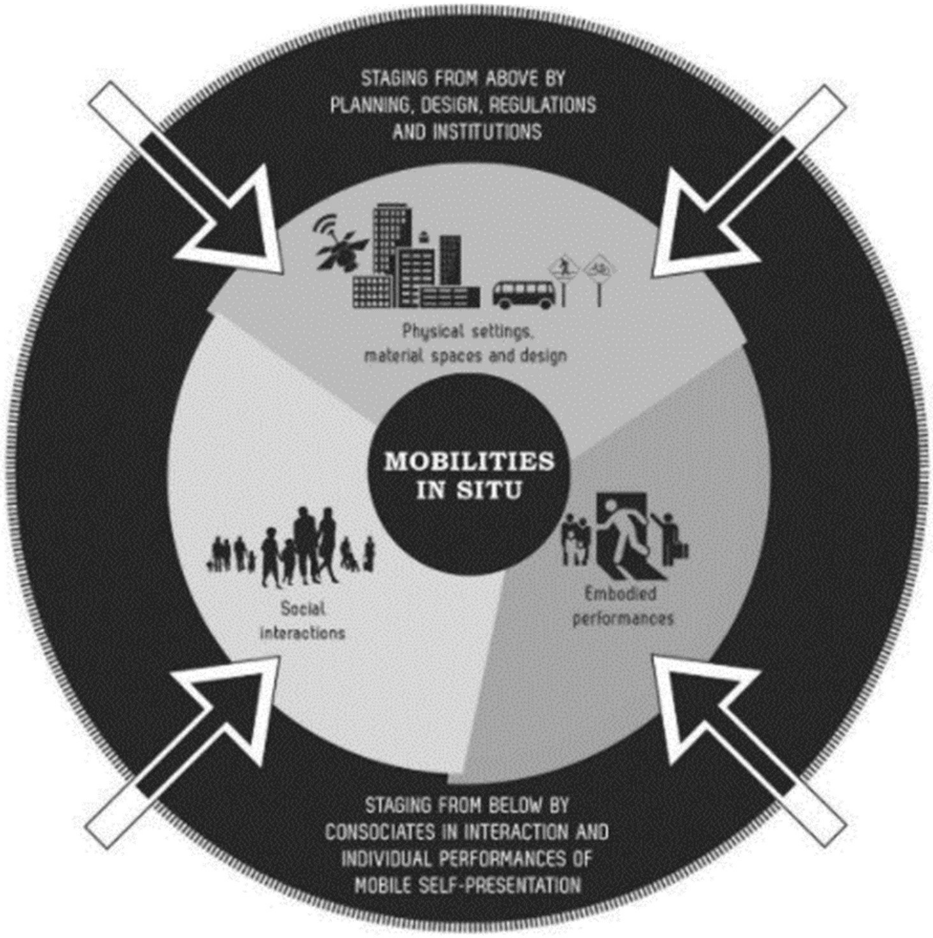

Figure 36 - Jensen’s model of mobilities as creating staging

Note. Reproduced from Jensen (2013).

This study investigates the staging required from above and below to enable walking, cycling, and rolling to be performed. The Staging Mobilities Model provides a complement to Bronfenbrenner’s SEM and informs the adaptation shown in Figure 37 for the context of street use.

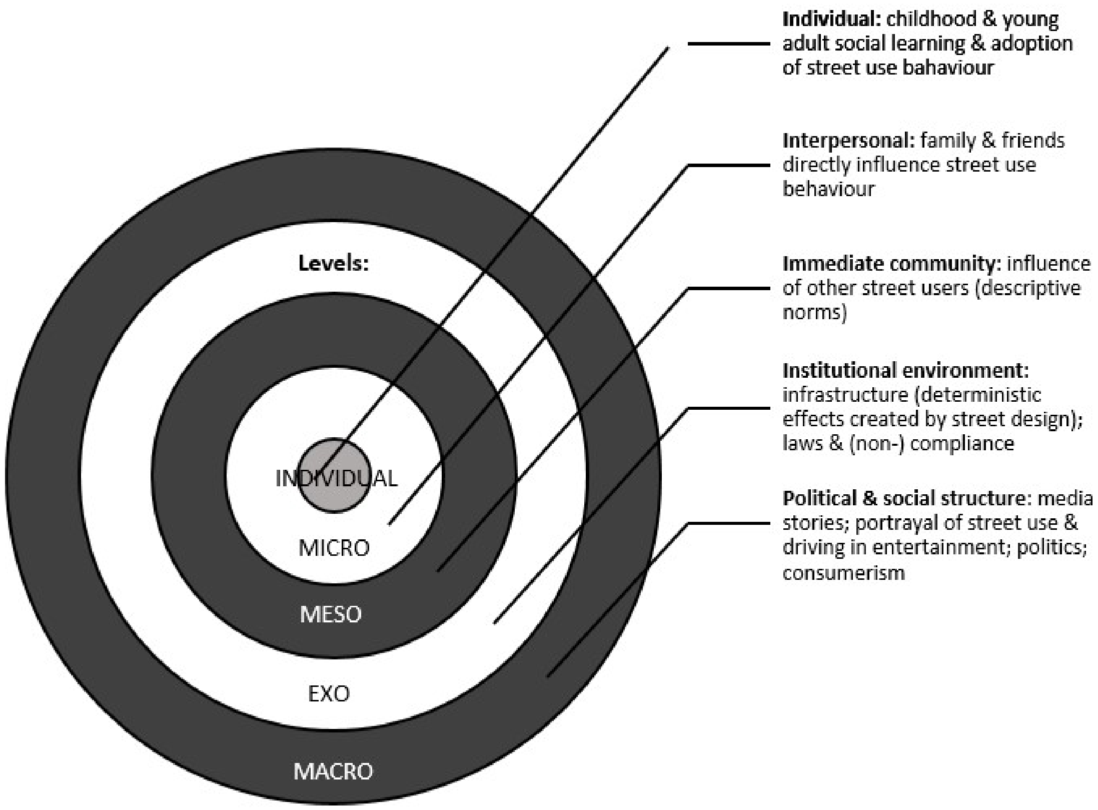

Figure 37 - Adapted Social Ecological Model: influences on street use behaviour

Note. Model adapted by the author from Bronfenbrenner (1974)

One advantage of Bronfenbrenner's model is that it is it can neatly bring together policy, the law and regulation, infrastructure design and engineering, with road user behaviour. The theory proposes that people have pre-conceptions that affect judgements due to influences that have come from different levels: individual, inter-personal (which is termed micro-level), immediate community (meso-level), institutional environment (exo-level), and the political and social structure (macro level).

In some cases, these individual, inter-personal, community, institutional and social structure influences are so strong that they are shared across much of society. An example of this is automobility (Henderson, 2013), which since the 1920s has grown to become the default mode of transport in most societies. Walker, Tapp and Davis (forthcoming) have coined the phrase motonormativity to describe contexts such as the UK that have become dominated by the car. In such cultures many non-motorists have assimilated a motorist's perspective on streets in terms of how they function and what they are for. This is illustrated in Figure 37 where the psychology of individuals is seen within the context of cultural and social influences, with layers of influence radiating out from individuals, through families, to wider societal structures, physical infrastructure, and national cultures. This model suggests that road user behaviour is ingrained at multiple levels and so is not likely to be quickly acquired or dismantled. It has been built up over lifetimes and there is a whole ecosystem of influences. These influences need to be considered and addressed at times when major changes in road user behaviour and thinking are required, such as when policy makers seek to address urban congestion, or poor air pollution, or as in 2020 when temporary walking and cycling infrastructure was introduced in many cities due to the coronavirus.

Applying the SEM to cycling, a person may initially learn about cycling from family, friends and through school or out of school clubs and organisations. This initial knowledge, combined with on-going experiences, influences the skills of urban cyclists, and builds their identity as cyclists (Aldred, 2013). Sayagh (2018) demonstrated that the take up of cycling by children and young people in France is influenced by their gender and social background. Schooling, family context, peer groups and locality all contribute to, or detract from, individuals becoming urban cyclists. Although urban cycling is practised globally, its nature varies greatly between nations, cities and even streets (Rosen, Cox and Horton, 2007). As well as social influences at the individual, inter-personal and community levels, the institutional environment such as regulations and infrastructure will also contribute to a person's decision to cycle regularly or not. The flexibility and construction of the SEM means it is highly applicable to the study of health and safety on streets, and it allows for the consideration of individual behaviours in a much broader social context. The model locates street user behaviour within individuals, something akin to the Medical (or individual) Model of Disability (Haegele and Hodge, 2016). Something is missing when the focus is on individuals alone, which is addressed in the next section on The Social Model of Disability (SMD).

4.2.2 The Social Model of Disability

A focus on the individual, acknowledges that people are different as are their behaviours. However, a focus on individuals alone is insufficient. To focus only on the individual might suggest that if some people walk, cycle, or use other human-scale modes in a typical street, then anyone could: it would be just a matter of changing the individual. To address this inappropriate individual focus, the research will also use the SMD, which recognises that the environment and culture can be disabling.

The SMD (Oliver 2013) was developed to be used as an alternative and to be a challenge to the Medical Model of Disability and focuses on removing disabling barriers from the environment rather than 'fixing' the impairments of individuals. As Barnes (2020, p17) puts it: *"the social model of disability is a tool with which to provide insights into the disabling tendencies of modern society in order to generate policies and practices to facilitate their eradication."* The notion of applying the SMD beyond people with impairments to anyone disabled by their environment is not new. Oliver (2009), somewhat satirically, called the aeroplane a mobility aid for non-flyers, in the same way that wheelchairs are a mobility aid for non-walkers. By treating people with and without impairment alike it moves away from treating disabled people as in Hunt's (1966) words: *"set apart from the ordinary"*. Urban public space has become dominated by motor traffic, disabling those who have difficulty using, or accessing that mode, or negotiating the spaces it dominates (Freund, 2001). Sheller (2018) uses the language of motility, or potential mobility, and how for some people that potential is undermined (they are disabled) by *"design features as mundane as stairways, lack of public toilets, or inaccessible transportation systems"*. Aldred and Woodcock (2008) suggest that use of the model can be extended and has the potential to bring environmentalists and disability activists to a point of agreement that car-dominated environments disable, or marginalise, large swathes of the population and not just those that are conventionally seen by society as disabled. In some inner cities those that do not own, have access, or use cars are no longer just a significant minority. 45% of London households do not own a car or van (Department for Transport, 2020f), nor do the majority of Inner London households, reaching 65% in Hackney (@citycyclists, 2012) Hicks (2015) used the SMD to argue that one way of overcoming the physical barriers that users of mobility scooters face on streets is to grant them access to cycle infrastructure. It would make sense to permit access to cycle (which could be renamed mobility) tracks to all human-scale modes that travel at cycle speeds (Figure *14* and Figure 16).

Applying a model that focuses on people as individuals to streets would suggest that the problem could be solved by 'fixing them', by changing their attitudes or providing mobility aids. So a parent with a double buggy could be 'cured' with a sport utility vehicle (SUV), a mobility scooter user could upgrade to a car with Motability[7] (BBC, 2013), or a competent 12-year-old cyclist could be driven to school in a car.

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[7] Motability is a scheme in the UK that helps people with mobility impairments get mobile by using their higher rate mobility allowance to lease a new affordable car, wheelchair accessible vehicle, mobility scooter or powered wheelchair

The SMD, by contrast, would see the disabling street as the problem that needs to be adapted so that it is fully accessible, easy, attractive, and safe, for the double buggy, mobility scooter and competent 12-year-old cyclist. Dutch cycle guidance (CROW, 2016) has similar guiding principles that street infrastructure should be direct, attractive, comfortable, safe, and coherent. The SMD focuses on removing the barriers that prevent full participation by every member of society. If all streets should be open for people and their mobility, then this requires that safe and equitable access be provided to all groups. Not all streets need to be accessible by public transport or privately-owned cars, but many will be. Many demographic groups including children, women, disabled people, and older people, can face significant barriers to their experience of, and interaction with, transport systems and travel. These barriers shape their travel choices. The bicycle was once a symbol of women's emancipation, and inclusive cycling can reclaim that heritage, but in the 21st century cycling is no longer a mainstream activity in countries like the UK (ARUP, 2019). Ensuring that cycle infrastructure can accommodate the dimensions of non-standard cycles is one way of removing some of the physical barriers to cycling for all (Wheels for Wellbeing, 2019).

The Individual Model of Disability, sometimes referred to as the Medical Model (Boxall, 2002) presents disability as an individual condition, primarily resulting from the impairments of individuals. Oliver, the author of the SMD, never denied the relevance of the Individual Model of Disability, but the SMD recognises that it is not about individuals alone. There can be appropriate individual interventions to address educational, rehabilitation, medical, or employment needs (Barnes 2020). The SEM demonstrates how individuals are shaped and influenced which explains why they cope and react to their environment in different ways. If barriers to participation are put up by society, then people will be disabled by their environment, independent of anything intrinsic to those individuals.

4.2.3 The Social Ecological Model of Ability

To fully encapsulate all the issues of behaviour, regulation, design and ability, a new model, to be called the Social Ecological Model of Ability (SEMA) has been developed as the theory to guide this thesis. The Social Ecological Model works from the bottom up, providing the perspective of the individual in the context of a broader ecosystem, whereas the Social Model of Disability functions from the top down, identifying the barriers in society that shape people's experiences. To more fully understand the street environment, the two models have been combined as seen in Figure 38 as a framework for this research. The model defines the dynamic interrelations among various personal and environmental factors with a particular focus on barriers in relation to personal abilities. The model fills the gap between behavioural theories, anthropological theories, and theories of disability.

The Social Ecological Model of Ability

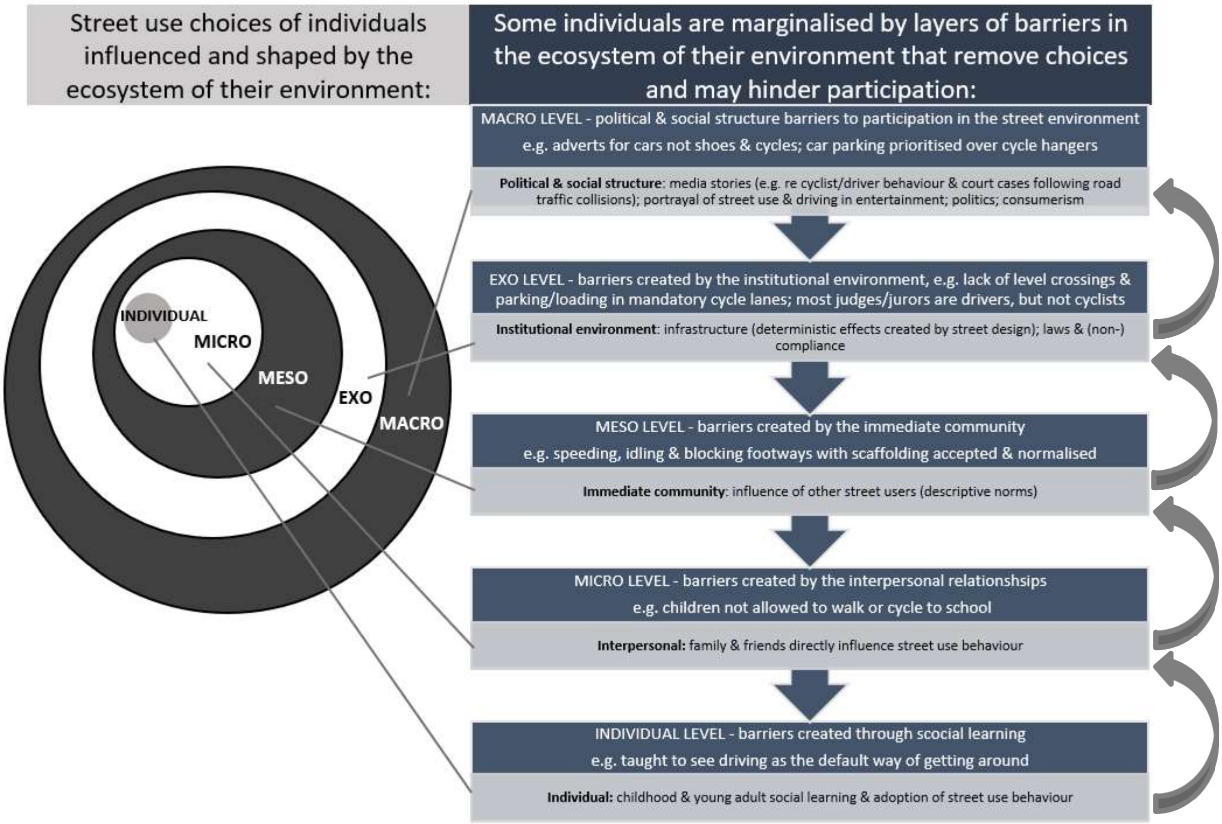

Figure 38 - SEMA, showing disabling barriers to participation

The SEM recognises that an individual's street use behaviour evolves in a way that is influenced by the behaviour of other street users (individual, micro and meso-levels), street infrastructure design and regulations (exo and macro levels). The SMD helps to highlight that some individuals and groups are marginalised by the environment they find themselves in. It also challenges whether all individuals have a choice about their behaviour, as the barriers that they face in society may mean that they cannot access the street environment or that they only have limited options open to them if they do. It recognises that individuals may not only be influenced by other street users' behaviour, regulations, and infrastructure design, but are disabled by the barriers these pose to their mobility. Street environment and culture mean that the most marginalised individuals have little or no choice.

4.2.4 Operationalising the Social Ecological Model of Ability

Consideration now turns to operationalisation of the Social Ecological Model of Ability. A multi-perspective outlook is required within the methodological framing because streets are places where the engineered geometry meets the legal systems of highway law and the social constructs of street users and their behaviour. A useful way of considering this required multi-perspective outlook is Habermas's (2002) theory of communicative action. This theory has been used in the field of transport planning by Khisty and Leleur (1997) to assess good practice guidelines and ensure that it is useful in the real world and not too abstract to be useful.

The German philosopher Habermas (2002) defined three of what he calls 'worlds' which he maps to three attitudes, namely: objectivating – *the world*; expressive – *my world*; norm-conformative – *our world*. The objective world tends to be associated with positivist and quantitative methods and cognitive–instrumental rationality, using an objectivating attitude, while the subjective and social worlds tend to be associated with interpretive and qualitative methods and aesthetic–practical rationality (using an expressive attitude) or moral–practical rationality (using a norm-conformative attitude). This is summarised in Table 13.

Table 13 - Three worlds of Habermas

Worlds	Attitudes	Philosophy	Methods	Application
the world	objectivating	positivist and cognitive–instrumental rationality	quantitative	engineered geometry of road junctions
my world	expressive	aesthetic–practical rationality	interpretive and qualitative methods	street user behaviour
our world	norm-conformative	moral–practical rationality	interpretive and qualitative methods	legal systems of Highway Law and regulations

The tools required to address all three worlds, with their associated attitudes and rationalities, can be obtained by using mixed methods and paradigms. In the next section a methodology is outlined that does not compromise the elements of the subjective and social worlds (subjects, subjective experiences, subjective and collective intentions, norms, rights, social rules, and relationships) with the elements of the objective world (physical entities and their properties). This will allow the subjective and social worlds to be studied without being forced into the conceptual framework of natural science and technology, which would risk depriving them of their subjective, social, institutional, and pragmatic dimensions. Quantitative techniques can be used alongside qualitative techniques and participative interaction to achieve a more holistic understanding of the different rationalities that underpin the socio-material and socio-technical realities that affect street space (Ågerfalk *et al.*, 2013). Such a framing of the methodology helps ensure that the levels and interactions in the Social Ecological Model of Ability are fully and appropriately explored.

4.3 Research methodologies

This study covers issues linked with design, regulation and behaviour, and its aim resonates with Jensen's (p16, 2013) research question: *"What are the physical, social, technical and cultural conditions for the staging of contemporary urban mobilities?"* The physical, social, and technical have parallels in design, behaviour, and regulations. The focus of this study is the sub-set of the contemporary modes walking, cycling, and rolling, and the street network provides the context. Jensen's staging mobilities work was cross-disciplinary, led by a sociologist hosted in a design research environment, which inevitably influenced the direction of the work. It did not adhere to a prescribed ontology or epistemology and endeavoured to free itself from the shackles of notions such as nomad versus sedentary or local versus global. It drew on Sheller's notions of mobilities research, discussed in Chapter 2. Jensen (*ibid.*) concludes with 10 pointers for future mobilities research six of which have direct relevance for this work:

i. No single discipline has a copyright on how to make sense of contemporary mobilities,
ii. The basic structures of mobilities (in this study, streets) should be seen as more than a necessary evil for getting from A to B, but also as meaningful spaces for social interaction,
iii. Critical mobilities thinking must seek to identify not only the problems, but also the solutions, which will help contribute to the grand challenges such as climate change and resource scarcity,
iv. Mobilities must consider questions of design in relation to sites, spaces, and systems,
v. Mobilities research is empirical, theoretical, and conceptual, but it must also have at its heart the pragmatic question of, what might the practical effects be?
vi. Mobilities are staged from above in regulation, design and planning (in this study the behaviour of local authorities and policy makers), and from below in social interactions (in this study the behaviour of street users) and this complexity can be studied in everyday practices and lived situations, such as on the street network of town and cities.

So, Jensen's concluding remarks for future mobilities research contain some useful suggestions that served as a stepping off point for this study which has not stayed within a single discipline and has sought not only to identify problems in streets, but also pragmatic solutions that can be adopted by both policy makers and street users.

4.3.1 Examination of the methodological options

This thesis seeks to gain an understanding of the social phenomenon of how people behave on streets. As such, the research requires the application of multiple perspectives, or paradigms to generate a complete understanding. In order to do this, a methodology was sought to bring together the three worlds after Habermas (1984), introduced above:

(i) The objective (or material) world,
(ii) The subjective (or my, personal) world, and
(iii) The social (or our, inter-subjective) world (Mingers, 2001).

The three worlds of Habermas (2002) helped refine the research aim and establish how to answer the research questions.

The research aim restated in Section 4.1 is supported by the following research questions:

1. What are the aspects of street user behaviour, design and regulation that are most important to the most marginalised people on foot, cycle or rolling?
2. What is the relative importance of behaviour, design and regulation to a street environment and culture that is conducive to walking, cycling, and rolling?
3. What are the interactions of street user behaviour, design and regulation that create a network of streets that is conducive to walking, cycling, and rolling?

The purpose of this sub-section is to establish what methods and research design will facilitate the carrying out of an inquiry to answer these research questions.

In Sub-section 4.2.3 the Social Ecological Model of Ability (SEMA) was established as a theoretical framework for the research. This model demonstrates that individual street users have evolved subjective perspectives of street environments from their life experience. It also highlights the importance of ensuring that the voices of individuals and groups that are marginalised by those environments are heard. The theory raises both the issue of subjectivity and the prospect of clusters of opinion.

Epistemology, the study of the nature of knowledge, which defines the criteria used for determining valid knowledge, is based on the researcher's world view (Salmons, 2021) and shapes, guides and justifies the methodological choices made in this study. That world view is partly based on the researcher's background as a transport planner, current position as an active social science researcher and recent research experience, including: "Simpler, Safer Junctions for All - Exploring the implications of turning vehicles giving way to pedestrians and cyclists", submitted as a dissertation for a Master of Research degree (Flower and Parkin, 2018). The findings from the dissertation helped shape the aim of this research. All of this framed how the researcher understands the world and ways of knowing in the context of the research project.

As well as theory and epistemology, the Covid-19 pandemic also shaped the research methods used and necessitated a move from face-to-face data collection to online methods. Consideration in the choice of methods was also given to what participants would feel able and comfortable doing, including their familiarity with technology and accessibility (to old and young, male and female, people who were visually impaired, and those who had mobility difficulties).

In the very early stages of the research before the research aims and questions were firmly set, an experimental design was considered using the Bristol Robotics Laboratory (BRL) driving simulator. This experimental design would have constructed a variety of virtual and typical urban street scenes and explored responses from drivers and other road users to those scenes and different road user behaviour in those settings. This was agreed in principle with the BRL, but additional funds would have been required, and so a proposal was put into the Horowitz Foundation for Social Policy to pay for this, but this was not successful. The experimental design was therefore not pursued, and methods more suitable for answering the finalised research questions were sought.

The research aim of understanding how street user behaviour, design and regulation shape street environments and the implications for walking and cycling, seems to require a qualitative research method that would help to understanding how the world is seen and experienced. Figure 39 shows the methodological options that were considered before arriving at the study's adopted method, Q-methodology.

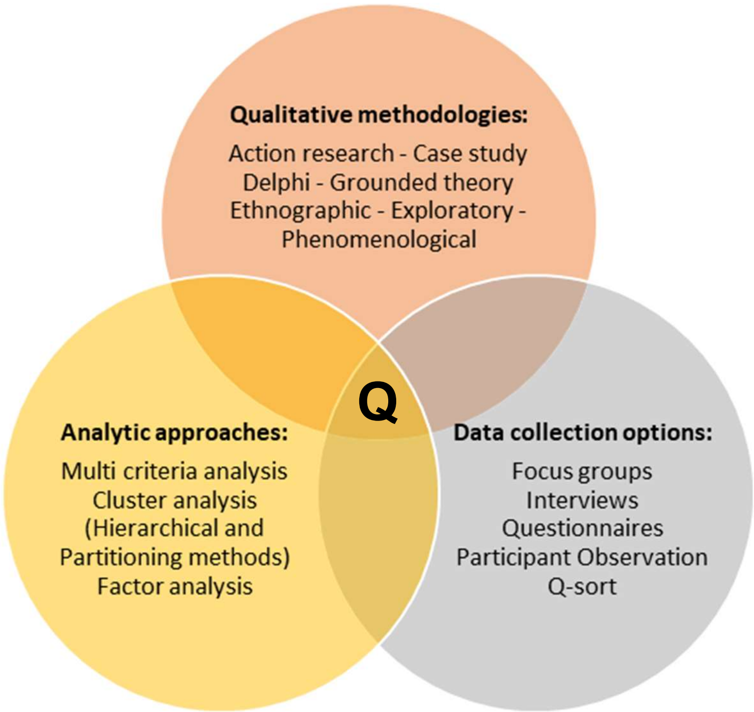

Figure 39 - Charting the methodological options for the study

Each of the following qualitative methodologies were considered:

- Action research - systematically examining behaviour to improve practice
- Case study - a study of cases that serve as exemplars of the research phenomenon
- Delphi - an approach to find consensus among a panel of experts in the field
- Ethnographic - a study of cultural sense making
- Exploratory - designed to find generalisations about a group or topic of study
- Grounded theory - designed to develop new theoretical constructs or models
- Phenomenological - how individuals experience a concept, event, or phenomenon

Of these methodologies, phenomenology, a study of the ways individuals give meaning to a phenomenon (in this case, street environments) seemed to most closely relate to the research aim and questions. However, it was also noted how each of the methodologies could potentially contribute something to the research topic area. From the research questions expressions such as *"what aspects are most important to people"* and *"the relative importance"* allude to subjectivity. Subjective research, concerned with experiences from the perspective of individuals, is generally referred to as phenomenological research (Open University, 2022).

The research questions also speak about *"the most marginalised people on foot, cycle or rolling"* which raises the expectation that clusters of opinion will form around the perspectives of groups of individuals. So, a method for aggregating into clusters was sought. Several analytic approaches were considered:

- Multi-criteria analysis - ranking weighted criteria to make decisions
- Cluster analysis (Hierarchical and Partitioning methods) - an exploratory technique to group related data; hierarchical and partitioning methods use different statistical approaches to create clusters of similar data points (Ehlert and Orr, 2019)
- Factor analysis - a statistical approach that identifies data points that are closely associated and creates factors from closely associated data

All these analytical approaches are quantitative ways of analysing and understanding qualitative data. Multi-criteria analysis (MCA) could have been used for this study had the questions been framed in the language of decisions. One potential limitation of MCA in the context of this study, may have been arriving at appropriate weightings for each criterion, from across a diverse group of participants, or street users.

The various forms of cluster analysis can be applied to coded qualitative data to mine the findings for themes and sub-themes across groups of participants (Henry *et al.*, 2015). A limitation when applied to qualitative data is that the analysis is only as good as the researcher's coding.

Factor analysis, like cluster analysis is a statistical technique, but as Ehlert and Orr (2019) state in their comparison of grouping results between cluster analysis and Q-methodology, when used in the context of Q, rather than grouping participants using externalised characteristics, the method groups individuals by a more internal measure, their viewpoints.

Finally, different forms of data collection were considered:

- Focus groups - discussions between two parties, guided by a topic guide of structured or unstructured questions, typically involving groups of 4-8 people who are connected by a common characteristic
- Interviews - research opportunities which are also usually structured or semi-structured, for mutual discovery, understanding, reflection, and explanation, often with individuals, but sometimes with groups
- Questionnaire - a list of questions that can either be administered directly by the researcher like a structured interview, or self-completed by participants

- Participant Observation - observation of participants in situ
- Q-sort - a ranking of statements by participants as part of Q-methodology

Focus groups involve discussions between two parties, guided by a topic guide of structured or unstructured questions. Yona (2020) describes focus groups as informal discussions that are planned and moderated, allowing one person's ideas to bounce off another to create a chain of informative dialogue, aimed at addressing a specific topic or research theme in depth, and providing rich qualitative information. Good management is key to good data management and includes timekeeping and participant selection. A mixture of different demographics helps avoid bias and can add depth to the discussion.

Tracy (2019) describes interviews in research as opportunities for mutual discovery, understanding, reflection, and explanation. They can be organic, adaptive, and even energising. From an ethical standpoint the researcher when interviewing should be aware that they almost always have more control in terms of directing the dialogue, and they should treat the informant and the resulting data appropriately. Interviews could be considered a form of art that requires study and practice, and reflexivity on the part of the researcher. The level of structure in an interview should depend on the purpose for which the data is being collected. More structured interviews with an interview schedule are most appropriate when the aim is to compare data across a large sample and is also very useful when assistants need to be trained to carry out some or all the interviews in a consistent manner. By contrast, semi-structured interviews do not stick to a rigid pattern of fixed questions, by are guided by a more flexible interview guide that may contain probe questions or bullet points. It allows for more emergent understandings to be uncovered and can adapt to follow the interests and knowledge of the informant. Interviews can be categorised as different types: ethnographic, informant, respondent, narrative and discursive, each of which serves different research aims and are suitable for different categories of participants.

Both focus groups and interviews were used in this study and how they were applied is described later in the chapter. Although questionnaires were not directly used, the principles behind preparing a list of questions used when designing a questionnaire were applied to the preparation of the semi-structured interview guides developed for the focus groups and key informant interviews.

Although participant observation in street environments was considered as a form of data collection for this study it was not ultimately employed. However, statistical modelling of observational data was undertaken by the researcher for two parallel pieces of research on side road crossings (Flower, Ricci and Parkin, 2020; Flower and Parkin, 2020) commissioned by Sustrans and the Road Safety Trust respectively. The present thesis was informed by the observational findings from these studies.

The Q-sort is unique to Q-methodology and is fully described in Section 4.4. According to Gauttier and Liberati (2020) in their comparison of Q-methodology and phenomenology, Stephenson the author of Q described Husserl's phenomenology as being congruent with Q-methodology. They acknowledge that Q does not originate from phenomenology but from the factor theory of Spearman, but state that both scholars were concerned with aspects of cognition. Both approaches seek to study human experience, but the terms that they adopt differ somewhat. Gauttier and Liberati (*ibid.*) suggest that Q-methodology addresses Husserl's call to investigate subjectivity in an objective manner and both methods enable research into human experience from the viewpoint of the study participants. The point of departure from one another is subtle, but important. Whereas Q studies are often used to explain, or make sense of a phenomenon, such as street environments, phenomenology aims at pure description. So, although this study has sought to understand how individuals experience street environments and has been informed by phenomenology, it has not stayed entirely within its accepted methods and language. Rather it has identified Q-methodology as the most appropriate way of addressing the research aim and answering the research questions. As an approach it is both able to investigate the subjectivity of different street user views, and to make sense of them by clustering similar ideas into shared perspectives. With reference again to the three worlds after Habermas (1984), in this study Q-method addressed: the objective world via the statements used in the Q-sort; the subjective world with the perspectives from the individuals in the focus groups and key informant interviews used to collect the data for the Q-sort; and the inter-subjective world using the viewpoints identified through factor analysis, that emerged from groupings of people that shared those views.

4.3.2 Introducing Q-methodology

Q-methodology was developed by William Stephenson and featured in a letter he wrote to Nature (1935). According to Stenner, Watts and Worrell (2008, p.215) it was *"designed expressly to explore the subjective dimension of any issue towards which different points-of-view can be expressed".* Q uses factor analysis to find groups of similar opinions around a topic and why people hold them (the latter are revealed in post Q-sort interviews with participants).

Q-methodology has been used across a variety of fields including Education, Health Care, Political Science, Psychology, Public Policy, and Sociology. The method has also been used in the field of transport: Excel, de Graaf and Rietveld's (2011) study explored preferences for middle-distance travel; Cools *et al*. (2009) explored shifts towards environment-friendly modes of transport; Rajé (2007) carried out an exploratory study to gain insights on transport and social inclusion; Jones *et al*. (2012), as part of a wider study examined subjective opinions on walking and cycling in English cities.

Q-methodology requires a topic, a research question, a sample of statements or items that represent the breadth of the topic and a group of research subjects that represent the breadth of opinion on the topic. Table 14 maps the research questions to the research methods.

Table 14 - Sequence of the methods

Research Method	Research Question (Summarised)	Comment
Q-methodology: 1/ *Key informant interviews*	What elements of behaviour, design and regulation are conducive to movement? (Q1)	The primary purpose was to develop and validate items for the Q-sort (Q-set), for which a deductive approach was used. Additionally, a simple inductive review of the transcripts ensured that any other related issues that emerged would not be lost and could be reported. Participants were subject matter experts. Occurred in parallel to focus groups.
Q-methodology: 2/ *Focus groups*	Ditto above (Q1)	Used to develop the Q-set through a deductive analysis of the transcripts, and to recruit participants (P-set) for the Q-sort. An inductive scan of the transcripts ensured that any other related issues that emerged were not lost and could be reported. Participants included: people that use buggies and prams; people that use mobility scooters, wheelchairs, or other mobility aids; competent cyclists aged 12 to 17 and their parents or carers; visually impaired people; older people aged 65 and over and younger people aged 18 to 24 who walk.
Q-methodology: 3/ *Q-sort*	What is the relative importance (Q2) and interactions (Q3) of behaviour, design and regulation?	Participants (P-set) included the same categories as for the focus groups (except only the parents or carers of children that cycle were included given the role that they play in deciding whether children cycle or not and the methodology was deemed unsuitable for 12- to 17-year-olds). This took place after the interviews and focus groups were completed.
Q-methodology: 4/ *Post Q-sort interview*	Ditto above (Q2 and Q3)	Participants (P-set) were all interviewed following the Q-sort to understand why they sorted as they did and additionally to understand how the unfolding impact of Covid-19 was changing their perspective on streets. A thematic analysis was carried out on the themes that emerged from the data collected on Covid-19.

Q-methodology was chosen as the main research method which contributed to all of the research questions. The Q-sort and post sort interviews specifically contributed to Research Questions 2 and 3. They were used to investigate the relative importance of behaviour, design, and regulation and how they interact to create a network of streets that is conducive to walking, cycling, and rolling for people of all ages. This methodology lends itself to the scientific study of subjectivity, and more specifically, inter-subjectivity, the social world described by Habermas (1984). The research aim and questions depend on the subjective opinions of street users. Q-methodology can investigate that subjectivity.

The nature of streets is complex and solutions that take this complexity into account need to be found. Professionals tend to be very focused: those from the police and Department for Transport tend to focus on road markings, signs, regulations, and enforcement; from transport planning and highway engineering on design; from politics and legislation on the law and behaviour. The fact that a Q-sort enables participants to process a high level of complexity is part of the power of Q-methodology.

4.4 The seven steps of Q-methodology

As a way of fully understanding Q-methodology the seven steps involved in the whole process, shown in Figure 40, are described in the following sub-sections.

Figure 40 - Seven steps of Q-Methodology

4.4.1 Step 1: defining and building the concourse

Step one is to define and build a concourse which is the initial set of all possible interrelated statements about the research topic, from which the statements to be used in the Q-sort, known as the Q-set, are derived. A range of materials are typically used as sources of statements to be included in the Q-concourse, which seeks to cover the breadth of all the things people say or think about the issue being investigated. Rajé’s (2007) sources included academic papers, newspaper articles, research reports, policy documents, journal articles and research participant statements to cover the wide variety of views available on the theme. In this study the researcher consulted, focus groups, key informants and other sources. Initially a list of 14 highway regulations, street infrastructure and street-user behaviours were compiled that encourage or discourage people of all ages to use typical streets on foot, cycle or other human-scale modes based on the Welsh Government Active Travel Guidance (2020, pp.144-146). The majority of statements were generated through a process of analysis of transcripts from focus group discussions and key informant interviews. The utility of using focus groups and interviews as a method to generate the Q-set could be seen by the extent of additional new ideas that were produced. Once duplicate ideas were removed the concourse stood at 77 statements. 14 of which were effectively validated by the Active Travel Guidance but given the nature of such a document it would not be expected to include the wide range of items included by the participants in the six focus groups (street users) and seven key informant interviews (highways professionals).

Application of focus groups

Focus groups were used with groups that at times find typical street environments disabling when they attempt to use them on foot, cycle, mobility scooter or wheelchair. Six different groups were convened to elicit the range of opinions that exist on what is required to create typical streets that are conducive to active travel. Participants were recruited from those that live, work or study in Bristol, a city that features all of the typical street features you would expect to find. Recruitment was purposeful, seeking out people that met one of the criteria listed above, while ensuring diversity in terms of socioeconomics, sex, age, ethnicity, and geography. The following groups illustrate where recruitment of participants for focus groups took place (and they were also used to recruit participants for the Q-sort, known as the P-set):

- Twins' clubs (peer support groups for parents with twins)
- Parent/carer and toddler groups
- Bristol Disability Equality Forum[8] and impairment linked associations
- Schools
- Religious organisations (e.g., mosques, churches, and other faith groups)
- Councillors in underrepresented[9] post codes
- Community groups and forums
- Student groups
- Care homes

[8] BDEF is an organisation of disabled people who live, work or study in the Bristol area and who seek to influence the way the city and its services are run.
[9] As the study sought to include a range of demographics, councillors of wards that were underrepresented among the participants were contacted to recruit additional participants from those wards

- Life Cycle (who train child cyclists in Bikeability Level 2[10])

Focus groups are an appropriate tool to use with these groups of people because, although they are familiar with typical streets and their design and regulation, these may not be things that they give much thought to. A focus group is a useful method to bring together people with something in common, that allows them to respond to each other, and in so doing to generate ideas and understanding. They are also an opportunity for the researcher to elicit information about the topic. Focus groups were primarily used to build the concourse for the Q-study and used to recruit participants (P-set) for the Q-sort.

People who use double buggies were included as the double buggy test is a good indication of street walkability (All Party Parliamentary Cycling Group, 2018). Not all footway users are pedestrians, and a group of wheelchair and mobility scooter users were included. Requirements for these users are like those using buggies except steps and kerbs can prove an impassable barrier to an electric wheelchair.

One focus group was dedicated to child cyclists who had Bikeability Level 2, a good indication of their cycling competence. Testing whether streets are conducive to competent 12-year-olds to cycle is a good bellwether for cyclability.

The remaining three groups were people who regularly make local journeys on foot. Visually impaired people were included as they have particular navigation and safety issues in the street environment and those needs vary depending on whether they are guided by a guide dog, use a guidance cane or have residual vision. A range of visually impaired people, covering each of those scenarios was included in both the focus groups and the Q-sort. Older people who were not visually impaired or mobility scooter users were added as a standalone group at the suggestion of Ruth Cadbury MP[11] who suggested that issues such as seating might be missed if they were not included as a group. The final group were younger people who may use streets at different times, such as late at night, and face a different set of challenges when using city streets.

[10] Bikeability is a UK government recognised training scheme for cyclists. Level 2 develops riders' skills and confidence for cycling on roads and negotiating simple junctions.
[11] Member of the Transport Select Committee, Co-chair of the All Party Parliamentary Group for Cycling and Walking, and key informant in this study

Six focus groups were carried out, using the following selection criteria to identify participants:

1. FG1 - visually impaired people that walk in Bristol streets independently using a long guidance cane, a symbol cane[12], or guide dog,
2. FG2 - users of mobility scooters (Class 2, up to 4 mph and Class 3 up to 8mph) and wheelchairs,
3. FG3 - users of buggies and prams, including double buggies,
4. FG4 - older pedestrians, aged 65 or over,
5. FG5 - competent child cyclists, aged 12 to 17, and their parents or carers, and
6. FG6 - young people aged 18-24 who walk on Bristol streets alone.

FG4 was scheduled to take pace at St Monica Trust Westbury Fields retirement village and to include older people with some sight loss (most visually impaired people have some useful residual vision, unlike those included in FG1), but it had to be cancelled due to Covid-19. The replacement focus group comprised of different participants than those originally recruited. FG5 was scheduled to take place in Ashton Park School at the time that schools were closed due to Covid-19. The replacement focus group only consisted of one child and his mother. He had attempted to get other cycling peers to join, but they did not join the group in the end. Although then not a focus group as such, and being far from ideal, it still had dynamic interaction between mother and child, and it did raise some new insights that produced additional Q-sort statements that were drawn forward to the later stages of the research. It was considered that, although a compromise compared with the original intention, it adequately served the purpose and did not need to be repeated with a larger group.

Administering the focus groups

The focus groups were scheduled to last for 75 minutes, with 15 minutes for introductions and 60 minutes for discussion. Two focus groups were conducted face to face in Bristol before the Covid-19 lockdown restrictions came into place and the remaining four were conducted virtually using Skype for Business. The schedule, locations and number of participants were as follows:

1. FG1 (visually impaired people), 06/03/20, Arnolfini, Bristol, four participants, all male, from three different wards, all long guidance cane users and one also used

[12] Symbol canes are shorter than guidance canes, to indicate to others that the bearer has a visual impairment. They are not used for guidance and the bearer will usually have some residual vision that they can use.

a guide dog, none of them any longer met the eyesight criteria for driving and they all used a combination of walking, taxis, and public transport to get around – three had experienced cycling as back riders on tandems,

2. FG2 (users of mobility scooters and wheelchairs), 12/03/20, Arnolfini, Bristol, three participants, all male from three different wards, two arrived in class 3 mobility scooters[13] (one of these also uses an electric wheelchair, a manual wheelchair, an e-assist wheelchair, depending on context and he drives and owns a car) and one in an electric wheelchair, one was a student on placement at Bristol City Council, one was working, and one was retired,
3. FG3 (users of buggies and prams), 30/03/20, conducted on-line, three participants, two female and one male, from two different wards, all used or had used double buggies, either because they had twins or two young children of different ages, all were drivers,
4. FG4 (older pedestrians, aged 65 or over), 03/04/20, conducted on-line, three participants, two female, one male from three different wards (one was village-based, but had recently moved out from eastern Bristol to a rural BS post code area), although they did have experience cycling and using public transport, their main modes were now walking and driving,
5. FG5 (competent child cyclists and parents/carers), 28/04/20, conducted on-line, two participants, one male and one female (12-year-old cyclist and his mother), the mother was a driver,
6. FG6 (young people aged 18-24), 28/4/20, conducted on-line, four participants, three female and one male from three different post codes, all walked, cycled and used public transport and two were also drivers.

Others were willing to join some of the focus groups above but were not available at the same time as everyone else. All of these agreed to participate in the Q-sort instead, which is described later. The focus group topic guide (a copy is provided in Appendix A: Focus group topic guide) was used to guide the focus group discussions. All participants gave their informed consent to participate and were assured that their responses would be anonymised. The focus groups were designed to be informal discussions on how the behaviour of others, infrastructure design and regulation interact to create typical streets that are conducive to movement on foot, cycle, or other human-scale modes. The purpose was to build the concourse by identifying behaviours, infrastructure designs and regulations

[13] Permitted for both on pavement use (when limited to 4mph) and on carriageway use (limited to 8mph)

that either make important contributions towards this, or which seriously detract from this. The focus groups were recorded, transcribed, and analysed to identify a list of items (statements) that became part of the concourse for this study. The researcher positioned themselves as a facilitator of a friendly informal discussion between the group members.

Application of key informant interviews

Informants, or key informants, tend to be experienced insiders or professionals, often willing and enthusiastic to share their insights into the research topic from their vault of detailed knowledge. The police, highway and traffic engineers, urban planners and designers, policy makers and legislators, all have a professional interest in the behaviour, infrastructure, and regulation present in typical streets. Semi-structured key informant interviews are an appropriate tool to use with these professionals because part of their daily work involves thinking about the research topic. They will have considered what new and emerging infrastructure designs, standards, guidance, and regulation contribute. Seven key informants were recruited from around the UK, ensuring that the professional viewpoints listed above were all represented. Geographical spread, a range of ages and gender balance was sought. These interviews and focus groups were carried out in parallel to the focus groups because they were part of an iterative process to build the concourse for the Q-study. The interviewer positioned themselves as a transport planner, someone that other transport professionals felt comfortable talking to as a peer.

Administering the key informant interviews

Each interview was scheduled to last for 60 minutes, including an introduction, but the actual length was flexible depending on the informant's availability of time and interest. Most lasted for at least an hour and the longest last two hours. KI5 was interrupted and paused mid-way through as the MP concerned was called to the division lobbies to vote. Seven key informant interviews were conducted, following a semi-structured interview format using the topic guide presented in 9.3. It was explained that the objective of the interview was to seek their views on the street environment and culture from the perspective of their profession and job role. They were all conducted face to face, four in London and three in Bristol:

1. KI1 - Transport Planner, Chairman of a medium sized engineering consultancy; British Museum, London, 18 February 2020,
2. KI2 - Head of Traffic Signs and Street Design Policy; Department for Transport, London, 18 February 2020,

3. KI3 - Traffic Management Assistant, Avon and Somerset Constabulary; Arnolfini, Bristol, Tuesday 3rd March 2020,
4. KI4 - Walking and Cycling Design Specialist, SWECO, London, 10 March 2020,
5. KI5 – Member of Parliament, Co-Chair All Party Parliamentary Group Cycling and Walking/Member of Transport Select Committee, Houses of Parliament, London, 10 March 2020,
6. KI6 - Speed Enforcement Officer, Avon and Somerset Constabulary, UWE Frenchay Campus, Bristol, 11 March 2020, and
7. KI7 - Project Manager Bristol City Council, Arnolfini, Bristol, 12 March 2020.

The key informants came from Birmingham, Bristol, London and South Gloucestershire. Three of them were women and they ranged in age from their 20s to their 60s. The interviews were recorded and transcribed.

4.4.2 Step 2: developing the Q-set

Step two is the process of developing the Q-set. The transcriptions from both the interviews and focus groups were used to build the concourse of statements. The 77 statements that were defined when building the concourse were then categorised by theme (regulations, infrastructure, and behaviours) and whether they encouraged or discouraged the use of streets for active travel. As modelled by Rajé (2007) the Q-set was derived from the concourse by refining and rephrasing statements in order to retain their essence but make them more readily understandable to a broad audience. From the categorised concourse, 64 items were chosen for the final Q-set. The whittling process involved removal of duplicates, rephrasing, selection of the clearest, most comprehensive expression of an item, to confirm the final selection. The complete list was then reviewed and validated by the key informants to ensure that it was complete and comprehensible and made sense from their professional perspective. Once they had confirmed this the list was finalised (see 9.2). Comments from the key informants indicated that they were comprehensive and understandable:

> *"I think the summary is really good and I like the way the answers are split. I don't think you need to make any changes." (KI4)*

> *"I would say that they're understandable, comprehensive and no obvious duplication." (KI7)*

The 64 items in the Q-set cover items of street design, regulation, and behaviour. Almost all the behaviours (in the Q-set) relate to street user behaviour, but the members of the focus groups and key informants identified three other behaviours that they thought were important to include. These additional three Q-sort items represent actions of people who influence the street environment in relation to the influence of politicians (item 27 and 61) as being either pro-walking and cycling or pro-car, and street maintenance (29).

Additionally, three of the items relating to regulations focused on enforcement, which could also be understood as actions or inactions of people that are not street users, but that influence the street environment in some way. The final 64 items of the Q-set can be seen with the other results in Chapter 5 and are listed in Table 18 and Table 19 along with the source(s) for the items and the categorisation given by the researcher.

4.4.3 Step 3: selecting the P-set

The third step in Q-methodology is the selection of participants who will undertake a Q-sort and they are known as the P-set. As with the focus groups, the P-set were a purposeful sample of those that are the most marginalised within street environments. The same recruitment criteria and methods were used as for the focus groups (see Section 4.4.1), except parents and carers of children who cycle were recruited and not children themselves as the methodology was not deemed suitable for under 18s.

49 people (Table 15) participated in the study, recruited from across Bristol (BS) postcodes. BS postcodes cover Bristol, and parts of South Gloucestershire, Bath and North East Somerset and North Somerset. This combination sought to both ensure divergent views around the subject matter and to establish good subject knowledge on what would make streets conducive to walking, cycling, and rolling.

Table 15 - Q-study participant profile

Number	Gender split	Mean age	Median age	Mode ages	Standard deviation	Age range
n=49	24 female, 25 male	56 years	66 years	18 & 70 years (4 of each)	19.56	18-81

The sample was skewed towards certain age groups in that the selection criteria of belonging to groups that are the most marginalised by street environments had a relationship with particular age groups (for example users of buggies are most likely to be parents of young children and users of mobility scooters are more likely to be retired). The same selection criteria used for the focus groups (as described previously and shown in Figure 41) were used for the Q-sort participants, except only the parents or carers of cyclists were included as the methodology was not thought to be suitable for under 18s. Three of the selection criteria either: a) required people to be older (65 or over); or b) meant they were more likely to be old (user of a mobility aid such as a mobility scooter, or visually impaired); or c) required participants to be young (between 18 and 24). The distribution of participants by category is shown in Figure 41.

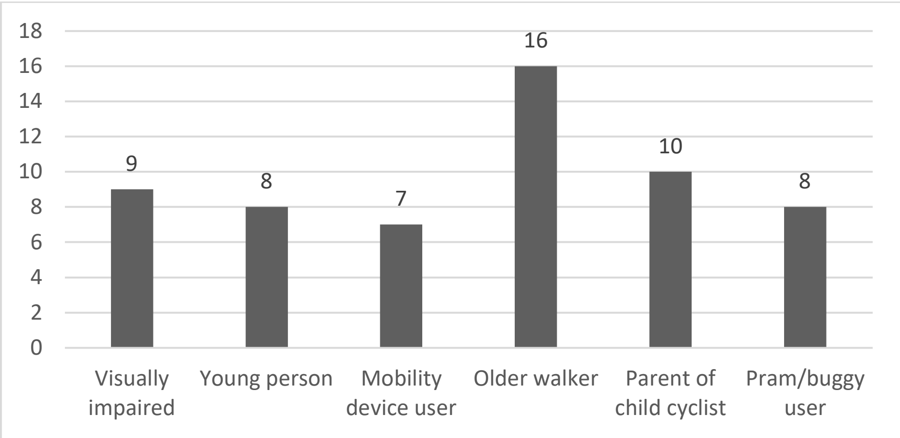

Figure 41 - Categories used to recruit participants

The six groups were not mutually exclusive, so it was possible to be a young person who also uses a mobility device. The older people were all 65 or over who frequently made local journeys on foot. Parents of cyclists had to have children under the age of 18 who cycle. The final category were people that push buggies or prams, including double buggies. Figure 42 shows where the participants live.

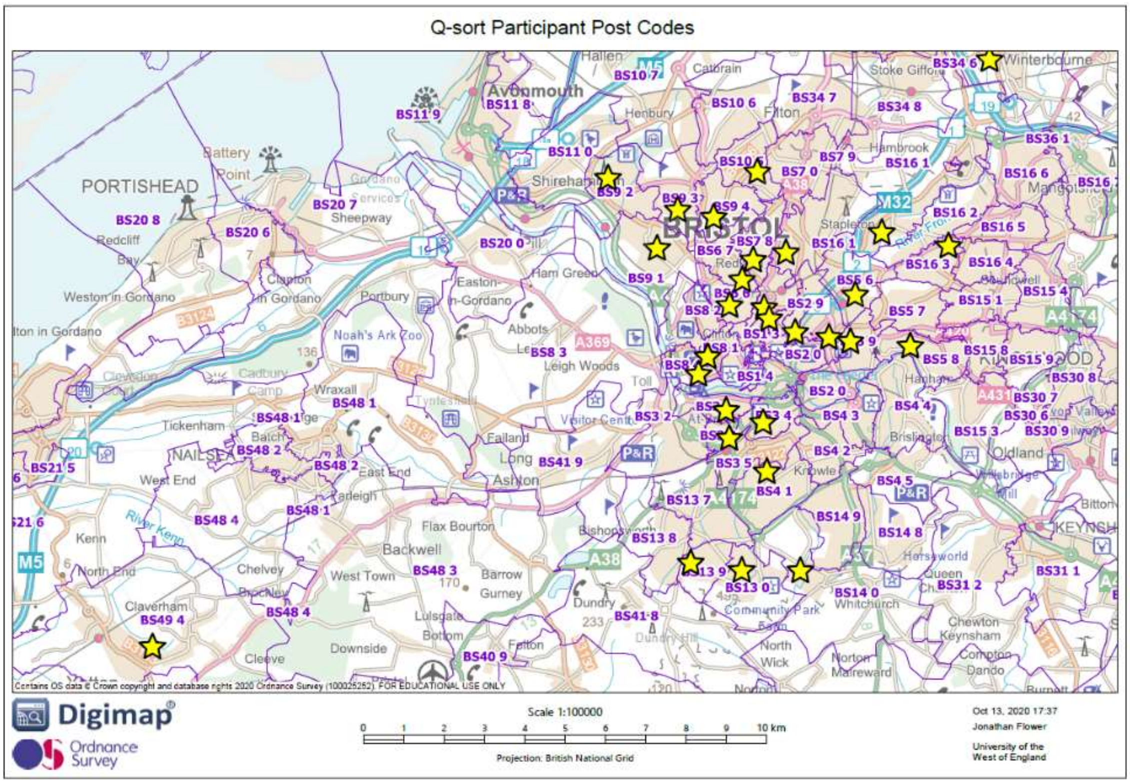

Figure 42 - Bristol post codes with Q-sort participants

The postcodes include the most socio-economically deprived and more affluent areas. Most participants came from Bristol city wards, with two participants from further out, one from Winterbourne (BS34) and another from Yatton (BS49). Both of these participants, in addition to their more local knowledge, had experience of city streets, through having lived, worked or studied in Bristol.

Participants were asked whether they hold a driving licence and, if so, when they passed their test. 38 of the 49 participants had passed a driving test, although four participants had surrendered their driving licence due to deteriorating vision, or by choice in retirement. Table 16 profiles driving experience based on the time elapsed since passing the test.

Table 16 - Participant driving experience

Test passed	≥ 10 years	1-10 years	< 1 year	No driving licence
Number of participants	30	4	4	11

Participants were asked how frequently they drove, cycled, 'walked'[14] locally, or used the bus with the results as shown in Figure 43.

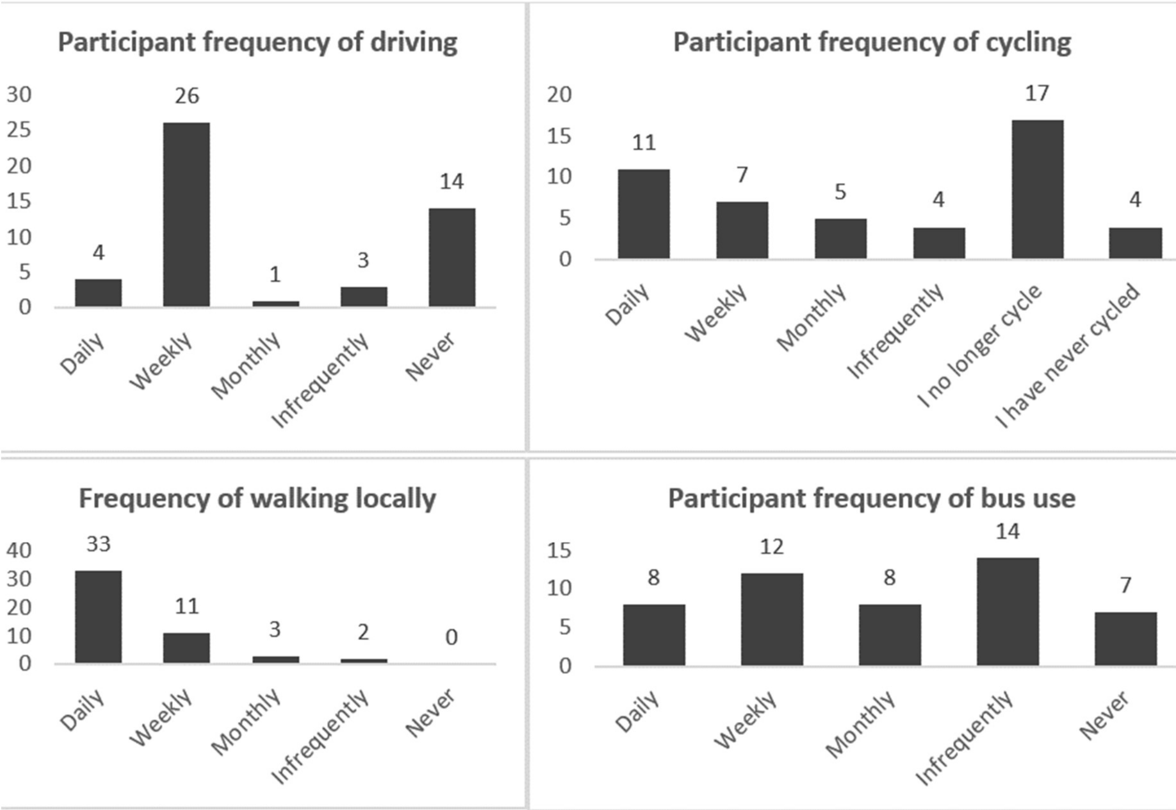

Figure 43 - Frequency charts for participant journeys

As can be seen in the charts above, all participants walk for local trips, 44 of them at least weekly. Almost two thirds of participants drive at least weekly, but a third drive infrequently or not at all. Cycling and bus use by participants is more mixed with about one third using these modes at least weekly, but more than a third (21) never cycling, and the same number never using the bus, or using it infrequently. However, cycling and using the bus were more frequent for urban daily trips than driving.

Looking at each mode in turn:

a. **Driving -** a total of 30 participants drive daily or at least once a week, four drive monthly or less frequently and the remaining fourteen never drive, including those that no longer drive.

[14] For those that used mobility devices such as mobility scooters, their use was considered as 'walking'.

b. **Cycling** - of those who cycle regularly, 18 cycle daily or at least once a week, and five cycle monthly. Most participants (25) cycle infrequently, or not at all.

c. **Walking** - participants were asked how often they walked for local journeys in excess of 10 minutes duration. All participants make local journeys on foot or with the aid of their mobility device, 33 daily, 44 at least weekly and five monthly or less frequently.

d. **Using the bus** - 20 participants use the bus daily or at least once a week, eight monthly and 21 infrequently or never.

There were several additional and relevant characteristics of street use for people on foot summarised in Figure 44.

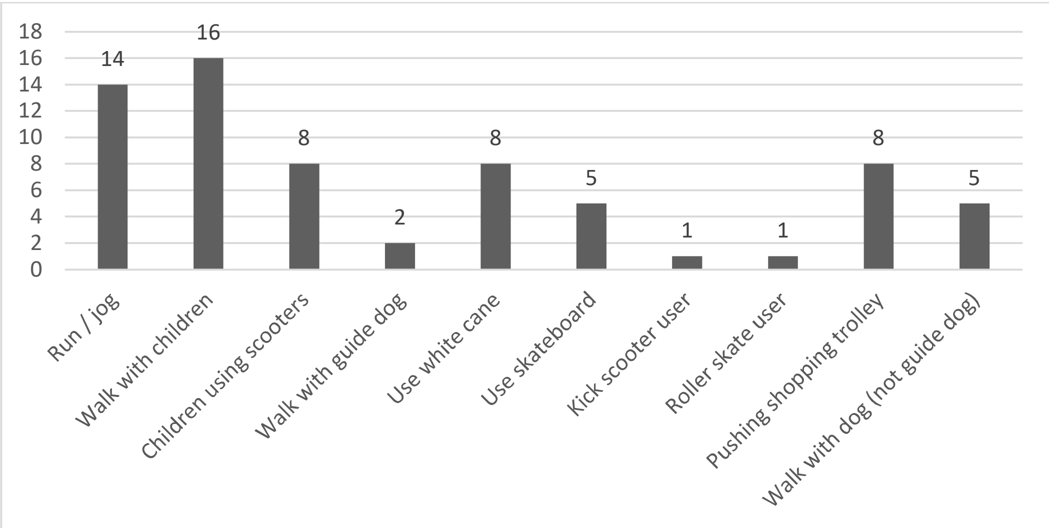

Figure 44 - Relevant participant characteristics in relation to street use

Participants may have more than one additional characteristic. Someone may use a guide dog, but on other occasions use a white guidance cane, or the same person may alternate between jogging, walking with children, walking the dog and pulling a shopping trolley.

About a dozen people who agreed to participate in the Q-study subsequently withdrew. They were mainly older participants who did not fall into any other category, but also included one visually impaired person and a parent of a child that cycles. There were a variety of reasons that included:

- Illness (self or spouse)
- Struggled with the exercise and so gave up
- One completed the exercise, but then had to be excluded from the analysis as they did not meet any of the participant criteria

- Decided not to participate as their spouse had already participated
- One withdrew without further explanation

Ethical implications of research

When planning and designing a study, consideration needs to be given to ethical issues that might arise and mitigate against them. Data collection is the main focus, but ethics should cover all phases through to publication of the work. It is always important to give particular attention to vulnerable groups, which in this study included children (Creswell and Poth, 2017). Approval for this study was sought and granted by the University Research Ethics Committee (UREC), at the University of the West of England on 10 December 2019. Adaptations were required due to the on-set of Covid-19 which are described in Sub-section 4.4.5 and an amendment to the existing research ethics approval was granted by the UREC on 25 March 2020. The two ethics applications and letters of approval are included in 9.4. These approvals, along with the accompanying supplementary documentation (participant information sheets for focus groups and for key informant interviews, participant privacy notice, participants consent forms and topic guides) were used throughout the study as a reference point for the research team to ensure that the highest ethical standards were maintained.

4.4.4 Step 4: conducting the Q-sort and Step 5: post Q-sort interview

The fourth step is conducting the Q-sort which is when each member of the P-set (the research participants) sort a number of statements (in this study items that had been defined in the developing of the Q-set as behaviours of other street users, regulations and infrastructure designs).

The number of items in a Q-set depends on the full extent of ideas generated. In this study 64 items were distilled from the focus groups and interviews, representing the breadth of what encourages people to use typical streets on foot or cycle (Appendix B: Q-sort items). In another study the Q-set could contain 49 statements, in which case they would be coded from 1-49 for the purpose of analysis. Initially participants sort the items into three piles: those statements that they agree with, those that they disagree with and those that they are neutral, or unsure about. Then participants take one pile at a time and rank them, taking particular care about their top choices. Before the sorts are analysed, they are placed in a forced-choice distribution grid as shown in Figure 45Figure 45.

-6	-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	+6
38	22	6	15	4	5	2	1	8	11	9	7	32
(1)	35	16	24	13	17	18	3	14	12	26	10	**(1)**
	(2)	19	45	20	23	29	30	25	31	27	**(2)**	
		(3)	49	21	28	34	33	36	41	**(3)**		
			(4)	47	39	37	42	44	**(4)**			
				(5)	46	40	48	**(5)**				
					(6)	43	**(6)**					
						(7)						

Figure 45 - Forced-choice distribution grid with 49 items

In this study the Q-sort, which was undertaken by each participant, consisted of them sorting the items on a 13-point ranking scale from most agree (+6) to most disagree (-6), based on how they felt about each statement, using a forced choice distribution grid similar to the one in Figure 45. They initially did a simple sort of the items (which were also illustrated with images, examples of which can be seen in 9.2) based on whether they encouraged or discouraged walking, cycling, or using other non-car-based methods of travel in local streets. If they neither encouraged nor discouraged there was a neutral option. Once the participants had done this, they ranked the two sets of items (encourage and discourage) in order of importance. They were not required to rank the neutral items that fell in the central column of the forced choice distribution grid but were restricted to a maximum of 10 neutral items.

Piloting the Q-sort

Prior to administering the Q-sort with the P-set of participants the method was piloted and adjustments made to the method in response. The Q-sort participants had to process and sort 64 items that either contribute to, or detract from, creating typical streets that are conducive to movement on foot, cycle, and other human-scale modes. The pilot helped to simplify this challenging process and to make it more manageable and accessible to people regardless of their age, and adaptable if they were visually impaired. It also helped to refine it as a method that could be conducted online which was required due to Covid-19 restrictions in place at the time.

Administering the Q-sort

The Q-sort was set up for the 49 participants in the P-set using a Qualtrics survey in which they sorted and ranked the 64 items in the Q-set to complete the forced choice distribution grid. As Brown says (1980) Q-studies need enough participants to determine the existence of viewpoints and to compare them with each other. They do not establish the proportion of the population that belongs to a particular viewpoint. 40-60 participants are usual sufficient for this purpose and there are typically fewer participants than statements in the Q-set. 64 items were at the upper end of what is manageable for participants. Participants saw the items in a random order as generated by the Qualtrics software. There were pictures to accompany each item, examples of which are shown in 9.2, along with the full text of all 64 items. Those that were visually impaired had the option of an audio description of the items. Participants were also given the choice of either completing the Q-sort independently on Qualtrics (a software package that can be used for surveys and other research tools) or the process could be facilitated using Skype for Business for audio, with the researcher inputting the participants responses into the Qualtrics software.

Post Q-sort interview

Step five is an interview with each participant in the P-set after they complete their Q-sort. During the brief interview participants are asked to explain the reasons behind the way they had sorted the statements. In this studied the interviews lasted between 10 and 30 minutes guided by how much the participants had to say. Two additional elements were added to the interview which are more fully described in Section 4.4.6 on methodological innovations and adaptations, the first to identify thresholds at which each participant would be prepared to walk or cycle in a street environment and the second to give participants the opportunity to express the impact that Covid-19 had had on their view of streets.

4.4.5 Step 6: analysis and Step 7: interpretation

Step six is analysis. The factor analysis used to analyse the Q-sorts is described below. This is followed by a description of the thematic analysis used with the interview and focus group transcripts.

Factor analysis

Factor analysis seeks to explain as much of the variance, or range of opinions, in a data set as possible. Factors are dimensions of meaning, or viewpoints shared by a sub-set of the participants in a study. So, if a sub-set of a group of people agrees with a series of statements suggesting that, for example, abortion is inappropriate, they could be described as having a shared ‘pro-life’ viewpoint. Whereas another sub-set of the same group might coalesce around a ‘pro-choice’ viewpoint or factor.

In this study data from the Q-study was analysed with the assistance of PQMethod (Schmolck, 2015) software. Although the analysis could have been undertaken using SPSS or other more generic statistics packages, PQMethod is tailored to Q-methodology. In Q factor analysis, the statements (Q-set), rather than the participants (P-set), are the sample.

Factor analysis is a data reduction technique because the number of extracted factors is considerably fewer than the number of participant responses in the study. A first step identifies sorts that are closely associated with each other. A second step creates factors from these closely associated sorts, which are referred to as the defining sorts for each factor. The correlation coefficient between an individual sort and a composite sort is called the factor loading. When reducing the original sorts to factors the maximum amount of variance contained within them should be maintained.

Factors shared by a sub-set of the participants, were extracted using principal components analysis (PCA), a form of factor analysis, to account for as much of the observed variance in the data as possible. There are a number of different factor extraction methods (PQMethod offers PCA and Centroid; SPSS offers others including principal axis factoring, maximum likelihood factoring, image factoring, and alpha factoring) with each approach using a different orthogonal solution. However, when the sample size is large, as in this study with a Q-set of 64, the differences in the extracted factors when using different extraction methods, are usually negligible (Kim 2008).

PCA, chosen for this study, is the most common factor extraction method and is available in the PQMethod statistical programme as it is commonly used in Q-methodology. Brown (2009) suggests that PCA should be used if the goal of the researcher is to explore patterns that emerge from their data, as is the case in this study. He recommends using factor analysis when theoretical ideas about relationships between variables already exist. In PCA uncorrelated linear combinations of the observed Q-sorts are extracted. The highest level of variance in the dataset is explained by the first factor and the second highest level of variance is explained by the second factor, and so on until all the variance in the dataset is explained by the factors (Akhtar-Danesh, 2017). Watts and Stenner (2012) point out that PCA is not strictly producing factors, but components, but they acknowledge that the results are similar. However, Kim (2008) notes that in the literature the term factor has commonly been used to refer to both components and factors.

Thematic analysis

The post Q-sort interviews carried out with the P-set participants were transcribed, and an inductive thematic analysis of the participants' responses was carried out. This was in contrast to both the focus groups and key informant interviews transcripts, when a deductive or theoretical (Braun and Clarke, 2006) analysis was employed to develop the Q-set. This was supplemented by a simple inductive review of the focus group and key informant transcripts to ensure that any other related issues that emerged were not lost and were reported. For the post Q-sort interviews, as a second phase, the bottom-up inductive themed responses were grouped by the overarching themes of this study, namely behaviour, regulation, and design.

Interpretation

Step seven is the interpretation of the factors by the researcher who describes the perspectives that each factor represents. Patterns emerge that can be represented by composite Q-sorts that convey an aggregated meaning, representing the shared viewpoint of a subset of participants in a study. The researcher compares the positioning of the statements in the composite Q-sorts that represent each factor. Interpretations are also guided by the post Q-sort interviews, the literature review and subject knowledge.

4.4.6 Methodological innovations and adaptations

Innovations on Q-methodology

The Q-method has been adapted for this research to identify the tipping point, or threshold, at which each participant would be prepared to walk or cycle in a street environment. As part of the interview each participant was asked to identify the points at which they considered a street or route is either good enough to persuade them to use it, or so bad that they would avoid it. This therefore identified the elements of street environment, and culture of use of that environment, that make routes easy, attractive, and safe enough for people to use them on foot, cycle, or other human-scale modes. Conversely, it also identifies the elements that, if present, would mean that people would avoid such streets. Where at least half of the participants identified the same item, it was defined as a 'tipping point' in the study. This 50% threshold was chosen to ensure that tipping point items were shared views and not outlying views that could be of interest, but for which there was little evidence that this was a more widely held viewpoint.

The second innovation aimed at identifying the relative roles of design, behaviour, and regulation for each viewpoint. Using shading (as seen in the composite arrays for each viewpoint in Chapter 5, e.g., Figure 49) the Q-sort items have been categorised by the researcher (only the items and not the categories were seen by participants). The importance of the role of design, behaviour and regulation is revealed by their positions in the grid, with the most important present at both ends of the grid (e.g., items 38 and 32 in Figure 45), and the least important in the middle.

It should be noted that these methodological innovations do not compromise the conventional way of applying Q-method, as these additions occurred after the main method had been completed by participants. Whether or not the innovations were successful is concluded in Chapter 7.

Covid-19 pandemic impact statement

All the Q-sorts and subsequent interviews took place during the initial Covid-19 lockdown or shortly afterwards (from May to September 2020). A major event like this is very disruptive. There was a marked impact on travel. Such disruption to travel allowed for a period of reflection on the pre-Covid-19 situation, how Covid-19 has changed travel, and on the possibilities for change in travel after Covid-19.

Data collection for the research started prior to the initial Covid-19 lockdown measures. As a result, the key informant interviews and early focus groups were carried out as planned, face-to-face (f-2-f). Once the lockdown measures were introduced in March 2020, the remaining focus groups were concluded online, along with follow up interviews with the key informants to ratify the Q-sort statements. All of the Q-sorts and post Q-sort interviews took place during the initial Covid-19 lockdown or shortly afterwards and so the methodology was adapted so that it could be conducted online. **Error! Reference source not found.** shows more information about the interviews, focus groups and Q-sorts.

Table 17 - Adaptations to methods in the light of Covid-19

Method	Start date	End date	No. f-2-f	No. virtual
Key informant interviews	18 February 2020	12 March 2020	4, London 3, Bristol	0
Focus groups	6 March 2020	28 April 2020	2, Bristol	4
Q-sorts	May 2020	September 2020	0	49
Follow up interviews to Q-sorts	May 2020	September 2020	0	49

As part of the Q-sort interviews with each Q-sort participant, Covid-19 presented the opportunity to explore the subject area of street use in more detail, and from the point of view of the changes brought about as a result of Covid-19 and the participants' reflections on that. All Q-set participants were asked to comment on changes to their walking, cycling, running/jogging, driving and bus use due to the Covid-19 pandemic. **Error! Reference source not found.** shows how patterns of behaviour changed. Of the 37 participants that said they use the bus less, 18 no longer use it at all. At the same time there also seems to have been an overall decrease in driving and an increase in walking, running, and cycling.

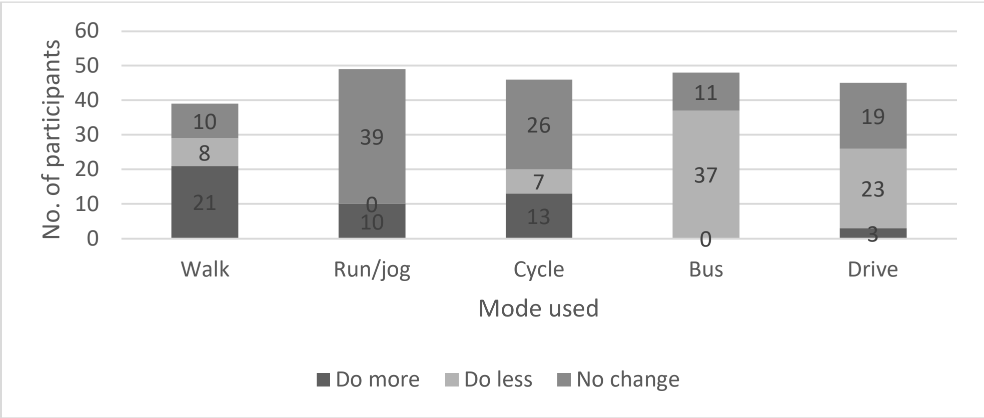

Figure 46 - Changes in travel behaviour due to Covid-19

4.5 Summary of the chapter

The chapter restates the research aim, establishes a theoretical foundation for the research and describes Q-methodology as the method that was deployed to address the research questions and how the research was adapted in response to Covid-19. The Social Ecological Model (Bronfenbrenner, 1974) and the Social Model of Disability (Oliver, 2013) were adapted to form a framework for this research, the Social Ecological Model of Ability (SEMA). The three 'worlds' of Habermas (1984) were also used to help guide the research to combine multiple perspectives that generate a complete understanding of street environments. The SEMA as a new conceptual framework was developed that was suitable for the under-researched topic area from the perspective of all street users. It enables the research to encapsulate all the issues of behaviour, regulation, design and ability more fully in street environments.

After exploring other possible approaches, Q-methodology was chosen as the main research method. This methodology lends itself to the scientific study of subjectivity, and more specifically, inter-subjectivity, the social world described by Habermas (1984). The research aim and questions depend on the subjective opinions of street users. Q-methodology was used to investigate that subjectivity. The fact that a Q-sort enables participants to process a high level of complexity is part of the power of Q-methodology.

The seven steps of Q-methodology are as follows: defining a comprehensive set of statements about a topic; redacting those to generate a so-called Q-set of statements; sampling participants, called the P-set; asking the P-set to sort the Q-set; interviewing participants after they have completed the sort; analysing, and then interpreting the results. The next chapter presents the results and analysis that emerged from the application of Q-methodology.

5 RESULTS AND ANALYSIS

5.1 Structure for the chapter

This chapter presents the research findings and the analysis of the results. The main output from the focus groups and key informant interviews was the Q-set, the 64 statements that were used in the Q-sort and these are presented first, in Section 5.2. The results of a Q-sort in Q-methodology are analysed using factor analysis, which is presented in Section 5.3. Factor analysis led to the emergence of five main different viewpoints on streets which are described in Section 5.4. As well as the distinguishing viewpoints there were some convergent and interrelated views across the participants which are explored in Section 5.5. A post-Q-sort interview with each of the participants included a discussion on changes that they had observed and experienced during the Covid-19 pandemic, and this is the focus of Section 5.6. The chapter concludes with a summary of the findings in Section 5.7.

5.2 Outcomes of key informant interviews and focus groups

As described in Chapter 4 on methodology, the concourse of ideas arising from the key informant semi-structured interviews and focus groups were grouped by three themes that were determined by the researcher in the light of the literature:

1. Regulation,
2. Infrastructure, and
3. Behaviour.

The process of transforming this broad set of ideas, catalogued in the form of statements, into a more refined Q-set of 64 statements, was described in the previous chapter, especially Sections 4.4.1 and **Error! Reference source not found.**. It is summarised below in Figure 47.

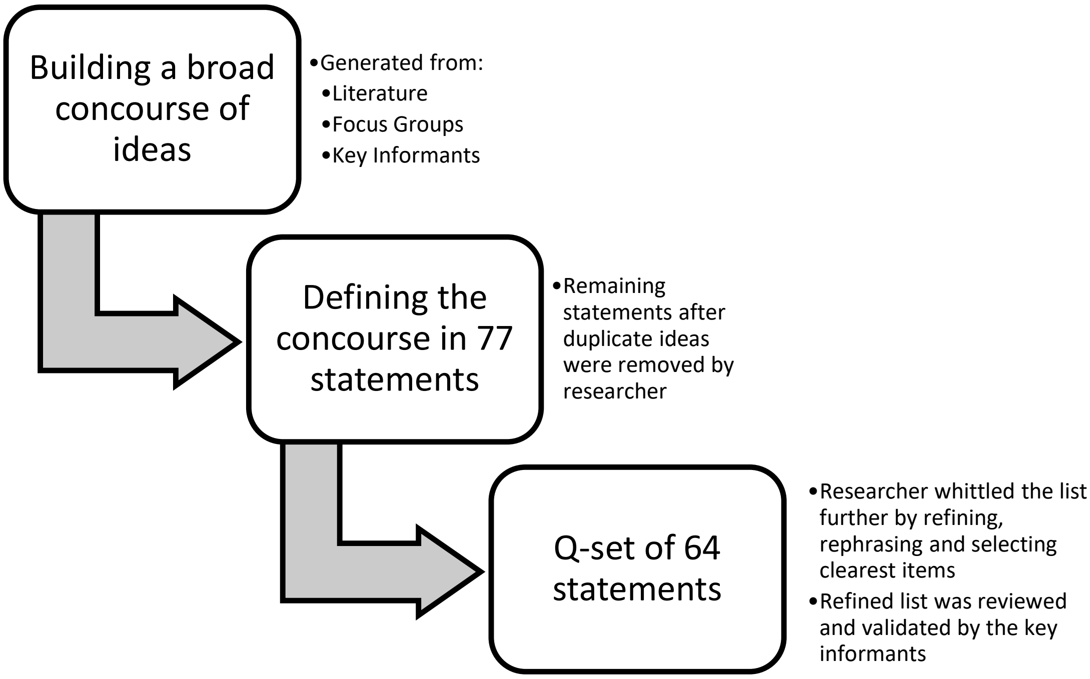

Figure 47 - developing the Q-set from the concourse

The final 64 items were the Q-set used in the Q-sort. The Q-set statements were the principal outcomes of the interviews and focus groups and became the inputs for the Q-sort. The 64 items are listed in Table 18 and Table 19 along with the source(s) which are labelled KI 1-7, and FG 1-6, corresponding to the seven key informants and six focus groups described in the previous chapter. The use of ‘encourage’ and ‘discourage’ are indicative and varied according to each participant’s perceptions.

Table 18 - Q-sort items 1-32 (encourage)

Category	Item	Source
Encourage…		
Regulation	1. 20mph maximum speed limits 2. Warning signs or road markings 3. Drivers have read the Highway Code and passed a driving test 4. Laws such as the Highways Act (1980)/Road Traffic Act (1988)/Traffic Management Act (2004) 5. Civil enforcement by local authorities and their agents of parking restrictions (e.g., Resident Parking Zones and double yellow lines near junctions) and bus lanes 6. Enforcement by the police of speed limits, close passing of cyclists, drink driving, using a mobile phone while driving, cycling on the pavement, pavement parking, and other traffic offenses	KI1, 3, 6 KI2, FG6 KI1 KI3 KI3, 6, FG4 KI3, 6, 7, FG3, 4
Infrastructure	7. Direct routes for pedestrians that avoid deviations and for cyclists that are at least as direct as those for motorised traffic 8. Time saving routes that are designed to minimise the need to slow, stop or wait (e.g., allow high walking or cycling speeds, no/few crossing points or obstacles) 9. Routes that are wide enough to accommodate expected flow – pedestrian routes that can accommodate double buggies and allow mobility scooters to pass, and cycle tracks that enable overtaking 10. Adequate geometry, visibility and space for cyclists to avoid running into the path of motor traffic or pedestrians, allowing for errors and evasive manoeuvres 11. Physical separation between cyclists and motorised traffic and between pedestrians and cyclists (e.g., kerbs, different levels or bollards) 12. Route surfaces are smooth 13. Roads are designed for low traffic speeds (e.g., physical measures that make it difficult to drive fast, visual appearance that causes drivers to slow down) 14. Routes are overlooked (e.g., by the fronts of houses or shops) 15. Street design is attractive or interesting (e.g., plantings, architecture and artwork) 16. Contrast in the look of footways, cycle tracks, carriageways and changes in level, including colour contrast 17. Consistency of design approaches (e.g., along a street, within a town or nationally) 18. Zebra crossings at side roads (or parallel crossings if there is a cycle track) 19. Seating, both formal and informal (wall or planter with a wide rim) 20. Useable cycle parking facilities (eg Sheffield stand), suitable for different cycle types 21. Routes provide some shelter and shade from wind, rain and sun – shelter/seating at bus stops should include adequate space for waiting that enables the safe passage of people around the stop 22. Routes are navigable (clear wayfinding/direction signs or markings, including guidance path surfaces in open spaces) 23. Routes engage the senses – pleasant, localised smells (e.g., bread, coffee, flowers), ambient noise (e.g., music, bird song, church bells), tactile 24. Cycle routes and adequately wide footways including dropped kerbs are provided around temporary works that minimise diversions or restricting movements	KI1, 2, 3, 7, FG3 FG1 KI1, 2, 4, 7, FG3, 4, 6 K1, 2, 3 KI1, 2, 3, 7, FG1, 5, 6 KI1,3-5,7, FG1, 3-6 KI3 KI3, FG6 KI2, FG3, FG4 KI1 ,3, FG1 KI1, 2, FG1 KI1 K13, FG4 KI3 KI5, FG1, 4 KI1 ,2, FG1, 5, 6 FG1, 3 KI2, 7, FG3, 6
Behaviour	25. Drivers and cyclists turning in or out of a side road stop for crossing pedestrians and cyclists (if there is a cycle track) at zebras, parallel crossings or informal crossing points 26. People respect and have consideration for the safety and general well-being of other users of the street 27. Politicians (local and national) stand up for walking and cycling and promote it as being a good thing, supported by policies (e.g., allocating more space and resources) 28. People use and respect the infrastructure that has been provided and use it as intended (pavement, cycle track/lane and road) 29. Routes are cleaned, cleared of leaves/rubbish and drains are kept unblocked 30. Clear communication between drivers, cyclists and pedestrians (e.g., verbally, using bell or hands, or making eye contact) to give priority, to let people know they are there or that they have been seen 31. Other people are doing the same as me (e.g., walking, cycling, or moving in the same direction) 32. Shops or businesses are open and/or there is other activity on the street	KI1, 2, 7, FG5, 6 KI2, 6, FG1, 5 KI2 KI2, FG5 KI4, FG4, 5, 6 FG5 FG6 FG6

Table 19 - Q-sort items 33-64 (discourage)

Category	Item	Source
Discourage…		
Regulation	33. "Cycling dismount" (or similar) signs	KI1
	34. Cycle tracks closed to wheelchairs/mobility scooters and other wheeled vehicles such as e-scooters	FG2
	35. Lack of public information films and adverts to reinforce understanding of rules (including changes) and good street behaviour	KI1, 2, 7
	36. Each local authority has its own design guidance (no UK-wide walking and cycling standards)	KI2, 7
	37. Lack of enforcement by local and national government of air quality standards	FG4
Infrastructure	38. Gradients, slopes and cross falls	KI1, 7, FG5
	39. Steps	FG3
	40. Lack of pavement	KI1, FG4
	41. Wide mouths to side road junctions	KS2, 7, FG6
	42. Incorrect or missing tactile paving	KI2, 7
	43. Dropped kerb missing or away from desired crossing point	KI2, 7, FG3, 4
	44. Routes are cluttered with street furniture that restricts or obstructs movement (guard rails, lights, signs, bins, seats, unused telephone boxes, etc)	KI1, 2, 7, FG1, 3, 4, 6
	45. Routes are poorly lit (not lit, too dim, lit in wrong places, places to hide in shadows, etc)	KI2, 3 ,4, FG4, 6
	46. Overhanging trees and branches or untrimmed hedges (and other head hazards)	FG1, KI4, FG4
	47. Routes are poorly maintained (e.g., fading paint markings, roots and potholes)	KI2,4,6, 7, FG4, 5, 6
	48. Route surfaces are slippery, especially when wet or icy (and ungritted)	FG1
Behaviour	49. Noise caused by others using the street (e.g., vehicle noise, shouting or using heavy machinery)	KI1, FG1
	50. Drivers/cyclists disobeying speed limits or driving/cycling too fast for the conditions	KI1, 7, FG5
	51. Drivers and cyclists not indicating	FG5
	52. Uninvited, unwelcome, inappropriate interaction with strangers (e.g., pedestrians deliberately blocking path of cyclists on a shared path or unwelcome or abusive comments from a passer-by)	FG5, 6
	53. Blocking or restricting width of footways, cycle tracks, drop kerbs or other crossings, or the view of people with buggies, in mobility scooters, children, etc (with parking, bins, A-frames, deliveries, scaffolding, temporary signs, hedges, etc)	KI1 ,2, 7, FG1, 3, 4, 6
	54. Cycling on the pavement	KI3, FG4, 5, 6
	55. Cyclists or mobility scooter users approaching others assuming that pedestrians will move aside	FG1
	56. Distracted people that do not look where they are going or are not aware of their surroundings (e.g., looking at phones, chatting to friends, listening to music)	FG1, 5
	57. Drivers splashing users of footways or cycle tracks	KI6, FG4
	58. Drivers close passing cyclists or cyclists close passing pedestrians and other shared path users	KI2, 6, 7, FG5
	59. Drivers driving too close or too fast to pedestrians, especially when footways are narrow (e.g., threat or perceived threat of being hit by a wing mirror)	FG4
	60. Approaching others (especially) from behind in (almost) silent vehicles (electric cars, cycles or mobility scooters) without any audible warning	FG1
	61. Politicians (local and national) stand up for parking and driving, supported by policies (e.g., allocating or protecting space and resources)	KI2
	62. Opening car doors, especially across footways and cycle tracks/lanes, without first checking that it is safe and convenient to do so	FG3, 4
	63. Antisocial behaviour (e.g., dealing drugs, drunkenness)	FG6
	64. Too many people choosing to drive for the location	KI7, FG6

5.3 Factor analysis

The inter-correlation matrix shown in Table 20 confirms patterns of similarity within the participants' responses (sorts 1-49).

Table 20 - Intercorrelation matrix

SORTS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
1	1.00	0.68	0.69	0.72	0.69	0.66	0.65	0.63	0.70	0.67	0.52	0.67	0.66	0.70	0.69	0.65	0.66	0.69	0.73	0.69	0.62	0.66	0.70	0.68	0.66	0.76	0.63	0.65	0.48	0.58	0.74	0.70	0.60	0.67	0.61	0.58	0.72	0.56	0.71	0.58	0.74	0.69	0.57	0.75	0.52	0.63	0.68	0.63	0.67
2		1.00	0.54	0.64	0.63	0.65	0.52	0.74	0.73	0.62	0.54	0.61	0.58	0.73	0.53	0.67	0.61	0.65	0.60	0.58	0.59	0.70	0.71	0.63	0.68	0.69	0.62	0.59	0.47	0.58	0.61	0.61	0.51	0.65	0.57	0.68	0.65	0.62	0.62	0.67	0.66	0.60	0.53	0.55	0.53	0.51	0.61	0.68	0.78
3			1.00	0.61	0.67	0.68	0.55	0.67	0.65	0.70	0.61	0.61	0.50	0.57	0.63	0.50	0.56	0.71	0.61	0.58	0.58	0.61	0.65	0.64	0.45	0.66	0.47	0.54	0.61	0.53	0.68	0.68	0.65	0.71	0.52	0.55	0.63	0.66	0.63	0.51	0.66	0.64	0.60	0.67	0.58	0.51	0.55	0.61	0.57
4				1.00	0.83	0.72	0.75	0.72	0.68	0.72	0.64	0.70	0.63	0.71	0.70	0.66	0.66	0.64	0.70	0.71	0.64	0.71	0.72	0.62	0.63	0.75	0.64	0.78	0.54	0.61	0.67	0.69	0.54	0.70	0.65	0.62	0.70	0.66	0.73	0.52	0.70	0.72	0.58	0.66	0.63	0.63	0.72	0.65	0.64
5					1.00	0.73	0.64	0.77	0.70	0.67	0.61	0.72	0.66	0.70	0.73	0.67	0.72	0.67	0.71	0.76	0.73	0.67	0.78	0.67	0.63	0.70	0.64	0.76	0.57	0.65	0.72	0.71	0.53	0.67	0.69	0.59	0.73	0.67	0.65	0.53	0.65	0.73	0.55	0.72	0.66	0.59	0.69	0.72	0.68
6						1.00	0.56	0.64	0.63	0.72	0.56	0.73	0.63	0.69	0.69	0.66	0.65	0.72	0.66	0.67	0.68	0.70	0.74	0.68	0.68	0.71	0.45	0.67	0.56	0.66	0.73	0.72	0.64	0.76	0.66	0.68	0.75	0.72	0.74	0.62	0.77	0.71	0.63	0.60	0.61	0.59	0.77	0.68	0.69
7							1.00	0.59	0.62	0.54	0.48	0.60	0.60	0.56	0.66	0.61	0.47	0.59	0.71	0.62	0.60	0.67	0.59	0.66	0.55	0.70	0.51	0.75	0.47	0.57	0.62	0.63	0.50	0.64	0.52	0.61	0.64	0.53	0.68	0.46	0.55	0.62	0.53	0.68	0.51	0.64	0.60	0.61	0.55
8								1.00	0.78	0.61	0.60	0.69	0.64	0.75	0.60	0.66	0.71	0.73	0.65	0.65	0.75	0.76	0.78	0.65	0.63	0.75	0.61	0.69	0.58	0.60	0.65	0.61	0.53	0.67	0.59	0.55	0.73	0.75	0.61	0.69	0.61	0.63	0.66	0.68	0.61	0.55	0.57	0.73	0.75
9									1.00	0.66	0.57	0.69	0.64	0.78	0.64	0.70	0.71	0.72	0.77	0.70	0.78	0.75	0.77	0.70	0.71	0.82	0.68	0.72	0.49	0.65	0.66	0.65	0.60	0.77	0.61	0.62	0.75	0.72	0.67	0.67	0.59	0.70	0.69	0.67	0.65	0.59	0.61	0.76	0.75
10										1.00	0.63	0.69	0.58	0.61	0.69	0.51	0.61	0.61	0.54	0.72	0.61	0.70	0.63	0.65	0.52	0.75	0.56	0.67	0.49	0.53	0.72	0.63	0.58	0.71	0.56	0.52	0.75	0.68	0.63	0.53	0.71	0.66	0.62	0.58	0.67	0.57	0.71	0.63	0.63
11											1.00	0.59	0.61	0.59	0.65	0.59	0.58	0.52	0.55	0.55	0.59	0.57	0.65	0.66	0.47	0.70	0.42	0.63	0.55	0.53	0.66	0.68	0.54	0.59	0.46	0.41	0.55	0.63	0.60	0.54	0.54	0.60	0.53	0.57	0.56	0.53	0.52	0.64	0.54
12												1.00	0.76	0.69	0.68	0.67	0.67	0.78	0.66	0.64	0.74	0.69	0.70	0.70	0.64	0.73	0.66	0.75	0.50	0.62	0.70	0.68	0.62	0.71	0.66	0.57	0.65	0.72	0.75	0.67	0.71	0.74	0.65	0.66	0.62	0.66	0.67	0.70	0.65
13													1.00	0.66	0.71	0.68	0.66	0.71	0.65	0.68	0.71	0.62	0.79	0.71	0.72	0.67	0.53	0.74	0.56	0.63	0.72	0.72	0.60	0.70	0.58	0.59	0.69	0.66	0.67	0.71	0.70	0.70	0.63	0.64	0.63	0.61	0.65	0.66	0.65
14														1.00	0.57	0.67	0.73	0.74	0.66	0.62	0.69	0.78	0.76	0.59	0.66	0.75	0.58	0.63	0.50	0.60	0.74	0.66	0.53	0.72	0.55	0.58	0.71	0.72	0.71	0.74	0.67	0.67	0.57	0.66	0.66	0.60	0.70	0.70	0.84
15															1.00	0.69	0.65	0.62	0.66	0.79	0.71	0.60	0.75	0.74	0.67	0.75	0.45	0.74	0.57	0.73	0.77	0.75	0.64	0.70	0.67	0.56	0.68	0.64	0.62	0.61	0.72	0.68	0.66	0.71	0.57	0.59	0.63	0.65	0.61
16																1.00	0.66	0.64	0.73	0.66	0.76	0.69	0.72	0.70	0.73	0.74	0.50	0.76	0.51	0.68	0.70	0.72	0.60	0.71	0.68	0.65	0.63	0.66	0.75	0.69	0.66	0.67	0.57	0.60	0.56	0.59	0.63	0.64	0.64
17																	1.00	0.69	0.68	0.69	0.74	0.68	0.77	0.65	0.65	0.70	0.57	0.66	0.58	0.66	0.75	0.65	0.60	0.64	0.70	0.54	0.63	0.73	0.60	0.71	0.65	0.67	0.68	0.69	0.69	0.57	0.57	0.62	0.76
18																		1.00	0.67	0.62	0.80	0.68	0.75	0.66	0.62	0.72	0.48	0.64	0.64	0.63	0.76	0.73	0.76	0.71	0.68	0.61	0.64	0.80	0.64	0.61	0.71	0.64	0.70	0.68	0.63	0.56	0.59	0.66	0.70
19																			1.00	0.67	0.74	0.69	0.72	0.74	0.69	0.78	0.60	0.74	0.50	0.73	0.67	0.75	0.61	0.72	0.64	0.68	0.73	0.65	0.72	0.56	0.67	0.75	0.57	0.75	0.60	0.63	0.62	0.69	0.65
20																				1.00	0.70	0.66	0.76	0.75	0.60	0.77	0.59	0.72	0.56	0.67	0.68	0.74	0.61	0.71	0.63	0.59	0.73	0.68	0.63	0.58	0.66	0.67	0.63	0.72	0.62	0.61	0.63	0.65	0.61
21																					1.00	0.72	0.77	0.66	0.64	0.72	0.53	0.75	0.60	0.71	0.74	0.72	0.69	0.71	0.71	0.53	0.66	0.81	0.61	0.61	0.57	0.58	0.72	0.66	0.64	0.57	0.53	0.63	0.70
22																						1.00	0.70	0.66	0.58	0.75	0.62	0.72	0.51	0.58	0.64	0.65	0.60	0.75	0.58	0.59	0.73	0.71	0.71	0.70	0.65	0.63	0.70	0.58	0.67	0.66	0.70	0.67	0.74
23																							1.00	0.71	0.73	0.76	0.55	0.72	0.56	0.68	0.78	0.76	0.58	0.75	0.64	0.63	0.70	0.81	0.67	0.72	0.68	0.67	0.66	0.73	0.62	0.55	0.59	0.72	0.77
24																								1.00	0.67	0.79	0.58	0.74	0.57	0.75	0.74	0.81	0.71	0.75	0.66	0.67	0.72	0.66	0.67	0.71	0.70	0.75	0.59	0.69	0.67	0.68	0.63	0.82	0.64
25																									1.00	0.70	0.50	0.65	0.48	0.79	0.64	0.66	0.57	0.71	0.73	0.56	0.63	0.59	0.67	0.75	0.67	0.73	0.54	0.53	0.54	0.51	0.69	0.66	0.72
26																										1.00	0.58	0.75	0.56	0.69	0.75	0.78	0.59	0.77	0.64	0.62	0.77	0.72	0.74	0.61	0.75	0.78	0.64	0.77	0.63	0.63	0.71	0.74	0.71
27																											1.00	0.63	0.37	0.48	0.49	0.52	0.35	0.57	0.50	0.52	0.56	0.44	0.56	0.53	0.48	0.59	0.51	0.59	0.51	0.51	0.48	0.63	0.57
28																												1.00	0.51	0.66	0.68	0.69	0.53	0.73	0.66	0.67	0.72	0.63	0.74	0.59	0.60	0.67	0.66	0.61	0.66	0.67	0.66	0.69	0.64
29																													1.00	0.61	0.59	0.64	0.56	0.59	0.52	0.51	0.54	0.45	0.49	0.49	0.59	0.51	0.57	0.53	0.53	0.52	0.47	0.55	0.54
30																														1.00	0.65	0.71	0.66	0.72	0.78	0.54	0.63	0.64	0.65	0.70	0.66	0.64	0.61	0.55	0.63	0.60	0.60	0.67	0.66
31																															1.00	0.78	0.70	0.69	0.68	0.58	0.67	0.74	0.64	0.65	0.71	0.71	0.58	0.78	0.69	0.59	0.62	0.73	0.71
32																																1.00	0.71	0.80	0.64	0.64	0.71	0.69	0.71	0.63	0.72	0.75	0.61	0.71	0.64	0.60	0.63	0.67	0.66
33																																	1.00	0.68	0.68	0.49	0.54	0.70	0.59	0.64	0.65	0.61	0.69	0.54	0.61	0.57	0.52	0.57	0.54
34																																		1.00	0.66	0.70	0.77	0.69	0.76	0.74	0.76	0.74	0.65	0.61	0.69	0.66	0.74	0.66	0.72
35																																			1.00	0.48	0.53	0.64	0.65	0.62	0.60	0.63	0.56	0.48	0.67	0.58	0.60	0.61	0.64
36																																				1.00	0.63	0.53	0.58	0.52	0.68	0.58	0.56	0.58	0.53	0.57	0.61	0.64	0.67
37																																					1.00	0.65	0.72	0.63	0.70	0.72	0.65	0.62	0.64	0.64	0.75	0.71	0.71
38																																						1.00	0.63	0.66	0.61	0.63	0.74	0.64	0.67	0.56	0.55	0.70	0.68
39																																							1.00	0.67	0.69	0.74	0.62	0.55	0.60	0.71	0.79	0.64	0.61
40																																								1.00	0.67	0.61	0.62	0.49	0.61	0.60	0.60	0.66	0.77
41																																									1.00	0.75	0.55	0.65	0.62	0.55	0.76	0.60	0.67
42																																										1.00	0.54	0.73	0.66	0.65	0.75	0.75	0.64
43																																											1.00	0.51	0.64	0.59	0.54	0.60	0.60
44																																												1.00	0.48	0.56	0.52	0.68	0.65
45																																													1.00	0.62	0.71	0.63	0.63
46																																														1.00	0.70	0.65	0.60
47																																															1.00	0.63	0.70
48																																																1.00	0.74
49																																																	1.00

Using Cohen's descriptions of effect size, most correlations in Table 20 have a high effect size (i.e., 0.5 or greater). Small effect size correlations less than 0.5 are shaded light grey, correlations 0.5 to 0.75 have no shading, and dark grey shading is used for large effect size correlations above 0.75. This assists the eye in confirming the majority of correlations are medium to large.

Each correlation is based on the ranking of 64 items, and this relatively high number of individual observations leads to high levels of significance in the results. Based on the number of items, a correlation of 0.35 has p=0.0051. A p-value of 0.05 indicates a 5% probability the correlation is due to chance, and hence indicates a high confidence of a real effect. The largest correlation is 0.84 and this has a p value which is a very small value, approaching zero. This relatively high level of correlation within the sample shows there was a good degree of commonality in the views of the respondents. The task becomes one of differentiating between the sorts to provide a clearer explanation of differences within the views of the respondents where they exist.

Factor loadings show the strength of the relationship or the extent to which responses of an individual participant can be said to exemplify a viewpoint, or factor, and are expressed as correlation coefficients. A significant factor loading for the study was calculated. For the $p < 0.01$ significance level the equation[15] is:

$$r = 2.58 \times \frac{1}{\sqrt{n}}$$

Where:

$r = \mathit{the\ correlation\ coefficient}$
$n = \mathit{number\ of\ statements\ in\ the\ Q\ set}$

Factor loadings are shown in Table 21 and eight factors were identified. Shading highlights the significant sorts and boxes highlight confounded sorts, that is, where sorts load significantly on more than one factor.

With 64 items in the Q set and a p value of less than 0.01, the correlation coefficient needs to be greater than 0.323 to be significant. All 49 sorts had at least one correlation coefficient greater than 0.323. 41 of the sorts loaded significantly (highlighted with shading) for Factor

[15] In Q-methodology participants have to carry out a ranking of statements or items as part of the Q-sort. Ranking is like sampling without replacement, however for large samples as with the 64 statements in this study, the probabilities associated with sorts is very similar to sampling with replacement. All of the possible correlation coefficients in this study would form a near perfect normal distribution curve. With a normal distribution it is known that 99% of the area of a normal curve lies within ±2.58 standard errors of the mean. So any correlation coefficients outside of this area have a one percent chance of occurring randomly (Brown, 1980).

A. Eight sorts loaded significantly for more than one factor; for example, Sort 10 loaded significantly for both Factor A and Factor E (highlighted with boxes). In cases where sorts load significantly for more than one factor they are described as confounding and dismissed as defining sorts for a particular viewpoint or factor.

Table 21 - Unrotated factor matrix

	Factors								h^2 (%)
SORTS	A	B	C	D	E	F	G	H	
1	0.8202	-0.1936	-0.0760	-0.0584	-0.0192	-0.1947	0.0152	-0.1309	78
2	0.7757	-0.1371	0.3449	-0.0081	0.0699	-0.2138	0.0842	0.0324	80
3	0.7559	0.0689	-0.2262	-0.2837	0.2512	-0.1275	0.1350	-0.0085	81
4	0.8368	-0.2454	-0.0929	-0.0796	0.0187	0.0933	-0.1343	-0.1803	84
5	0.8470	-0.1188	-0.0489	-0.1619	-0.0883	0.0299	-0.2182	-0.1553	84
6	0.8391	0.0189	-0.0762	0.0959	0.2251	-0.1035	-0.0044	-0.1873	82
7	0.7447	-0.2804	-0.2143	-0.0148	-0.1884	0.1520	0.2317	-0.0745	80
8	0.8274	-0.0016	0.2747	-0.2638	-0.0062	0.0333	0.0091	0.0203	83
9	0.8542	-0.0574	0.2449	-0.1344	-0.0783	0.0627	0.0982	0.0160	83
10	0.7901	-0.0946	-0.1509	-0.1486	0.3472	0.0663	-0.1879	-0.0258	84
11	0.7164	0.0874	-0.1630	-0.1847	0.0552	0.0530	-0.2228	0.3853	79
12	0.8417	-0.0093	0.0127	-0.0006	0.0309	0.1116	-0.0791	-0.0651	73
13	0.8185	0.0719	-0.0014	0.1087	-0.1147	0.0011	-0.0744	0.1091	72
14	0.8332	-0.0670	0.3157	-0.0674	0.1237	-0.1034	-0.0531	0.0031	83
15	0.8264	0.0970	-0.2878	0.0210	-0.1537	-0.0219	-0.1383	-0.0106	82
16	0.8182	0.0201	0.0742	0.1802	-0.2292	0.0053	0.0464	-0.0358	76
17	0.8194	0.1893	0.1758	-0.0916	-0.0590	-0.0118	-0.1848	-0.0587	79
18	0.8369	0.2575	0.0385	-0.1311	0.0834	-0.0706	0.1909	-0.1993	87
19	0.8387	-0.1239	-0.0613	0.0286	-0.2624	-0.0213	0.1612	-0.0729	82
20	0.8268	-0.0259	-0.1635	-0.0858	-0.1185	0.0585	-0.0943	-0.0258	75
21	0.8398	0.2703	0.0917	-0.1417	-0.1807	0.1696	0.0478	-0.1650	90
22	0.8350	-0.0968	0.1910	-0.0623	0.1706	0.1897	0.1196	-0.0113	83
23	0.8756	0.1046	0.1292	-0.1276	-0.1254	-0.1160	-0.0816	-0.0030	85
24	0.8542	0.0283	-0.1649	0.1014	-0.1191	-0.0162	0.0645	0.2978	88
25	0.7934	0.0359	0.1799	0.3706	-0.1847	-0.1742	-0.1067	-0.0614	88
26	0.8907	-0.1080	-0.0594	-0.0861	-0.0464	-0.0585	-0.0187	0.0380	82
27	0.6786	-0.3496	0.2144	-0.1452	-0.1411	0.1451	-0.0366	0.0678	70
28	0.8443	-0.1502	-0.0536	0.0317	-0.1758	0.3025	-0.0082	-0.0230	86
29	0.6710	0.2503	-0.1854	-0.0619	0.0569	-0.0645	0.1573	0.1328	60
30	0.7990	0.2107	-0.0300	0.2996	-0.1944	0.0150	-0.0172	0.0168	81
31	0.8544	0.1561	-0.1216	-0.1045	-0.0181	-0.1634	-0.1317	0.0095	82
32	0.8562	0.1035	-0.2180	0.0280	-0.0760	-0.1254	0.0560	0.0963	83
33	0.7468	0.4115	-0.1822	0.0954	0.1032	0.0136	0.1710	-0.0342	81
34	0.8734	-0.0124	-0.0310	0.1489	0.1255	-0.0085	0.1318	0.0236	82
35	0.7721	0.2171	0.0092	0.2560	-0.1194	0.1099	-0.1566	-0.2500	82
36	0.7357	-0.1942	0.0103	0.0886	0.0011	-0.1410	0.3862	0.0019	76
37	0.8418	-0.1893	-0.0178	-0.0064	0.1360	0.0151	0.0465	0.0428	77
38	0.8246	0.2874	0.1125	-0.1959	0.0742	0.0926	-0.0232	-0.0675	83
39	0.8267	-0.1754	-0.0481	0.2237	0.1007	0.1111	0.0257	-0.0383	79
40	0.7817	0.1759	0.3191	0.2554	0.0588	-0.0517	-0.0269	0.2425	87
41	0.8220	-0.0333	-0.1345	0.1511	0.2057	-0.3057	-0.0109	-0.0833	86
42	0.8384	-0.1569	-0.1365	0.1047	0.0026	-0.1115	-0.1350	0.0659	79
43	0.7603	0.2398	0.0584	-0.0821	0.1212	0.3108	0.2069	-0.0127	80
44	0.7881	-0.0938	-0.1604	-0.3359	-0.2394	-0.2342	0.0138	0.0108	88
45	0.7687	0.1123	0.0081	0.0703	0.2259	0.2452	-0.1419	0.0519	74
46	0.7459	-0.1337	-0.1090	0.1685	0.0748	0.2772	0.1015	0.1685	74
47	0.7945	-0.2607	-0.0594	0.2883	0.3109	0.0143	-0.1213	-0.0781	90
48	0.8311	-0.0718	0.0769	-0.0542	-0.0569	-0.0113	-0.0088	0.2791	79
49	0.8331	-0.0138	0.3471	0.0098	0.0750	-0.1624	-0.0064	0.0297	85
Eigenvalues	32.1857	1.3962	1.3047	1.2067	1.0719	0.9368	0.7981	0.7441	
% variance explained	66	3	3	2	2	2	2	2	

It has been seen that there is relatively high correlation between individual sorts. Communality is a single measure of both how much each sort has in common with all the other sorts and the percentage of the variance in each participants' responses that is accounted for across all factors.

The equation for communality is:

$$h^2 = L_{F1}^2 + L_{F2}^2 + \cdots L_{Fn}^2$$

Where:

$h^2 = Communality$
$L_{Fn} = \ Loading\ on\ Factor\ n$
$h_{Sn}^2 = Communality\ of\ Q\ sort\ n$

The communality for Q sort 1 is 0.78 and suggests that 78% of the variance in that Q sort has been accounted for by the study factors. The percentage of study variance explained by each factor is described by the eigenvalue, which is the sum of the squares of the loadings of each of the Q-sorts on that factor (the values in each column), according to the following equation:

$$V_F = \ 100\ \times \frac{E_F}{n}$$

Where:

$V_F = \ Variance\ for\ \text{a}\ \text{factor}$
$E_F = eigenvalue\ for\ a\ factor$
$n = number\ of\ Q - sorts\ in\ the\ study$

Factor A has an eigenvalue of 32.19 and explains 66% of the study variance. The other seven factors each explain a further 2-3% of the study variance, 16% in total.

Applying a 0.32 significance loading factor to the correlation coefficients in Table 21, 41 loaded significantly and eight sorts confounded, as shown in Table 22.

Table 22 - Sorts that loaded significantly by factor (unrotated solution)

Loaded Significantly for….	Participant responses (Q-sorts):
Factor A	1, 2, 3, 4, 5, 6, 7, 8, 9, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 26, 28, 29, 30, 31, 32, 34, 35, 37, 38, 39, 40, 41, 42, 43, 45, 46, 47, 48
Confounded between Factors A and B	27, 33
Confounded between Factors A and C	49
Confounded between Factors A and D	25, 44
Confounded between Factors A and E	10
Confounded between Factors A and G	36
Confounded between Factors A and H	11
Non-significant	None

The solution in Table 22, with Factor A accounting for 66% of the total study variance, would ordinarily be considered a sound solution[16] based on common factors (Kline, 1994). However, it does raise issues for analysis. With 42 of the sorts loading significantly for only one factor the solution goes a long way to helping to understand the shared views of many of the participants, but it does little to tease out the nuances of difference. When confounding was taken into consideration, no sorts loaded significantly for Factors B, C, D, E, G and H, yet they do account for 16% of the study variance.

In a Q-sort, factors could be represented by axes. When comparing two factors the x axis could represent Factor B and the y axis Factor A. The sorts from a study could then be plotted against these factors using the correlation coefficients for each participant's Q-sort as the coordinates. Different solutions can be developed by rotating the axes.

Figure 48 is a correlation plot for all the sorts, and sorts 27 and 33 have been highlighted. The values on the x-axis show the strength of association of a sort with Factor B and the values on the y-axis the strength of association with Factor A. Q sort 27 has an association of 0.68 with Factor A and -0.35 with Factor B - these factor loadings have been used as coordinates to define and fix its position. Similarly, Q sort 33 has an association of 0.75 with Factor A and 0.41 with Factor B.

[16] Anything in the region of 35–40% or above

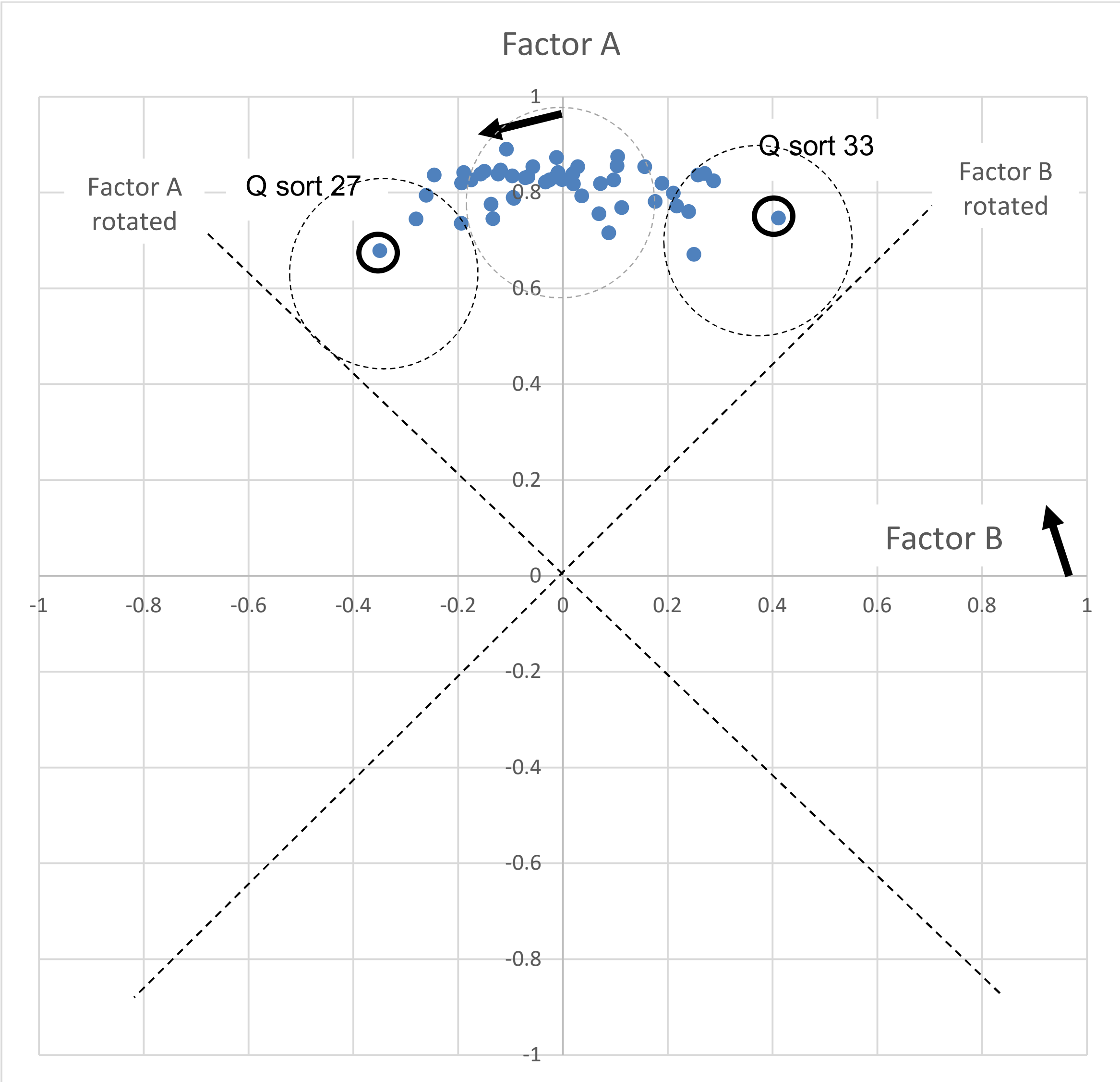

Figure 48 - Factor rotation

It can be seen that Q sort 33 shares much in common with Q sort 27 along the vertical dimension defined by Factor A, reflected by the small difference between the factor loadings of 0.68 and 0.75 of only 0.07. However, the difference between the factor loadings of −0.35 and 0.41 for Factor B are large at 0.76.

Q-methodology uses 'factor rotation' as a way of providing alternate views of the data that may provide better solutions for analysis. Figure 48 shows with dotted lines an anticlockwise rotated position for the two axes. As a result, it can be seen that there is now greater variability in association for all the sorts on both axes, rather than just the one axis of the unrotated solution. The rotation offers a better explanation of the differences between the Q-sorts.

By rotating the axes for the factors, the Q-sorts themselves do not change, but the position from which they are viewed changes. Before factor rotation the difference in association for Factor A of sort 27 and 33 was only 0.07, but this has increased with rotation to 0.40. The opposite has happened for Factor B, however, with a reduction in the original difference of 0.76 to 0.64. By observing the dotted circles, it can be seen that each of these Q-sorts also has a small cluster of other similar sorts which are more closely associated with one of the rotated factors than they were with the unrotated factors.

Varimax rotation follows Thurstone’s (1947) principle of simple structure and is the most common rotation method used in factor analysis. It has the effect of maximising the variance of each factor loading by making high loadings higher and low loadings lower, which helps to simplify factor interpretation. It achieves this by redistributing the total variance among sorts between a smaller number of factors with relatively equal variances. By this process, the amount of variation among the major unrotated factors is redistributed among the other smaller factors, thereby generating factors with relatively equal importance. Varimax rotation tends to eliminate a ‘general’ factor if one exists (Akhtar-Danesh, 2017).

The unrotated solution (Table 21) had one general factor that illustrated the commonality shared by the participants’ responses. Before settling on a final rotation to be used for analysis, four and six factor rotations were also carried out. Fewer sorts loaded significantly for single factors when four and six factor rotations were conducted, and so more of the participants’ responses had to be excluded due to confounding than with a five-factor rotation. The strategy employed in selecting how many factors to retain was to try to explain as much variance as possible with the fewest number of factors whilst maximizing the number of individual sorts, and so the five-factor result was accepted.

Figure 48 shows rotation of just two factors. Factor rotation in Q-methodology rotates multiple factors simultaneously to create a solution with the maximum difference between sorts for all factors. One accepted way of deciding how many factors to rotate is to see how many factors in the unrotated solution have an eigenvalue above one (Watts and Stenner, 2012). The rational for this is that the eigenvalue is indicative of a factor's statistical strength and explanatory power. A value of less than one would account for less study variance than a single Q sort and therefore not be useful. Table 21 shows that Factors A to E have eigenvalues above one, with Factor A accounting for 66% of the study variance and Factors B to E accounting for a further 10%. In the light of this, rotation was carried out on five factors and the result can be seen in Table 23: the shaded correlation coefficients represent sorts that loaded significantly on a particular factor, defined as having a factor loading in excess of the correlation coefficient of 0.51; the solid boxes indicate confounded sorts, where the same sort loaded significantly for more than one factor; the dotted boxes represent sorts that were not significant across all five factors, where a sort had no factor loadings above the correlation coefficient of 0.51.

Table 23 - Rotated factor matrix with defining sorts highlighted

	Factor Loadings					h² (%)
QSORT	1	2	3	4	5	
1	0.5354	0.3049	0.3478	0.2214	0.4124	72
2	0.2648	0.1830	0.6644	0.2636	0.3604	74
3	0.3503	0.6596	0.2483	0.0002	0.3890	77
4	0.5597	0.3030	0.3553	0.1763	0.4619	78
5	0.5716	0.3806	0.3995	0.2176	0.2991	77
6	0.2579	0.4572	0.3077	0.3131	0.5494	77
7	0.6755	0.1961	0.1829	0.2484	0.3532	71
8	0.3693	0.4019	0.6826	0.1766	0.1861	83
9	0.4216	0.3171	0.6342	0.2874	0.2323	82
10	0.3230	0.5147	0.3121	0.0177	0.5759	80
11	0.3794	0.5400	0.2395	0.1512	0.2623	58
12	0.3775	0.3967	0.3998	0.3262	0.3788	71
13	0.3813	0.3613	0.3281	0.4850	0.2848	70
14	0.2564	0.3042	0.6796	0.2444	0.3719	82
15	0.5282	0.5025	0.1125	0.4230	0.2758	80
16	0.4208	0.2425	0.3683	0.5733	0.2451	76
17	0.2878	0.4740	0.5246	0.3789	0.1541	75
18	0.2463	0.6272	0.4321	0.3085	0.2376	79
19	0.6151	0.2549	0.3201	0.4214	0.2624	79
20	0.5540	0.4321	0.2616	0.2993	0.2844	73
21	0.3729	0.5527	0.4613	0.4243	0.0452	84
22	0.2905	0.3379	0.5814	0.2056	0.4442	78
23	0.4208	0.4573	0.5258	0.3687	0.1667	83
24	0.4850	0.4063	0.2145	0.4641	0.3469	78
25	0.2797	0.1415	0.3927	0.6967	0.3110	83
26	0.5444	0.3927	0.3911	0.2747	0.3728	82
27	0.5306	0.0398	0.5571	0.1254	0.2459	67
28	0.5781	0.2596	0.3368	0.3803	0.3325	77
29	0.2496	0.5846	0.1488	0.2771	0.2268	55
30	0.3029	0.3554	0.2218	0.6953	0.2459	81
31	0.4123	0.5849	0.3027	0.325	0.2665	78
32	0.4673	0.5154	0.1871	0.4163	0.3249	80
33	0.1324	0.6748	0.1284	0.4598	0.2812	78
34	0.3122	0.3899	0.3425	0.4003	0.5243	80
35	0.2436	0.3712	0.2589	0.6275	0.2554	72
36	0.4082	0.1822	0.3409	0.2919	0.4309	59
37	0.4191	0.3190	0.4018	0.2088	0.5300	76
38	0.2230	0.6395	0.5027	0.2793	0.1723	82
39	0.3670	0.2299	0.3008	0.3842	0.5924	78
40	0.0524	0.2921	0.5382	0.5709	0.3298	81
41	0.2912	0.4072	0.2397	0.3290	0.5862	76
42	0.4875	0.2987	0.2574	0.3435	0.496	76
43	0.1755	0.5631	0.4041	0.2919	0.253	66
44	0.7107	0.4358	0.3156	0.1316	0.1179	83
45	0.1553	0.4673	0.3433	0.3083	0.4518	66
46	0.3628	0.2546	0.2225	0.3321	0.5136	62
47	0.2601	0.1928	0.2816	0.2957	0.7816	88
48	0.4443	0.3270	0.4639	0.3044	0.3095	71
49	0.2229	0.2847	0.6751	0.3428	0.3412	82
Eigenvalues	8.0442	8.2363	7.7892	6.3199	6.7752	
% of variance explained	16	17	16	13	14	

A correlation coefficient of 0.32 ($p < 0.01$) was used as the significant loading factor for the unrotated solution (Table 21). If this had been used for the rotated solution, there would have been a high number of confounded sorts (the first five sorts in Table 23 for example would have all confounded). Instead, a higher correlation coefficient of 0.51 was used, with therefore also a higher level of significance. This had the effect of including many more sorts in the final analysis as it ensured that fewer sorts were dismissed due to confounding with multiple factors.

Each factor defines between 13-17% of the study variance respectively and 76% in total. Although the percentage of variance per factor is more evenly spread than in the solution identified in Table 21, the total across five factors is the same. By contrast the communality per sort (h^2 column in Table 21 and Table 23) only changed a little (two thirds of the sorts changing by less than five percentage points), the difference due to the rotated solution being based on five sorts whereas the unrotated solution was based on eight sorts. Table 24 provides a summary.

Table 24 - Sorts that loaded significantly by factor (varimax rotated solution)

Loaded Significantly for….	Q-sorts:	Number of defining sorts
Viewpoint (Factor) 1	1, 4, 5, 7, 15, 19, 20, 26, 28, 44	10
Viewpoint (Factor) 2	3, 11, 18, 21, 29, 31, 32, 33, 38, 43	10
Viewpoint (Factor) 3	2, 8, 9, 14, 17, 22, 23, 49	8
Viewpoint (Factor) 4	16, 25, 30, 35	4
Viewpoint (Factor) 5	6, 34, 37, 39, 41, 46, 47	7
Confounded between Factors 1 and 3	27	
Confounded between Factors 1, 3 and 4	40	
Confounded between Factors 2 and 5	10	
Non-significant	12, 13, 24, 36, 42, 45, 48	

Table 25 shows the factor arrays for Factors 1 to 5. All of the items sorted by participants in the Q-sort are listed in rows and the Q-sort values (the position in the forced-choice distribution grid from -6 to +6) for each factor are list in the columns on the right.

Table 25 - Factor arrays

No.	Q-sort item/statement (abbreviated)	Factor Arrays F1	F2	F3	F4	F5
1	20mph maximum speed limits	4	5	1	1	2
2	Warning signs or road markings	0	1	1	1	2
3	Drivers who have read the Highway Code and passed a driving test	1	0	0	2	6
4	Laws regulating use such as the Highways Act (1980)/Road Traffic Act (1988)/Traffic Management Act (2004)	0	0	1	1	3
5	Local authority civil enforcement of bus lanes and parking restrictions and bus lanes	0	4	3	2	1
6	Police enforcement of speed limits, close passing of cyclists, drink driving, and other traffic offenses	3	3	3	0	3
7	Direct walking/cycling routes which avoid deviations, and are at least as direct as those for motorised traffic	6	4	3	6	1
8	Routes that are designed to minimise the need to slow, stop or wait	5	0	2	-5	2
9	Routes that are wide enough to accommodate the flow	5	3	5	5	5
10	Adequate geometry, visibility and space for cyclists to avoid running into the path of motor traffic or pedestrians	2	1	0	6	2
11	Physical separation between cyclists and motorised traffic and between pedestrians and cyclists	6	6	6	5	6
12	Route surfaces that are smooth	2	5	6	3	2
13	Roads that are designed for low traffic speeds	2	6	4	3	2
14	Routes that are overlooked (e.g. by the fronts of houses or shops)	0	1	0	-1	0
15	Street design that is attractive or interesting (e.g. plantings, architecture and artwork)	2	2	2	1	1
16	Contrast in the look of footways, cycle tracks, carriageways and changes in level, including colour contrast	1	2	2	0	3
17	Consistency of design approaches (e.g. along a street, within a town or nationally)	1	1	3	2	1
18	Zebra crossings at side roads (or parallel crossings if there is a cycle track)	2	1	2	4	4
19	Seating, both formal and informal (wall or planter with a wide rim)	0	3	1	0	0
20	Useable cycle parking facilities (e.g. Sheffield stand), suitable for different cycle types	2	2	2	2	3
21	Routes that provide some shelter and shade from wind, rain and sun	3	1	1	2	0
22	Routes are navigable	5	2	4	3	1
23	Routes that engage the senses: pleasant, localised smells, ambient noise, tactile	3	4	0	0	1
24	Cycle routes and adequately wide footways are provided around temporary works	4	2	4	4	4
25	Drivers and cyclists turning in or out of a side road stop for crossing pedestrians and cyclists	1	0	4	4	4
26	People who respect and have consideration for the safety and general well-being of other users of the street	4	4	5	3	5
27	Politicians (local and national) who create policies for walking and cycling and promote it as being a good thing	3	5	1	4	1
28	People who use and respect infrastructure that has been provided and use it as intended	1	2	1	1	4
29	Routes that are clean, cleared of leaves and rubbish and drains are kept unblocked	1	3	5	3	3
30	Clear and appropriate communication between drivers, cyclists and pedestrians	3	3	2	5	5
31	Other people that are doing the same as me (e.g., walking, cycling, or moving in the same direction)	4	0	0	1	0
32	Shops or businesses that are open and/or there is other activity on the street	1	1	3	1	0
33	“Cycling dismount” (or similarly constraining) signs	-1	0	0	0	0
34	Cycle tracks closed to wheelchairs or mobility scooters and other wheeled vehicles such as e-scooters	0	0	-2	-2	0
35	Lack of public information films and adverts to reinforce understanding of rules and good street behaviour	-1	-1	0	-2	-2
36	Each local authority has its own design guidance (no UK-wide walking and cycling standards)	0	-1	0	0	-2
37	Lack of enforcement by local and national government of air quality standards	-1	-6	-1	0	-1
38	Large gradients, slopes and cross falls	0	-2	-6	-4	-1
39	Steps	-1	0	-6	-3	-1
40	Lack of pavement	-5	-4	-5	-5	-4
41	Wide mouths to side road junctions	-1	-2	0	2	0
42	Incorrect or missing tactile paving	-1	-1	-3	-2	-2
43	Dropped kerbs that are missing or away from the desired	-3	-1	-5	-4	-1
44	Routes that are cluttered with street furniture that restricts or obstructs movement	-5	-3	-5	-1	-2
45	Routes that are poorly lit (not lit, too dim, lit in wrong places, places to hide in shadows, etc)	-4	-3	-3	-3	-4
46	Overhanging trees and branches or untrimmed hedges (and other head hazards)	-3	-4	-4	-1	-2
47	Routes that are poorly maintained (e.g. fading paint markings, roots and potholes)	-4	-6	-4	-4	-3
48	Route surfaces that are slippery, especially when wet or icy (and ungritted)	-4	-4	-3	-3	-2
49	Noise caused by others using the street (e.g. vehicle noise, shouting or using heavy machinery)	0	-1	-1	-1	0
50	Vehicle users disobeying speed limits or going too fast for the conditions	-6	-3	-2	-5	-5
51	Vehicle users who do not indicate a turn they are about to make	-2	-3	-1	-4	-4
52	Uninvited, unwelcome, inappropriate interaction with strangers	-3	0	-1	-3	-3
53	Blocking or restricting the width of pavements, cycle tracks, drop kerbs or other crossings	-5	-5	-4	-3	-3
54	Cycling on the pavement	-1	-3	-3	-1	-5
55	Cyclists or mobility scooter users who approach others assuming that pedestrians will move aside	-2	-1	-1	0	-4
56	Distracted people who do not look where they are going or are not aware of their surroundings	-2	-2	-2	0	-3
57	Drivers who splash users of footways or cycle tracks	-2	0	-2	-2	-1
58	Drivers who close pass cyclists or cyclists close passing pedestrians and other shared path users	-3	-5	-2	-6	-6
59	Drivers driving too fast or too close to pedestrians, especially when footways are narrow	-6	-2	-2	-6	-6
60	Approaching others (especially) from behind in (almost) silent vehicles without any audible warning	-2	-2	-3	-1	-5
61	Politicians (local and national) who stand up for parking and driving, supported by policies	0	-5	0	-2	0
62	Opening car doors without first checking that it is safe and convenient to do so	-3	-2	-1	-2	-3
63	Antisocial behaviour (e.g. dealing drugs, drunkenness)	-4	-1	-4	-1	-1
64	Too many people choosing to drive for the location	-2	-4	-1	0	-1

The table above contains the five model Q-sorts side by side which aids comparison. These each represent a viewpoint which will be described in turn in the next section and provides a useful reference point to return to.

5.4 Five viewpoints

The five factors and their defining sorts are now further explored and evaluated. Distinguishing characteristics and consensus statements have been used to determine the overall character of each viewpoint as suggested by Donner (2001, p34). Each factor has been given a summarising title by the author which seeks to provide a shorthand explanation of the type of statements associated with this viewpoint. Section 5.4.1 to 5.4.5 discuss each viewpoint in turn. The ensuing Section 5.5 discusses divergence and consensus that exist across the five factors.

The essence of the five factors, viewpoints 1-5, are summarised along with the titles that have been attributed to them in Table 26. The detail of each discourse (viewpoint) follows.

Table 26 - Viewpoints 1-5 summarised and compared

Eigenvalue and study variance	Description	Encouraged by	Discouraged by	View of streets	Exemplar participants
Viewpoint 1: We are the traffic 8.04 explains 16%	The viewpoint that walking, cycling and rolling is functional and a practical way of getting from A to B. They should be seen as traffic, with street networks designed for the movement of this traffic. These ways of getting around are part of people's identity. Street design is key to making routes more direct, safe, comfortable, coherent and attractive for those that travel this way. Excessive road speed and lack of separation discourages and threatens safety. Poor street design can stop some walking and rolling traffic. The bad behaviour of some makes streets unsafe, uncomfortable, and unattractive environments. Regulating lower speed limits and enforcing the rules would both be additional encouragements.	Functional street design and enforcement of regulations	Inconsiderate behaviour and poor design	Streets are places people pass along	N = 10 1, 4, 5, 7, 15, 19, 20, 26, 28, 44
Viewpoint 2: Safety and comfort first 8.24 explains 17%	The viewpoint that safety and comfort are more important than the ability to move quickly, and that the specific needs of older people (such as adequate seating and toilets) need to be catered for. Good place making design that recognises the need to rest and linger, supported by policy, regulation and enforcement will make streets safer, more comfortable, and attractive. However, a wide range of issues, from poor maintenance and air quality, to car-centric polices, can undermine street use. The corporate behaviour demonstrated by the priorities of local authorities, as well as the inconsiderate actions of drivers, cyclists, residents, businesses, and workers (both utilities and construction), all affect the street environment.	Safe street design backed by policy and regulation	Poor air quality & maintenance	Streets are places where some want to stop and linger	N = 10 3, 11, 18, 21, 29, 31, 32, 33, 38, 43
Viewpoint 3: Access is not optional 7.79, explains 16%	The viewpoint that street design will determine whether a street or route is useable by people, especially those that roll. If the design is accessible then streets can be open to all, but if it is not then many are deprived of access. The supportive behaviour of other street users also helps. For some, steps and missing dropped kerbs do not simply make a street environment unsafe, uncomfortable, or unattractive, they make routes unusable. The specific needs of people walking and rolling on pavements must be catered for.	Accessible street design and mutual respect	Inaccessible street design	Streets deny access to some	N = 8 2, 8, 9, 14, 17, 22, 23, 49
Viewpoint 4: Designed for all 6.32 explains 13%	The viewpoint that streets should have well-designed infrastructure that is safe and inviting with enough room so all can choose to walk, cycle or roll, supported by clear communication between different users. Dangerous behaviour creates streets that are unsafe, uncomfortable and unattractive. Infrastructure needs to be forgiving, accommodating different speeds and needs. Obstacles such as bollards need to be removed, the provision needs to be wide, obvious, and there needs to be clarity about its manner of use. While routes for people on foot and cycle must be direct, they do not need to be expressways.	Well-designed infrastructure and clear communication	Dangerous behaviour	Streets are attractive, diverse places where anyone can walk, cycle or roll	N = 4 16, 25, 30, 35
Viewpoint 5: Rules matter 6.78 explains 14%	The viewpoint that in order to make the current street environment function for everyone, users need to understand the rules, be considerate and take personal responsibility for the safety and comfort of others. Street users who can do the greatest harm have the greatest responsibility to reduce the danger or threat they may pose to people who walk, cycle or roll. Rule breaking and inconsiderate behaviour by drivers and riders is the biggest concern, particularly inappropriate speed and proximity. The law and regulation can be effective to moderate bad behaviour, aided by enforcement.	Laws, regulations, and consideration of others	Rule-breaking behaviour	Street rules prompt those that can harm most to take a greater share of responsibility for others	N = 7 6, 34, 37, 39, 41, 46, 47

All quotes in this section relating to the viewpoints, known as exemplar quotes, are from the Q-sort participants that represent that viewpoint (also known as exemplar participants who contributed the defining sorts) unless otherwise indicated. Adjacent to each of these exemplar quotes is a participant code in the form of Px, where x is a number between 1 and 49 to represent each of the 49 Q-sort participants. Defining sorts are those that loaded most on a particular factor and exemplar quotes illustrate why they might load heavily on that factor.

5.4.1 Viewpoint 1 - We are the traffic (explains 16% of variance)

Viewpoint 1, 'we are the traffic' is a shared perspective that street users who walk, cycle and roll comprise 'the traffic'. This viewpoint is in line with the Road Traffic Regulation Act 1984 (c.27) and the Traffic Management Act 2004 (c.18), in which cyclists and pedestrians are considered to be 'traffic', and duties to manage the road network include to secure the *"expeditious and safe movement for all traffic",* which applies equally to these non-motorised modes. Those that hold this viewpoint are determined that society more generally should view these ways of getting around in a similar way. They would like to see streets change so that more are encouraged to experience the benefits of walking, cycling, and rolling, and can feel comfortable, safe, and normal doing so. Streets should be designed to create networks that assume that walking, cycling, and rolling are the main ways of getting around.

"Nothing would actually stop me getting there on foot with a buggy because I am determined to do it. Sometimes that means I have to walk in the middle of road if needed." (P44)

This viewpoint sees walking, cycling, and rolling as ways of getting around that need to be considered seriously in street design and that good design is key to making street environments more conducive to these types of movement. Those who subscribe to this discourse perceive these modes as mass transit, because they see them as equally good ways of moving people in urban areas as public transport which is typically evoked by this term. For them there is encouragement in seeing other people walking, cycling, and rolling on the street, and perceive these ways of getting around as part of people's identity.

"Feeling that you are not on your own, being part of something that is normal and natural, would make me feel comfortable that it is a safe route to walk." (P5)

Those who most closely align to this discourse collectively fear that carriageway speed and lack of separation threatens safety, and that physical obstacles make some routes unusable. Their biggest concern is that the bad behaviour (for example, unthinking behaviour, without due concern for others using the street) of some street users makes street environments unsafe, uncomfortable, and unattractive for people walking, cycling or rolling. Additionally, they feel that poor street design makes some routes unusable for these people.

> *"It is so much easy being put off walking and cycling than being encouraged to do it. It is about feeling safe – or not feeling safe. The school run mums just feel that it is not safe to walk or cycle." (P20)*

> *"I have had aggressive drivers shouting at me even when I have my kid with me. Parking on pavements is normal and makes it unsafe." (P20)*

Figure 49 is the composite array from the defining Q-sorts that represent the 'we are the traffic' viewpoint. An array is the forced choice distribution grid used in Q-methodology, completed with the items or statements used in a study. The items represented by the numbers in the array and how this array compares with the composite arrays of the other four factors (viewpoints) can be seen in Table 25.

(most)	**Discourage people to walk, cycle or to use other non-car based methods of travel**				**(least)**	**(neutral)**	**(least)**	**Encourage people to walk, cycle or to use other non-car based methods of travel**				**(most)**
-6	**-5**	**-4**	**-3**	**-2**	**-1**	**0**	**+1**	**+2**	**+3**	**+4**	**+5**	**+6**
59	53	48	52	56	39	5	28	15	30	26	8	7
50	40	45	46	57	33	14	29	12	27	31	9	11
	44	63	62	64	35	4	32	18	6	24	22	
		47	58	51	37	2	16	10	21	1		
			43	60	54	19	17	20	23			
				55	41	34	3	13				
					42	38	25					
						36						
						49						
						61						

Key:
tipping point item
design
behaviour
regulation

Figure 49 - 'We are the traffic', composite array

As described in the methodology an innovation was applied in this study to reveal the relative roles of design, behaviour, and regulation for each viewpoint. This can be seen in the array above where Q-sort items have been categorised by the researcher. The importance of the role of design, behaviour and regulation is revealed by their positions in the grid, with the most important present at both ends of the grid, and the least important in the middle. The numbers in the array represent the items that were sorted in the Q-sort and can be seen in full in 9.2. It should be emphasised that this categorisation into design, behaviour and regulation is a post hoc filter applied to the results, and participants were not aware of these categories.

It can be seen that good street design encourages people to walk, cycle or roll, and bad behaviour of other road users discourages people. Poor street design can stop walking and rolling traffic by physically blocking it, or by making these street users feel too unsafe to try it. Regulating lower speed limits and generally enforcing the rules would be an additional encouragement (items 1 and 6 in the composite array above).

> *"It is actually easy to get to school and quicker to cycle, however, there is no dedicated cycle infrastructure and to be honest, at times it can be nerve racking." (P15)*

> *"Just talking to wheelchair users, I realised how rubbish many of the pavements are. It was a similar experience similar for me when pushing a buggy." (P15)*

The second innovation was to ask each participant to look at their Q-sort and ask themselves if any of the discouraging items would be enough to persuade them not to use a particular street or route to walk, cycle or roll. Similarly, they were asked if any of the encouraging items would be enough to persuade them to use a particular street or route if those items were present. If at least half of the participants defined an item as a 'tipping point', they are circled in Figure 49 and are shown in Table 27.

Table 27 - 'We are the traffic' tipping point items

If present would cause people to use/avoid the street or route	Item
Avoid	Streets or routes where drivers were driving too fast or too close to pedestrians, especially when the footways are narrow (59)
Use	Physical separation between cyclists and motorised traffic, and between pedestrians and cyclists (11)

> *"Physical separation is critical for the safety of people who are visually impaired. If you can't see you need a great deal of inner strength." (P5)*

It should be noted that the sample used is purposive, and not representative of the population. However, it is interesting to understand the composition of the participants that made up the defining sorts for Viewpoint 1, as shown in Table 28. The group included all participant categories except users of mobility devices.

Table 28 - 'We Are the traffic' participant profile

Number	Gender split	Mean age	Age range
n=10	7 female, 3 male	40	18-67

The items ranked at +6 or +5 (i.e., the most conducive) are as follows:

- Direct routes which for pedestrians avoid deviations, and for cyclists are at least as direct as those for motorised traffic (+6)
- Physical separation between cyclists and motorised traffic, and between pedestrians and cyclists *(e.g., by using kerbs, different levels or bollards)* (+6)
- Routes that are designed to minimise the need to slow, stop or wait *(e.g. they allow high walking or cycling speeds, with no or few crossing points and obstacles)* (+5)
- Routes that are wide enough to accommodate the flow: pedestrian routes that can accommodate double buggies and allow mobility scooters to pass, and cycle tracks that enable overtaking (+5)
- Routes are navigable because of clear wayfinding and direction signs or markings *(including guidance on pavement and track surfaces)* (+5)

The items ranked zero and with Z-scores closest to zero, i.e., they neither contribute nor detract, are as follows:

- Cycle tracks closed to wheelchairs or mobility scooters and other wheeled vehicles such as e-scooters (-0.079)
- Large gradients, slopes and cross falls (-0.141)
- Each local authority has its own design guidance *(no UK-wide walking and cycling standards)* (-0.187)
- Seating, both formal and informal *(e.g., bench or wall or planter with a wide rim)* (0.191)

The items ranked at -6 or -5 (i.e., the ones that most detract) are as follows:

- Drivers driving too fast or too close to pedestrians, especially when footways are narrow *(e.g., resulting in threat or perceived threat of being hit by a wing mirror)* (-6)
- Vehicle users disobeying speed limits or going too fast for the conditions (-6)
- Blocking or restricting the width of pavements, cycle tracks, drop kerbs or other crossings, or blocking the view of people with buggies, in mobility scooters, children, etc. *(with parking, waste bins, advertising A-frames, deliveries, scaffolding, temporary signs, hedges, etc.)* (-5)

- Lack of pavement (-5)
- Routes that are cluttered with street furniture that restricts or obstructs movement (guard rails, lighting columns, sign poles, litter bins, seats, unused telephone boxes, etc.) (-5)

5.4.2 Viewpoint 2 - Safety and comfort first (explains 17% of variance)

Viewpoint 2, 'safety and comfort first' is a shared perspective that safety and comfort are more important for people walking, rolling, and cycling, than the need to move quickly. Street users that express this viewpoint are sensitive to the specific needs of older people such as adequate seating and toilets. This group is convinced that good street design will make street environments safer, more comfortable, and attractive, but maintain that this needs to be supported by policy and regulation.

> *"You missed out toilets on the list (of items to sort). They are at least as important as seating for some groups. Covid-19 has demonstrated this even more with most toilets being closed which has meant that some people have not been able to get out." (P18)*

> *"My husband has Parkinson's disease. We walk every day, but as his balance is not very good, I have to hold his hand to walk alongside him. On bin day that is impossible and parking on the footway seriously hampers someone like my husband." (P43)*

This viewpoint sees that street environments are made unsafe, uncomfortable, and unattractive by a wide range of issues, from maintenance and air quality to inconsiderate behaviour and car-centric polices. For them, it is largely the behaviours demonstrated by the priorities of local authorities, as well as the inconsiderate actions of drivers, cyclists, residents, businesses, and workers (both utilities and construction), that make streets like this. This group see the unhealthy nature of streets as wide ranging, including the lack of enforcement of air quality standards.

> *"Finding solutions is likely to involve local if not national politics. Cars and air pollution are problems for pedestrians." (P33)*

Figure 50 is the composite array from the defining Q-sorts that represent 'safety and comfort first' and is best interpreted using Table 25.

(most)	Discourage people to walk, cycle or to use other non-car based methods of travel				(least)	(neutral)	(least)	Encourage people to walk, cycle or to use other non-car based methods of travel				(most)
-6	**-5**	**-4**	**-3**	**-2**	**-1**	**0**	**+1**	**+2**	**+3**	**+4**	**+5**	**+6**
47	53	46	54	41	42	25	10	15	9	7	12	13
37	61	40	45	56	49	4	32	28	30	26	27	11
	58	64	44	38	55	31	17	22	29	5	1	
		48	50	59	35	3	21	24	19	23		
			51	60	36	34	18	16	6			
				62	43	8	14	20				
					63	33	2					
						39						
						52						
						57						

Key: tipping point item; design; behaviour; regulation

Figure 50 - 'Safety and comfort first', composite array

'Safety and comfort first' see good street design intertwined with supporting policy and regulation that encourages people to walk, cycle or roll. Similarly, they feel that it is a mix of poor maintenance, unenforced air quality standards and the bad behaviour of other road users that discourages people. Generally, the role of politicians and policy makers is very important to this group.

> *"I am deterred (from cycling) when streets are poorly maintained as they are uncomfortable, slower and less safe." (P32)*

> *"I feel threatened - if traffic is too fast, close passing, car doors being opened suddenly, and drivers not indicating is a common experience when cycling around. Only last week someone cut across me without indicating and I had to take avoiding action." (P32)*

The two tipping point items identified in Figure 50 are listed in Table 29.

Table 29 - 'Safety and comfort first' tipping point items

If present would cause people to use/avoid the street or route	Item
Avoid	None
Use	Roads that are designed for low traffic speeds (13)
Use	Physical separation between cyclists and motorised traffic, and between pedestrians and cyclists (11)

> *"However, on the discouragement side it was about the things that deter me when walking. I was out with a companion yesterday and knew the proposed route had no pavements and a lot of traffic and so we avoided it." (P21)*

The participants that made up the defining sorts for 'safety and comfort first' shown in Table 30 were older walkers, people who were visually impaired and a parent of a child cyclist.

Table 30 - 'Safety and comfort first' participant profile

Number	Gender split	Mean age	Age range
n=10	2 female, 8 male	71	59-81

The items ranked at +6 or +5 (i.e., the most conducive) are as follows:

- Roads that are designed for low traffic speeds *(e.g., physical measures that make it difficult to drive fast, visual appearance that causes drivers to slow down)* (+6)
- Physical separation between cyclists and motorised traffic, and between pedestrians and cyclists *(e.g., by using kerbs, different levels, or bollards)* (+6)
- Route surfaces that are smooth (+5)
- Politicians (local and national) who create policies for walking and cycling, and who publicly support, and promote it *(e.g., by allocating more space and resources)* (+5)
- 20mph maximum speed limits (+5)

The items ranked zero and with Z-scores closest to zero, i.e., they neither contribute nor detract, are as follows:

- Cycle tracks closed to wheelchairs or mobility scooters and other wheeled vehicles such as e-scooters (-0.144)
- Drivers have read the Highway Code and passed a driving test (0.182)
- Other people that are doing the same as me (e.g., walking, cycling, or moving in the same direction) (0.196)
- Routes that are designed to minimise the need to slow, stop or wait *(e.g., they allow high walking or cycling speeds, and no or few crossing points and obstacles)* (-0.228)

The items ranked at -6 or -5 (i.e., the ones that most detract) are as follows:

- Routes that are poorly maintained *(e.g., fading paint markings, roots and potholes)* (-6)
- Lack of enforcement by local and national government of air quality standards (-6)
- Blocking or restricting the width of pavements, cycle tracks, drop kerbs or other crossings, or blocking the view of people with buggies, in mobility scooters, children, etc. *(with parking, waste bins, advertising A-frames, deliveries, scaffolding, temporary signs, hedges, etc.)* (-5)
- Politicians *(local and national)* who stand up for parking and driving, supported by policies *(e.g., allocating or protecting space and resources)* (-5)

- Drivers who close pass cyclists or cyclists close passing pedestrians and other shared path users (-5)

5.4.3 Viewpoint 3 - Access is not optional (explains 16% of variance)

Viewpoint 3 is a shared perspective that ‘access is not optional’. Street users that expressed this viewpoint had discovered that streets contain no-go areas for many, especially those who would like to roll. They are convinced that street design will determine whether or not a street or route is useable by people rolling. If the design is appropriate then streets can be open to all, if it is inappropriate then many are deprived of access.

“Wheels are the game changer. Rough ground or steps means I cannot use a route. Smooth routes are critical to me.” (P49)

This viewpoint sees that poor design can make routes unusable for some, but good design will make street environments more conducive, backed up by the supportive behaviour of others. For some, steps and missing dropped kerbs do not simply make a street environment unsafe, uncomfortable, or unattractive for people rolling, cycling, or walking, they make routes unusable. This group were particularly concerned about the needs of people walking and rolling on pavements.

“My difficulty is steps if they are not clearly marked with contrast.” (P22)

“Shared space with cyclists is particularly scary. I hate the bit of cycle track on the pavements leading up to the former Colston Hall. You start on the pavement, have to cross the cycle track and then you are back on the pavement and cyclists speed down there. I don’t know how accidents don’t happen. I don’t have a guide dog, but how would they know where the cycle tracks are?” (P22)

Figure 51 is the composite array from the defining Q-sorts that represent ‘access is not optional’ and is best interpreted using Table 25.

(most)	Discourage people to walk, cycle or to use other non-car based methods of travel				(least)	(neutral)	(least)	Encourage people to walk, cycle or to use other non-car based methods of travel				(most)
-6	-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	+6
39	44	46	48	59	55	3	28	18	17	24	29	12
38	40	53	54	56	52	10	27	15	5	22	9	11
	43	47	45	34	51	23	1	20	6	25	26	
		63	42	50	62	14	2	30	32	13		
			60	58	64	31	19	8	7			
				57	49	33	4	16				
					37	41	21					
						61						
						36						
						35						

Key: tipping point item; design; behaviour; regulation

Figure 51 - 'Access is not optional', composite array

Good design is very prominent for this viewpoint. Good street design encourages people to walk, cycle or roll and bad design strongly discourages use, or even makes routes unusable. The good behaviour of other road users is also an encouragement, but for this viewpoint regulation has little relevance in practice unless it is well enforced.

"For me in a wheelchair I cannot do any steps at all. A lot of people with other impairments can also struggle using steps." (P17)

"If antisocial behaviour for example was evident on a particular street, I would certainly avoid it." (P2)

The 'tipping point' items that if present would cause a person to use or avoid a particular street or route are circled in Figure 51, where at least half of the participants that define 'access is not optional' agree. They are shown in Table 31.

Table 31 - 'Access is not optional' tipping point items

If present would cause people to use/avoid the street or route	Item
Avoid	Steps (39)
Use	Route surfaces that are smooth (12)
Use	Physical separation between cyclists and motorised traffic, and between pedestrians and cyclists (11)
Use	Routes that are clean, cleared of leaves and rubbish and drains that are kept unblocked (29)

"Hills are not possible for a manual wheelchair user. It is different if I am using an electric chair, in which case hills are not such an issue." (P14)

The participants that made up the defining sorts for 'access is not optional' are shown in Table 32 and included five of the six participant categories (all except parent of a child cyclist).

Table 32 - 'Access is not optional' participant profile

Number	Gender split	Mean age	Age range
n=8	3 female, 5 male	55	22-74

The items ranked at +6 or +5 (i.e., the most conducive) are as follows:

- Route surfaces that are smooth (+6)
- Physical separation between cyclists and motorised traffic, and between pedestrians and cyclists *(e.g., by using kerbs, different levels or bollards)* (+6)
- Routes that are clean, cleared of leaves and rubbish and drains that are kept unblocked (+5)
- Routes that are wide enough to accommodate the flow: pedestrian routes that can accommodate double buggies and allow mobility scooters to pass, and cycle tracks that enable overtaking (+5)
- People respect and have consideration for the safety and general well-being of other users of the street (+5)

The items ranked zero and with Z-scores closest to zero, i.e., they neither contribute nor detract, are as follows:

- "Cycling dismount" *(or similarly constraining)* signs (-0.021)
- Wide mouths to side road junctions (-0.068)
- Politicians *(local and national)* who stand up for parking and driving, supported by policies *(e.g., allocating or protecting space and resources)* (-0.117)
- Other people that are doing the same as me *(e.g., walking, cycling, or moving in the same direction)* (0.204)

The items ranked at -6 or -5 (i.e., the ones that most detract) are as follows:

- Steps (-6)
- Large gradients, slopes, and cross falls (-6)
- Routes that are cluttered with street furniture that restricts or obstructs movement *(guard rails, lighting columns, sign poles, litter bins, seats, unused telephone boxes, etc.)* (-5)
- Lack of pavements (-5)
- Dropped kerbs that are missing or away from the desired crossing point (-5)

5.4.4 Viewpoint 4 - Designed for all (explains 13% of variance)

Viewpoint 4, 'designed for all', is a shared perspective that street design should be safe and inviting with enough room for all who choose to walk, cycle or roll. People that expressed this viewpoint are encouraged by well-designed infrastructure that helps to create street environments that are conducive to all, supported by clear communication between different users. The nature of both the walking and cycling environments are important, but their needs are clearly different.

"Important to change people's views and attitudes to walking and cycling. I have visited Amsterdam that has a lot of really good cycling infrastructure – it is a much safer system, but still not everyone is considerate." (P25)

This viewpoint sees that drivers and riders behaving dangerously make street environments that are unsafe, uncomfortable, and unattractive. It is more important to this viewpoint that street environments for people on foot or cycle both feel safe, and are safe, than the need to get around quickly. They feel that cycle infrastructure needs to be forgiving, accommodating different speeds and needs, from children to commuters and fit sports cyclists. Obstacles such as bollards need to be removed, the provision needs to be wide, obvious, and its manner of use needs to be clear. While routes for people on foot and cycle must be direct, they do not need to be expressways.

"As a young woman, female safety is the most important thing. I consider where it would be safe to walk. Things like poor lighting would make me avoid a certain route or street." (P16)

Figure 52 is the composite array from the defining Q-sorts that represent 'designed for all' and is best interpreted using Table 25.

(most)	Discourage people to walk, cycle or to use other non-car based methods of travel				(least)	(neutral)	(least)	Encourage people to walk, cycle or to use other non-car based methods of travel				(most)
-6	-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	+6
58	50	43	39	61	49	23	31	17	26	25	11	7
59	40	51	48	57	44	6	1	20	13	24	30	10
	8	47	52	62	60	19	32	5	29	18	9	
		38	45	42	63	36	15	3	22	27		
			53	35	14	55	28	21	12			
				34	46	16	2	41				
					54	37	4					
						33						
						56						
						64						

Key: tipping point item; design; behaviour; regulation

Figure 52 - 'Designed for All', composite array

The relative roles of design, behaviour, and regulation for 'designed for all' can be seen in the array. For 'designed for all', well-designed street infrastructure, supported by the good behaviour of other street users encourages people to walk, cycle or roll. The dangerous behaviour of other road users discourages people, undermined further by poor quality street design. For this viewpoint regulation has little importance.

> *"I feel really safe when a road has been divided with specific sections for pedestrians, cyclists and cars and it is clear to everyone where they should be, and cars are not going too fast." (P30)*

The 'tipping point' items that if present would cause a person to use or avoid a particular street or route are circled in Figure 52, where at least half of the participants that define 'designed for all' agree. This viewpoint agrees that many people can easily be discouraged from walking, cycling or rolling and that they require a lot of things to be in place before they will choose to use a particular street or route. The items are shown in Table 33.

Table 33 - 'Designed for all' tipping point items

If present would cause people to use/avoid the street or route	Item
Avoid	Drivers who close pass cyclists or cyclists close passing pedestrians and other shared path users (58)
Avoid	Drivers driving too fast or too close to pedestrians, especially when footways are narrow (59)
Avoid	Vehicle users disobeying speed limits or going too fast for the conditions (50)
Avoid	Lack of pavement (40)
Avoid	Dropped kerbs that are missing or away from the desired crossing point (43)
Avoid	Large gradients, slopes and cross falls (38)
Avoid	Uninvited, unwelcome, inappropriate interaction with strangers (52)
Use	Direct routes which for pedestrians avoid deviations, and for cyclists are at least as direct as those for motorised traffic (7)
Use	Adequate geometry, visibility and space for cyclists to avoid running into the path of motor traffic or pedestrians, allowing for errors and evasive manoeuvres (10)
Use	Physical separation between cyclists and motorised traffic, and between pedestrians and cyclists (11)
Use	Clear and appropriate communication between drivers, cyclists and pedestrians to give priority, to let people know they are there, or that they have seen other road users (30)
Use	Routes that are wide enough to accommodate the flow: pedestrian routes that can accommodate double buggies and allow mobility scooters to pass, and cycle tracks that enable overtaking (9)
Use	Politicians who create policies for walking and cycling, and who publicly support, and promote it (27)
Use	Roads that are designed for low traffic speeds (13)

The list of items that would either cause people that associate with this viewpoint to avoid or to use a particular street or route is much longer than for the other viewpoints. It suggests that many are easily discouraged and may indicate the scale of the task to make these modes an obvious choice for most people. This will be discussed further in the next chapter.

"Pedestrians are forced to cross the cycle path and there is no indication of how to do it. The same issue faces cyclists who have to cross the path of pedestrians. The issue of the flows of pedestrians and the flows of cyclists is chaos." (P35)

"Worth considering when planning that many people now use double buggies, so pavements need to be designed to be wider to accommodate this." (P25)

The participants that made up the defining sorts for 'designed for all' shown in Table 34 were both younger and older and included carers that push buggies or had a child that cycles.

Table 34 - 'Designed for all' participant profile

Number	Gender split	Mean age	Age range
n=4	3 female, 1 male	40	18-77

The items ranked at +6 or +5 (i.e., the most conducive) are as follows:

- Direct routes which for pedestrians avoid deviations, and for cyclists are at least as direct as those for motorised traffic (+6)
- Adequate geometry, visibility, and space for cyclists to avoid running into the path of motor traffic or pedestrians, allowing for errors and evasive manoeuvres (+6)
- Physical separation between cyclists and motorised traffic, and between pedestrians and cyclists *(e.g., by using kerbs, different levels, or bollards)* (+5)
- Clear and appropriate communication between drivers, cyclists and pedestrians to give priority, to let people know they are there, or that they have seen other road users *(e.g., verbally, using bell or hands, or making eye contact)* (+5)
- Routes that are wide enough to accommodate the flow: pedestrian routes that can accommodate double buggies and allow mobility scooters to pass, and cycle tracks that enable overtaking (+5)

The items ranked zero and with Z-scores closest to zero, i.e., they neither contribute nor detract, are as follows:

- Each local authority has its own design guidance *(no UK-wide walking and cycling standards)* (0.080)
- Cyclists or mobility scooter users who approach other users assuming that they will move aside (-0.177)
- Contrast in the look of footways, cycle tracks, carriageways, and changes in level, including colour contrast (-0.179)
- Lack of enforcement by local and national government of air quality (-0.181)

The items ranked at -6 or -5 (i.e., the ones that most detract) are as follows:

- Drivers who close pass cyclists or cyclists close passing pedestrians and other shared path users (-6)
- Drivers driving too fast or too close to pedestrians, especially when footways are narrow *(e.g., resulting in threat or perceived threat of being hit by a wing mirror)* (-6)
- Vehicle users disobeying speed limits or going too fast for the conditions (-5)
- Lack of pavement (-5)
- Routes that are designed to minimise the need to slow, stop or wait *(e.g., they allow high walking or cycling speeds, with no or few crossing points and obstacles)* (-5)

5.4.5 Viewpoint 5 - Rules matter (explains 14% of variance)

Viewpoint 5, 'rules matter' is a shared perspective that in order to make the current street environment function for everyone rules and laws are needed, which help generate appropriate behaviour. People that expressed this viewpoint agree that if street users understand the regulations, are considerate and take personal responsibility for the safety and comfort of others, within the bounds of the established rules, then street environments can be created that are conducive.

> *"I'm a retired solicitor and so regulation and safety were quite important to me. Now that I am older, and largely a pedestrian I feel increasingly vulnerable." (P47)*

Street users who can do the greatest harm have the greatest responsibility to reduce the danger or threat they may pose to others. Rule breaking and inconsiderate behaviour of drivers and riders is the biggest threat to street environments that are safe, comfortable, and attractive for people walking, cycling, or rolling. Inappropriate speed and proximity between street users are a particular concern. The viewpoint places a lot of weight on the law and regulation to moderate bad behaviour, aided by enforcement.

> *"I enjoy my cycling and so I will choose routes that feel safe and make for a pleasant ride. I live local to the Gloucester Road, which has the potential to be a good and useful route, but it gets very crowded depending on the time of day. Once it gets past eight-thirty it is a very busy street. If I know that people will be going into work or rushing to take the kids to school, I will avoid it and find another route." (P34)*

> *"Mutual respect between road users is important. They each have a responsibility to look out for their own safety and the safety of others on the street. However, one key difference is that drivers must realise the additional responsibility that comes with a licence to drive a motor car at high speed, that is a lethal weapon. Driving is a skill and a privilege really." (KI6)*

Figure 53 is the composite array from the defining Q-sorts that represent 'rules matter' and is best interpreted using Table 25.

(most)	**Discourage people to walk, cycle or to use other non-car based methods of travel**			**(least)**	**(neutral)**	**(least)**	**Encourage people to walk, cycle or to use other non-car based methods of travel**				**(most)**
-6	**-5**	**-4**	**-3**	**-2**	**-1**	**0**	**+1**	**+2**	**+3**	**+4**	**+5**	**+6**
59	60	55	52	35	63	21	27	13	4	25	30	11
58	50	40	53	42	37	32	5	1	16	18	9	3
	54	51	56	44	57	31	17	2	29	24	26	
		45	62	46	43	19	7	12	6	28		
			47	36	64	33	22	10	20			
				48	39	41	15	8				
					38	34	23					
						14						
						61						
						49						

Key: tipping point item; design; behaviour; regulation

Figure 53 - 'Rules matter', composite array

The relative roles of design, behaviour, and regulation can be seen in the array. A mixture of drivers knowing the rules, good street design, and the good behaviour of other street users will encourage people to walk, cycle or roll. The rule-breaking and inconsiderate behaviour of other road users strongly discourages, undermined further by missing street infrastructure such as pavements and adequate lighting.

“Streets where I have experienced uninvited interaction with strangers, I find quite scary. So even in broad daylight I feel a little of nervous and avoid them. So, I get a bus or drive instead of walking or cycling.” (p39)

“Bad negative experiences on streets are scary. Routes that I avoid are due to bad experiences that I have had on those routes.” (P46)

The ‘tipping point’ items that if present would cause a person to use or avoid a particular street or route are circled in Figure 53, where at least half of the participants that define ’rules matter’ agree. These items are listed in Table 35.

Table 35 - ‘Rules matter’ tipping point items

If present would cause people to use/avoid the street or route	Item
Avoid	Drivers driving too fast or too close to pedestrians, especially when footways are narrow (59)
Avoid	Drivers who close pass cyclists or cyclists close passing pedestrians and other shared path users (58)
Use	Physical separation between cyclists and motorised traffic, and between pedestrians and cyclists (11)

“Thinking as a cyclist, also as a pedestrian. It feels dangerous when things that are bigger than you plough past or near, it’s the scariness.” (P41)

“Where my daughter lives the cycle and pedestrian routes are wide and largely away from the roads. They are clean and clear of rubbish and generally feel safe. People chat to you, cyclists call and say thanks, people are sociable.” (P37)

The participants that made up the defining sorts for ’rules matter’ are shown in Table 36. They were both younger and older and included people who were visually impaired or used a mobility devise.

Table 36 - ‘Rules matter’ participant profile

Number	Gender split	Mean age	Age range
n=7	4 female, 3 male	55	18-73

The items ranked at +6 or +5 (i.e., the most conducive) are as follows:

- Physical separation between cyclists and motorised traffic, and between pedestrians and cyclists *(e.g. by using kerbs, different levels or bollards)* (+6)
- Drivers have read the Highway Code and passed a driving test (+6)
- Clear and appropriate communication between drivers, cyclists and pedestrians to give priority, to let people know they are there, or that they have seen other road users *(e.g., verbally, using bell or hands, or making eye contact)* (+5)
- Routes that are wide enough to accommodate the flow: pedestrian routes that can accommodate double buggies and allow mobility scooters to pass, and cycle tracks that enable overtaking (+5)
- People who respect and have consideration for the safety and general well-being of other users of the street (+5)

> *"When cars are turning into a side road it always helps if they indicate. When crossing side roads I feel safe when there is communication from drivers, either verbally with their window open, or using hand signals. At some side roads it is not clear who has the right of way." (FG5)*

The items ranked zero and with Z-scores closest to zero, i.e., they neither contribute nor detract, are as follows:

- Routes that are overlooked *(e.g., by the fronts of houses or shops)* (0.043)
- Politicians (local and national) who stand up for parking and driving, supported by policies *(e.g., allocating or protecting space and resources)* (-0.079)
- Cycle tracks closed to wheelchairs or mobility scooters and other wheeled vehicles such as e-scooters (0.164)
- Noise caused by others using the street *(e.g., vehicle noise, shouting or using heavy machinery*) (-0.212)

The items ranked at -6 or -5 (i.e., the ones that most detract) are as follows:

- Drivers driving too fast or too close to pedestrians, especially when footways are narrow *(e.g., resulting in threat or perceived threat of being hit by a wing mirror)* (-6)
- Drivers who close pass cyclists or cyclists close passing pedestrians and other shared path users (-6)
- Approaching others (especially) from behind in (almost) silent vehicles (electric cars, cycles or mobility scooters) without any audible warning (-5)
- Vehicle users disobeying speed limits or going too fast for the conditions (-5)
- Cycling on the pavement (-5)

Now that each viewpoint has been fully explored, the inter-relationships between them is discussed in Section 5.5.

5.5 Divergent, convergent, and interrelated views

This section presents firstly the divergence between the viewpoints in Section 5.5.1. Although each one of the viewpoints illustrates a distinct perspective there is also a clear consensus between them, and this is presented in Section 5.5.2. The interactions between design, behaviour, and regulations as revealed by the five viewpoints are explored in Section 5.5.3.

5.5.1 Divergence between the viewpoints

Each of the viewpoints featured distinguishing items that were ranked significantly differently from the other discourses, demonstrating points of strong divergence. Table 37 lists the items that distinguished each viewpoint from the other viewpoints, ranking them higher, lower or as neutral.

Table 37 - Distinguishing items by viewpoint

Viewpoint	Q-sort item	Significance	Q-SV	Ranked
We are traffic	Routes that are designed to minimise the need to slow, stop or wait (e.g., they allow high walking or cycling speeds, and no or few crossing points and obstacles)	$p < 0.01$	+5	higher
	Other people that are doing the same as me (e.g., walking, cycling, or moving in the same direction)	$p < 0.05$	+4	higher
Safety and comfort first	Roads that are designed for low traffic speeds (e.g. physical measures that make it difficult to drive fast, visual appearance that causes drivers to slow down)	$p < 0.05$	+6	higher
	Seating, both formal and informal (e.g., bench or wall or planter with a wide rim)	$p < 0.05$	+3	higher
	Routes that are designed to minimise the need to slow, stop or wait (e.g., they allow high walking or cycling speeds, and no or few crossing points and obstacles)	$p < 0.01$	0	neutral
	Lack of enforcement by local and national government of air quality standards	$p < 0.01$	-6	lower
Access is not optional	Steps	$p < 0.01$	-6	lower
Designed for all	Adequate geometry, visibility, and space for cyclists to avoid running into the path of motor traffic or pedestrians, allowing for errors and evasive manoeuvres	$p < 0.01$	+6	higher
	Police enforcement of speed limits, close passing of cyclists, drink driving, using a mobile phone while driving, cycling on the pavement, pavement parking, and other traffic offences	$p < 0.05$	0	neutral
	Contrast in the look of footways, cycle tracks, carriageways, and changes in level, including colour contrast	$p < 0.01$	0	neutral
	Routes that are designed to minimise the need to slow, stop or wait (e.g. they allow high walking or cycling speeds, and no or few crossing points and obstacles)	$p < 0.01$	-5	lower
Rules matter	Drivers have read the Highway Code and passed a driving test	$p < 0.01$	+6	higher
	Laws regulating use such as the Highways Act (1980)/Road Traffic Act (1988)/Traffic Management Act (2004)	$p < 0.05$	+3	higher
	Approaching others (especially) from behind in (almost) silent vehicles (electric cars, cycles or mobility scooters) without any audible warning	$p < 0.01$	-5	lower
	Cyclists or mobility scooter users who approach other users assuming that they will move aside	$p < 0.01$	-4	lower

Q-SV is Q-sort value.

The divergence between the viewpoints can be summarised in their view of streets for people who walk, cycle or roll. ‘We are the traffic’ viewed streets as places people pass along and so facilitating this by enabling high walking or cycling speeds, with no or few crossing points and obstacles, is very important. By contrast ‘safety and comfort first’ were neutral about this and ‘designed for all’ saw this as a discouraging thing. The first viewpoint was also encouraged by being part of a critical mass of people walking and cycling, something the other viewpoints did not emphasise.

‘Safety and comfort first’ viewed streets as places where some want to stop and linger and felt that streets were safer and more comfortable for when they were designed for low traffic speeds, with amenities such as seating. At the same time, they were disquieted by the lack of enforcement of air quality standards.

‘Access is not optional’ viewed streets as places that deny access to some and so the presence of any steps was seen as an absolute barrier to access, whereas the other viewpoints did not view steps in the same way:

> *“Steps are fine when walking, but not when cycling.” (P46)*

> *“Steps as are the most economical way of getting from A to B in hilly places. Those old steps of 300 years ago are beautiful.” (P43)*

‘Designed for all’ desired streets as attractive, diverse places where anyone can walk, cycle or roll and so unlike the other viewpoints saw the need for forgiving, accommodating design with adequate geometry, visibility, and space for cyclists, allowing for errors and evasive manoeuvres. Unlike the other viewpoints they were ambivalent about the police enforcing rules and design features such as contrast and changes in level.

‘Rules matter’ viewed street rules as having a pivotal role in prompting those that can harm most to take a greater share of responsibility for others, something that has since been enshrined in a new section about the ‘hierarchy of road users’ in an update of the Highway Code (Department for Transport, 2022). This viewpoint places more emphasis on drivers’ comprehension of the Highway Code and the presence of laws regulating the use of streets that the other discourses. Additionally, ‘rules matter’ were troubled by the lack of clear rules for street interactions with almost silent vehicles or with cyclists or mobility scooter users who approach other users assuming that they will move aside.

5.5.2 Consensus between the participants

Table 38 lists the consensus statements in abbreviated form (for the full statements see Appendix B: Q-sort items). Consensus statements are the ones that show no significant difference in the way that the exemplar participants for the five viewpoints sorted them.

Table 38 - Consensus statements across the five viewpoints

		Factors									
		1		2		3		4		5	
Statement		Q-SV	Z score	Q-SV	Z-SCR	Q-SV	Z-SCR	Q-SV	Z-SCR	Q-SV	Z-SCR
2	Warning signs or road	0	0.24	1	0.41	1	0.64	1	0.4	2	0.79
9	Routes that are wide.	5	1.38	3	1.17	5	1.71	5	1.53	5	1.40
11*	**Physical separation…**	**6**	1.74	**6**	1.73	**6**	1.75	**5**	1.65	**6**	1.84
15	Street design that	2	0.91	2	0.95	2	0.87	1	0.48	1	0.42
17	Consistency of design	1	0.46	1	0.61	3	0.97	2	0.80	1	0.55
20*	**Useable cycle parking**	**2**	0.84	**2**	0.71	**2**	0.81	**2**	0.71	**3**	0.96
21	Routes that provide…	3	0.96	1	0.57	1	0.49	2	0.59	0	0.34
24*	**Cycle routes and…**	**4**	1.21	**2**	0.82	**4**	1.06	**4**	1.36	**4**	1.22
26*	**People who respect…**	**4**	1.31	**4**	1.26	**5**	1.10	**3**	1.29	**5**	1.39
28	People who use and...	1	0.80	2	0.93	1	0.69	1	0.44	4	1.21
32	Shops or businesses…	1	0.73	1	0.62	3	0.93	1	0.50	0	0.31
35	Lack of public info. …	-1	-0.59	-1	-0.67	0	-0.30	-2	-0.61	-2	-0.95
40*	**Lack of pavement.**	**-5**	-1.40	**-4**	-1.22	**-5**	-1.63	**-5**	-1.50	**-4**	-1.29
42*	**Incorrect or missing…**	**-1**	-0.52	**-1**	-0.79	**-3**	-0.96	**-2**	-0.75	**-2**	-0.95
45*	**Routes that are poorly**	**-4**	-1.34	**-3**	-1.12	**-3**	-0.99	**-3**	-0.93	**-4**	-1.20
48	Route surfaces that…	-4	-1.34	-4	-1.17	-3	-1.11	-3	-0.94	-2	-0.76
49	Noise caused by…	0	-0.40	-1	-0.75	-1	-0.43	-1	-0.55	0	-0.21
51	Vehicle users who…	-2	-0.71	-3	-0.98	-1	-0.65	-4	-1.31	-4	-1.23
53	Blocking or restricting	-5	-1.46	-5	-1.49	-4	-1.38	-3	-0.93	-3	-1.07
56	Distracted people…	-2	-0.95	-2	-0.91	-2	-0.77	0	-0.36	-3	-1.06
57	Drivers who splash…	-2	-0.87	0	-0.44	-2	-0.69	-2	-0.79	-1	-0.64
62	Opening car doors…	-3	-1.11	-2	-0.81	-1	-0.56	-2	-0.79	-3	-0.99

All statements are non-significant at P>.01, and those marked with an * are also non-significant at P>.05. Q-SV = Q-sort value; Z-SCR = Z-score

The items participants agree on are the ones that most contribute to street environments that are conducive to people walking, cycling, or rolling:

- Physical separation between cyclists and motorised traffic, and between pedestrians and cyclists (+6, except Factor 4, +5)
- Routes that are wide enough to accommodate the flow (+5, except Factor 2, +3)
- People who respect and have consideration for the safety and general well-being of other users of the street (+5, Factors 3 and 5; +4, Factors 1 and 2; +3, Factor 4)

- Cycle routes and adequately wide footways including dropped kerbs around temporary works that minimise diversions and do not restrict free movement (+4, except Factor 2, +2)

> *"I have three children that cycle. As a parent letting my children cycle, safety is my main concern and things that made it feel easy for children to understand their environment while cycling. From my experience of cycling, I tend to feel safer on a separated route, that is clear, and you don't need to stop to know where to go." (P24 – non-significant for a particular factor)*

> *"Respect as well was important – some infrastructure, like tactile paving, is for a particular user group and people should respect that." (P17 – loaded significantly for F3)*

> *"With the recent changes around coronavirus people have more of a feeling that the road is there to share. It is not matter of who you are and what you are using – the road is not yours. No-one or no type of user owns it. We are all expected to act responsibly, but we have to acknowledge that bigger vehicles can do more damage to some more vulnerable users." (P42 – non-significant)*

The items that the participants agree detract from street environments conducive to people walking, cycling, or rolling are as follows, with the first two being the ones that distract the most:

- Lack of pavement (-5, Factors 1, 3 and 4; -4, Factors 2 and 5)
- Blocking or restricting the width of pavements, cycle tracks, drop kerbs or other crossings, or blocking the view of people with buggies, in mobility scooters, children, etc. (-5, Factors 1 and 2; -4, Factor 3; -3, Factors 4 and 5)

> *"Things that get in the way with a double buggy or just walking with the boys who are 22 months. If I have to step into the road with them, I move quickly around the obstacle and back on to the pavement, but I don't feel safe." (P23 – F3)*

- Routes that are poorly lit (-4, Factors 1 and 5; -3, Factors 2, 3 and 4)
- Route surfaces that are slippery, especially when wet or icy *(and ungritted)* (-4, Factors 1 and 2; -3, Factors 3 and 4; -2, Factor 5)

- Vehicle users who do not indicate a turn they are about to make (-4, Factors 4 and 5; -3, Factor 2; -2, Factor 1; -1, Factor 3)

Neutral items that the participants agree neither strongly encourage or detract from street environments that are conducive to people walking, cycling, or rolling:

- Noise caused by others using the street
- Warning signs or road markings
- Routes that provide some shelter and shade from wind, rain, and sun
- Shops or businesses that are open and/or there is other activity on the street
- Lack of public information films and adverts to reinforce understanding of rules (including changes to rules) and good street behaviour
- Street design that is attractive or interesting
- Consistency of design approaches
- People who use and respect infrastructure that has been provided, and who use it as intended
- Drivers who splash users of footways or cycle tracks
- Incorrect or missing tactile paving
- Distracted people who do not look where they are going or are not aware of their surroundings
- Useable cycle parking facilities suitable for different cycle types
- Opening car doors, especially across footways and cycle tracks/lanes, without first checking that it is safe and convenient to do so

Consensus summary

There was strong consensus across the five viewpoints that physical separation between cyclists and motorised traffic, and between pedestrians and cyclists (e.g., using kerbs, different levels, or bollards) is the item that would contribute the most to creating street environments that are conducive to people walking, cycling, or rolling. Beyond that they agreed that maintaining a direct, appropriate quality walking, rolling, and cycling network, of adequate useable width, even during temporary works, is of highest importance. In addition to functional design, mutual respect between those that use the streets is seen to also help make the street network work effectively. Items that some people find particularly annoying, such as drivers that drive through standing water and splash pedestrians, did not happen frequently enough to deter people from walking, rolling, or cycling.

All the viewpoints, and more than half of participants, agree that if physical separation between cyclists and motorised traffic, and between pedestrians and cyclists was present they would be in a position to choose to use that street or route. However, there was no consensus over what items would be enough to persuade people not to use a particular street or route.

> *"As a women cyclist I have sorted out routes separated from cars. I think it is the same for a lot of women – they don't feel safe mixing with traffic." (P20 - loaded significantly for F1)*

> *"I think separating out pedestrians from bikes and motor vehicles is most important. Pedestrians move and observe things totally different from people on bikes. As pedestrians we might suddenly change direction and put ourselves in danger from passing bicycles." (P33 - F2)*

5.5.3 Interactions between design, behaviour, and regulation

Each of the five viewpoints had a set of the most important items for creating streets that are conducive to walking and cycling, and by contrast contribute to streets that are hostile. The interactions between the elements can be classified as 'internally related', 'logically related', and 'stated as being' related, where:

- Internally related items are ones that have an internal interaction within them; for example, an item might be classified as a behaviour, but it is a rule-breaking behaviour which cannot be separated from the regulations that are being broken[17]
- Logically related items are ones that can clearly be seen to be related, for example design regulation and behaviour items related to speed
- Items stated as being related are ones that were described as tipping point items; all the tipping point items need to be in place as a condition of either use or avoidance of a street or route

The most straightforward way to demonstrate this is to extract the relevant items and these are shown in Table 39. The relevant most important (both positive and negative) items for each viewpoint are included, coded to demonstrate the interactions between design, behaviour, and regulations, where:

[17] The items were identified by focus groups and key informants and the way that they are expressed mean that some have layers of meaning in a single item

- D represents design items
- R represents regulation items
- B represents behaviour items
- Positive items are followed by a plus sign (+)

Table 39 - Demonstrating interrelations of behaviour, design, and regulations

Most important items that are interrelated	Internally related	Logically related	Stated as related
Viewpoint 1 – We are the traffic			
B1 Drivers driving too fast or too close to pedestrians B2 Vehicle users disobeying speed limits or going too fast for the conditions B3 Blocking or restricting the width of pavements, cycle tracks or drop kerbs D1 Lack of pavement D2 Routes cluttered with street furniture that restricts/obstructs movement	B1, B2, B3	B3 with D2 B1 with D1	
Viewpoint 2 – Safety and comfort first			
B+1 Politicians who create policies for walking & cycling, support & promote it D+2 Physical separation between cyclists, motorised traffic, and pedestrians D+6 Roads that are designed for low traffic speeds R+1 20 mph maximum speed limits	D+6	D+6 with R+1 D+2 with B+1	
B3 Blocking or restricting the width of pavements, cycle tracks or drop kerbs B4 Politicians who stand up for parking and driving, supported by policies B5 Drivers who close pass cyclists or cyclists close passing pedestrians D3 Routes that are poorly maintained R1 Lack of enforcement by local and national government of air quality standards	B3, D3, R1	B+1 with B4	
Viewpoint 3 – Access is not optional			
B+2 Routes that are clean, cleared of leaves & rubbish and drains kept unblocked D+2 Physical separation between cyclists, motorised traffic, and pedestrians D+4 Routes that are wide enough to accommodate the flow D+7 Route surfaces that are smooth		D+7 with B+2 & with D+4	D+7, D+2 & B+2
Viewpoint 4 – Designed for all			
B+1 Politicians who create policies for walking and cycling, and who publicly support, and promote it B+4 Clear, appropriate communication between drivers, cyclists, and pedestrians D+1 Direct routes for pedestrians and for cyclists D+2 Physical separation between cyclists, motorised traffic, and pedestrians D+4 Routes that are wide enough to accommodate the flow D+6 Roads that are designed for low traffic speeds D+8 Adequate geometry, visibility, and space for cyclists		D+8 with D+2 & with D+4 & with B+1	D+1/2/4/6/8, B+4 & B+1
B1 Drivers driving too fast or too close to pedestrians B2 Vehicle users disobeying speed limits or going too fast for the conditions B5 Drivers who close pass cyclists or cyclists close passing pedestrians B8 Uninvited, unwelcome, inappropriate interaction with strangers D1 Lack of pavement D5 Large gradients, slopes and cross falls D6 Dropped kerbs that are missing or away from the desired crossing point	B1, B2, B5	D+6 with B1 & with B2	B1, B2 B5, B8 D1, D6, & D5
Viewpoint 5 – Rules matter			
B1 Drivers driving too fast or too close to pedestrians B2 Vehicle users disobeying speed limits or going too fast for the conditions B5 Drivers who close pass cyclists or cyclists close passing pedestrians B7 Cycling on the pavement	B1, B2, B5, B7		

It can be seen from the table above that all the viewpoints except ‘access is not optional’ and ‘designed for all’ had perspectives that some internally related items were important. All except ‘rules matter’ had pairs or groups of logically related items that were important. Only the ‘access is not optional’ and ‘designed for all’ viewpoints included groups of items that were stated as related. These were the ones where the participants that exemplified these viewpoints described related items that needed to be in place as a condition of either use or avoidance of a street or route. The number of items that either encourage or deter use was particularly high for ‘designed for all’; seven positive items and seven negative items. These interrelationships are further discussed in the next chapter.

5.6 Covid-19 and the post Q-sort interviews

The principal purpose of the post Q-sort interviews is to better understand why participants have sorted the Q-sort statements the way they have and are used by the researcher to help interpret the factor analysis. Additionally in this study as part of the post Q-sort interviews participants were asked to comment on changes to their travel behaviours and view of streets in the light of the Covid-19 pandemic. Participant quotes were collated and matched to the emerging themes. It was an iterative process in which the refined themes were then organised by the overarching topics of investigation of the main study, as shown below:

1. Street design and environment:
    - (i) Creation of infrastructure
    - (ii) Enhancement of the environment
    - (iii) Allowing greater diversity
    - (iv) Being less busy
2. Regulations and policy:
    - (i) Rules
    - (ii) Policy Change
    - (iii) Using public transport
3. Behaviour:
    - (i) Tolerance and consideration
    - (ii) Joy of walking and cycling
    - (iii) Social changes

Statements that were made by the participants during the interviews have been organised by theme and can be seen in 9.6Appendix F: Participant quotes from Covid-19 thematic analysis have been interpreted in the following section.

Street design and environment themes

Coronavirus lockdowns meant that the environment changed while fewer cars were in circulation and streets were usually quiet. This in turn highlighted how much street space is taken for vehicle storage, leaving not enough for people on foot or cycles. Some city authorities responded by temporarily changing the design by reallocating parking bays to widened footways or to create lightly protected cycle lanes (Bristol City Council, 2021).

The street design and environment themes were: infrastructure, ambience, more diversity, and less busy. Some participants were encouraged by an improved street environment which they described as quiet, where they were able to hear bird song, breathe clean air, with less motorised traffic. They felt safer, aided in places by the emerging new temporary protected cycling infrastructure and footway widening. The overall reduction in motorised traffic and corresponding rise in the active modes of walking, running, and cycling appeared to be a generally positive trend. The make-up of those visible on the streets was more diverse, with more families and children particularly evident. There was a virtuous spiral of more people being active in their local streets because the environment was more conducive to active modes, which in turn attracted others to walk, cycle and run.

"Overwhelming feeling was how nice the streets are when they are empty." (P35)

Not everyone's experience of lockdown was the same, and for a minority of the participants it was the worst of times. Even for those that were positive, some of the initial enthusiasm turned to dismay as the motorised traffic began to return. For some the pandemic opened their eyes to the inadequacies of our walking and cycling infrastructure, especially narrow footways. Some were discouraged by feeling that they could not safely keep socially distanced, a particular challenge for visually impaired participants.

While some groups, such as families and children, found a new freedom to roam the streets on foot or cycle, or to stop and play, others felt more restricted, particularly if it was difficult or impossible for them, to step or roll into the road to avoid getting too close to someone coming the other way. Temporary footway widening rarely took account of people using mobility scooters or pushchairs and their need to move safely from the footway to the carriageway. Others felt hemmed in by big water filled barriers which restricted where people could cross the road. In some locations these created a 'racetrack' feel to streets and perversely encouraged drivers to speed up.

"I realise how small pedestrian spaces are." (P1)

"Now the traffic noise has restarted." (P29)

Regulation and policy themes

Most people quickly adapted to new street rules and social norms, but not everything worked so well. There seems to be a window of opportunity for policy makers.

The regulation and policy themes were: rules, policy change, and using public transport. Some participants saw opportunities for policy change in favour of active travel and opportunities for people who do not usually feel safe or comfortable, to get out and try walking and cycling. More people and a broader demographic cycling on the road appeared to make everyone a bit more conscious about the need to follow the rules of the road. People on foot were far more alert to rules than usual as they were expected to follow the new rule of keeping at least two metres away from others in the street. Generally, at least initially, almost everyone tried to comply.

"I loved the coronavirus lockdown. It was wonderful for walking and cycling." (P41)

Some negative sentiments were expressed about public transport, with advice that this should be avoided, or its use restricted. For those that had to use it there were new rules such as empty rows between passengers and no standing. Since the onset of Covid-19 restrictions there have been some concerning changes in public transport use. The dramatic reduction in public transport use as indicated by the participants was indicative of a broader phenomenon across other cities. 37 out of 49 participants used the bus less than before, including 18 that stopped using it altogether, and no-one used it more, **Error! Reference source not found.**.

Passenger demand collapsed generally across the UK and Vickerman (2021) reported an 80% to 95% drop in public transport usage during the initial lockdowns. The challenge will be how to attract the public back on to public transport when it is safe to do so, after months of encouraging people not to use it. Additionally, if requirements remain in place to distance, to wear masks and to be screened from others this could threaten the financial viability of services such as buses. If people are displaced to active forms of transport, they could have positive repercussions for streets, but inevitably some journeys will be displaced to private cars which would be detrimental.

As life began to return to something approaching normality in the summer of 2020, others feared that policy makers and politicians had missed the opportunity to make meaningful changes to the street environment.

"It has unfortunately now returned to normal." (P41)

Street user behaviour themes

Despite the post Q-sort interviews taking place during a pandemic, most participants had a positive outlook on their local streets in the light of Covid-19.

The street user behaviour themes were: tolerance and consideration; joy of walking and cycling; and social changes. Perhaps most surprisingly there were many positive expressions of pure joy, with people describing the period as being *"the best of times"*. This was sometimes accompanied by acknowledgements of guilt or selfishness, given that this came at a time of physical and economic hardship and sorrow for many. Some participants described being liberated to walk and cycle with more space. Others observed people being more thoughtful and respectful of one another and people on foot feeling empowered to assert priority in the carriageway. Social changes intended to protect people's health such as keeping a two-metre distance, helped liberate the street for people on foot and cycles. As people were pushed to step into the road, they become more confident to own the space. In some residential areas this went even further with streets resembling playgrounds, covered in coloured chalk for example for games, such as hopscotch. The 'occupation' of the carriageway was formalised in some places with local authorities extending footways into the carriageway, turning bus and general traffic lanes into protected cycle lanes and as high streets reopened, providing space for outdoor dining and drinking.

"Cyclists were having the most wonderful time and for us pedestrians going out was absolutely magnificent." (P33)

"…had to experience it to believe it." (P33)

Some participants and others who had wanted to participate in the study, experienced ill health, and bereavement, or were clinically vulnerable and had to shield. So, alongside the encouragement to use streets in different ways, others were discouraged by being confined to their homes and the associated challenges, and, of those that could get out, not everyone experienced streets full of people on foot and cycle in the same way. There were new challenges of pedestrian congestion in places and new social norms such as distancing and wearing masks. This caused some to feel unsafe, particularly when they saw a few people behaving thoughtlessly. Over time some of the initial tolerance and consideration wore off, and as driving began to increase once more there were occasional outbursts of pent-up anger. So, the joy expressed by many was tempered by the negative experiences of others and how they saw their local streets during this time.

“Everyone seems cross about what has happened, and they are looking out for themselves, but not others.” (P37)

“I am avoiding crowds.” (P8)

Of the 49 participants only two said that the changes due to coronavirus had not changed their perspective or experience of streets in any way and they had nothing to say.

5.7 Summary of the chapter

This chapter has presented and analysed the results of this study. The Q-methodology findings revealed five different viewpoints on streets, which will be discussed in Chapter 6. These viewpoints are as follows:

1. ‘We are the traffic’ views streets as places people pass along,
2. ‘Safety and comfort first’ views streets as places where some want to stop and linger,
3. ‘Access is not optional’ views streets as places that deny access to some,
4. ‘Designed for all’ views streets as places that should be attractive, diverse, and inclusive environments where anyone can walk, cycle or roll,
5. ‘Rules matter’ views street environments as places where the rules should prompt those that can harm the most to take a greater share of responsibility for others if they are to function for everyone.

The study took place during the Covid-19 pandemic. The impacts of this on the participants’ experiences of streets was explored. The majority expressed a positive outlook on their local streets in the light of the changes to environment and culture that resulted. This will be discussed further in the next chapter.

6 DISCUSSION

6.1 Structure of the chapter

The research has investigated the way that the combination of design, regulation and behaviour influence the street environment and culture to make it conducive to walking, cycling, and rolling. New evidence has been derived from the most marginalised street users and has resulted in the revelation of five viewpoints about the nature of streets and how they are used. This chapter considers the resulting evidence in the light of the literature.

Section 6.2 assesses the theoretical model, the Social Ecological Model of Ability (SEMA), specifically developed to provide the foundation for, and to guide the research. This then allows for the results to be discussed in the context of the model. The value and contribution of the resulting viewpoints from the Q-methodology analysis that describe the nature of streets are discussed in Section 6.3. Section 6.4 focusses on the disabling barriers within street environments and are a particular feature of the viewpoints that describe the nature of hostile streets. An overall response to the aim and the research questions is provided at the end of the chapter in Section 6.5. The threads of the discussion are drawn together in Chapter 7.

6.2 The value of the Social Ecological Model of Ability

Bronfenbrenner's (1974) Social Ecological Model (SEM) considers the individual and their wider relationship to their context. Beyond the *individual* level, he defined four other levels: the *micro*-level (inter-personal), *meso*-level (community level), *exo*-level (the environment and infrastructure) and the *macro*-level (political and social structures). It assumes behaviours are acquired through conditioning, which result from interactions that take place in a multi-layered environment. This model is a good basis for a framing of the nature of streets and how they operate because each of these layers can be clearly identified in relation to streets. It does not, however, explicitly account for the possibility of different types and levels of impact on the individual.

Oliver's (2013) Social Model of Disability (SMD) provides insights into the disabling barriers found in modern society in order to generate policies and practices to facilitate their eradication. SEMA is a combination of SEM and SMD and was postulated as a basis for ensuring that differences between individuals could be considered. This is because individuals are differently marginalised by layers of barriers in the ecosystem of their environment that remove choices and hinder participation, as shown in Figure 38.

Section 6.2.1 discusses the evidence from the data as encapsulated in the five viewpoints in relation to the levels in SEMA. Section 6.2.2 discusses the merits of the model.

6.2.1 The viewpoints and their relationship with the levels in SEMA

The findings described in the previous chapter described five different viewpoints on streets:

1. 'We are the traffic', a view that streets are places people pass along,
2. 'Safety and comfort first', a view that streets are places where some want to stop and linger,
3. 'Access is not optional', a view that streets are places that deny access to some,
4. 'Designed for all', a view that streets are places that should be attractive, diverse, and inclusive environments where anyone can walk, cycle or roll; and
5. 'Rules matter', a view that street environments are places where the rules should prompt those that can harm the most to take a greater share of responsibility for others, if they are to function for everyone.

The views expressed by the participants on the street environment, as revealed in the primary data from the focus groups and Q-methodology, were acquired as a result of their experiences and conditioning within and to the street environment. The resulting five viewpoints are the manifestation of experiences of interactions in the multi-layered (individual, micro, meso, exo, macro) street environment. Each level is now discussed in turn in relation to the viewpoints. Not all viewpoints are relevant at each level. The high level of self-identification evident in 'we are traffic' is relevant at the individual and micro levels. 'Safety and comfort first' illuminates issues at the meso- and macro-levels. 'Access is not optional' and 'rules matter' are only relevant at the exo-level. Of relevance in most levels is 'designed for all' which is relevant to the individual, meso- and exo-levels.

Individual level

The social conditioning of children and young adults and their adoption of street use behaviour has evolved over time. So, people growing up in pre-First World War streets, which were walking, and cycling dominated, would have learnt that these were the normal ways of engaging with streets. By contrast people born in the 1970s and 1980s would have grown up to accept streets dominated by motor vehicles as normal (Flower 2018).

The exemplar participants of the ‘we are the traffic’ viewpoint were the most likely to differ from a view that motor traffic is different in kind from the movement of people outside motor vehicles: they described in their interviews how they, as young adults, had learnt to see active travel as *“normal and natural” (P5)* street behaviour. For example, people who align with the ‘we are the traffic’ viewpoint have a liberated outlook, which accepts walking, cycling, and rolling as everyday ways of travelling along streets with a desire for others to see it in a similar light*: “I want to make walking normal” (P20)*.

At the other extreme, those who align with the ‘designed for all’ viewpoint accept that driving is the default way of travelling along streets which creates the perception that, to get out of motorised vehicles and to travel along streets in other ways, would require some significant changes to those streets. This was emphasised by the large number of tipping point items that this group identified that would have to be in place for them to consider the alternatives to driving. This viewpoint perceives driving as the default way of getting around which in turn becomes a barrier for people seeing any alternatives.

Micro-level

The micro-level describes interpersonal interactions. Childhood is an example of where decision processes at the micro-level are revealed, as it is the exposed reasoning of parents in terms of what they allow children to do which informs how the decision making at the micro-level works. In the 1970s families thought it acceptable for 80% of children in the UK to walk to school alone by the time they were eight (Mackett, 2013), but by 2018 only 3% of all primary aged children walked alone to school (Evans *et al.*, 2018). Some participants with the viewpoint ‘we are the traffic’ explained how they allow their children to walk and cycle to school, but for many parents that they met at the school gate active travel was not seen as either safe or acceptable: *“the school run mums just feel that it is not safe to walk or cycle, and so don’t consider it an option and add to the problem in their SUVs” (P20)*. Children who live in this environment are disabled by family and friends and the SUV becomes a barrier that they cannot escape from.

However, the way friends and family influence street behaviour can also change quite rapidly, as was demonstrated during Covid-19 when interviewees reported that parents allowed children to play in the carriageway: *“in my neighbourhoods all the kids were out on streets playing socially distanced games, like hopscotch. The streets were covered in chalk, covered in kids’ games” (P48)* and family groups were seen cycling down main roads: *“lovely seeing families out cycling with small children” (P12)*.

Meso-level

For street use, the meso-level relates to the inter-relationships between street users. This is manifest in behaviours towards each other, and in relation to rule compliance and rule-breaking behaviour within the street. The rule-breaking behaviours of other street users, such as speeding and close passing were highlighted by the 'designed for all' viewpoint as actions by their immediate community that deterred them from fully participating in street life. The SMD adds values to the SEM within the SEMA, by drawing attention to the barriers that hinder participation in full street life. Rule-breaking behaviour makes streets feel hostile which deters or sometimes prevents people from walking or cycling. *"For others who use pavements like wheelchair users or the elderly, so much revolves around the condition of our pavements. I understand why drivers park on the pavement, but we are becoming a very selfish society. These actions block people on the pavement" (P3).*

Such examples of 'bad' behaviour have become normalised and accepted. Some participants that exemplified the 'we are the traffic' viewpoint wanted to promote either walking or cycling: *"I want to make walking normal" (P20)*. Similarly, those that identified with 'safety and comfort first' saw themselves as advocates for streets as places to stop and linger: *"seating is important if you are old like me or disabled; there need to be places for people, not spaces for cars" (P29)*.

Exo-level

The exo-level is defined as the institutional level, particularly the environment and principles adopted for infrastructure design and management. 'Designed for all' considered that infrastructure either helps people to use or deters people from using streets. Good design enables people to walk and cycle and helps road users comply with regulations (e.g., streets designed for low speeds help drivers comply with speed limits) that 'rules matter' view as so important: *"the breaking of the 20mph speed limit makes walking around absolutely miserable; the police need to enforce it, or we might as well forget it" (P47)*. 'Access is not optional' typify participants for whom poor design creates barriers to participation, including accessibility issues such as a lack of level crossings: *"I make a mental note of routes that have steps and avoid them; uneven pavements are also a problem" (P22)*. Intimidating streets due to inadequate lighting, was a concern of 'designed for all': *"things like poor lighting would make me avoid a certain route or street" (P16)*.

At the exo-level it is particularly clear that the SEM would not deal with everything that SEMA addressed with the addition of the SMD, because individuals are differently marginalised by the ecosystem of their environment. The same infrastructure, laws and (non-)compliance have different effects on each individual. For some they will create insurmountable barriers that remove choices and hinder participation, whereas for others they will be inconveniences or even a challenge to overcome, which is reflected by the different perspectives of the five viewpoints.

Macro-level

The political and social structure is the level above the exo-level and can either support conducive streets or erect barriers that help make streets hostile. 'Safety and comfort first' considered that policies that support walking and cycling by allocating space and funding contribute to a very different street environment and culture than policies that support parking and driving, where journeys in motorised vehicles are prioritised over people who wish to be active on the street: *"parking on pavement doesn't discourage me it stops me" (P43)*.

> *"Politicians who make pro-walking and cycling policies and public support them are also important." (P12)*

The negative examples, actions and rule-breaking behaviours of family, friends, community, and other street users occur at the individual, micro and meso-levels in the model and were identified by the research participants as the things that most discourage and deter individuals from using streets to walk or cycle. Policy makers, practitioners, local authorities, and government have the power to enable walking, cycling, and rolling in streets. Actions to design conducive streets with supporting regulation and policies occur at the exo- and macro-level and were the things identified as most likely to encourage and persuade people to use streets and routes.

In the 1960s Smeed (1963) concluded that the ground space required for moving and parking for driving was many times more for private motor vehicles than other modes. He would have concurred with the 'safety and comfort first' viewpoint that policies that allocate space and funding for approaches other than driving and parking would contribute to a very different street environment and culture. However, he would have emphasised public transport (bus and rail) over active travel, and although he considered walking he made no reference to the space requirements of cycling. Both Smeed and his peer Buchanan (1963) recognised that policy makers, practitioners, local authorities, and national government had the power to influence the urban environment. However, they too had acquired ways of behaving and perceiving through conditioning, which resulted from interactions that took place in a multi-layered environment, and their framework was ‘traffic in towns’ and not ‘people in streets’.

6.2.2 Assessing the merits of SEMA

Having now understood how the primary evidence from the research relates to the theory, it is possible to judge the merits of the theory. Bhattacherjee (2012) proposes four attributes of a good theory, namely logical consistency, explanatory power, falsifiability, and parsimony. Each point is considered in turn.

It is logically consistent as the building blocks (the five levels) of the theory are consistent with each other. SEMA has five levels, which are the same five levels as defined in SEM. SEM has been a theory that has been used frequently before (Mandic et al., 2016; Kilanowski, 2017; Pikora *et al*., 2003; Feuillet *et al*., 2015) to good effect. The build-up of the levels from the individual level to the macro-level incrementally considers their impacts on the ecology of an environment. The macro-level has the greatest power to control and influence lower levels, for example, policy determines street design and regulation, which is at the lower meso-level. Lower levels still exert influence, for example the micro-level of community has an influence on the individual, but also upwards on the meso-level of street interactions. The addition of the SDM to SEM also then explicitly allows for differentiation in the way that individuals are affected by their environment. This is exemplified by the study participants view of steps and cobbles which for some were seen as impediments to street access and to others they were attractive heritage features.

Q-methodology is a mixed methods approach, but for the purposes of comparing the findings with the SEMA, the relevant findings were largely qualitative. The key point in relation to the explanatory power of the model is that each of the different levels of the model are associated with, and can provide further theoretical illumination of, the viewpoints, which are the qualitative output from the research.

Falsifiability in a strict experimental sense could be achieved for the theory by a methodology that examined the different street use choices of people who have been exposed to similar environments (e.g., siblings). Q-methodology has not led to a point where this level of falsifiability is possible. However, if it could be demonstrated that there was no logical link between exposure and experiences of an individual in a street environment and their subsequent behaviour, then the theory would be of little value. This is not the case from the evidence gathered. In relation to the addition of the SMD to the SEM to specifically considered disabling barriers for different individuals, again, an an experimental approach could be taken. However, again from the evidence gathered it is clear that there are different sorts of barriers within the street environment for different people.

The two source theories, SEM and SMD are both parsimonious and have been applied to a variety of settings and situations. The SEMA, because it combines two theories in a creative way, opens up the possibility for SEM to be used in a wider range of contexts. The seemingly simple, but powerful addition of SMD has, as identified in Figure 38, provided a basis for explicitly considering differentiation to the way that the layers of barriers marginalise different people.

So, in the light of Bhattacherjee's (*ibid.*) measures, the SEMA does have the attributes of a good theory to investigate the inter-relationships and viewpoints that relate to street use. There could be, therefore, other applications for this framework in wider transport planning, something that is returned to in the final chapter.

6.3 The nature of streets conducive to walking and cycling

Q-methodology was used in this study and the viewpoints that emerged from the analysis of the Q-sorts resonate with the principles described in the key informant interviews and set out in guidance of what makes a good and bad street environment for people walking, cycling, or rolling. Compared with other transport studies that have used Q methodology this study has been able to explain significantly more of the overall variance in the data collected. It explains 76% of the study variance, compared with Exel, de Graaf, and Rietveld's (2011) study that explored stated preferences for middle-distance travel which explained 57%, and Jones *et al.* (2012) who conducted perhaps the first Q-study on walking and cycling, and explained 42% of the study variance. This may partially be due to the large difference in the size of the P-sets. Jones *et al.* (2012) only had 25 in its P-set (small by Q-methodology standards), Exel, de Graaf, and Rietveld (2011) 39, compared with 49 in the present study (and which is within the more usual parameters of a Q-study). However, in other ways the methods employed by all three studies were similar, such as adopting a purposeful approach to sampling.

At their best streets are understood to need to have the following six characteristics: safe, comfortable, attractive, direct, coherent, (which includes legible and connected), and inclusive, or conducive to walking, cycling, and rolling (Department for Transport, 2020b; Transport for London, 2020a; CROW, 2016). The different viewpoints understood the same characteristics in different ways, so for example lighting was seen as a safety feature for one, but about legibility and navigation for another. Similarly, a feature such as steps was seen negatively by the ‘access is not optional’ viewpoint in relation to accessibility, but positively by others as heritage features or a good way of tackling gradients.

In the following two sections the emerging five viewpoints from the Q-sort are compared with these six characteristics of a street conducive to walking, cycling, and rolling. The final sub-section, 6.3.3, discusses the changed nature of streets because of the Covid-19 pandemic.

6.3.1 Safe, comfortable, and attractive

The Q-sort participants identified six aspects of street user behaviour, design and regulation that are most important to the most marginalised people on foot, cycle or rolling. Two related to safety: separation between modes and low speeds. Three related to comfort: route width for each individual separated part of the street, surface smoothness and mutual respect between users. They all spoke to what made a street attractive to different users.

Safe

Safety was of uttermost importance to ‘safety and comfort first’ because it helps create streets where people would want to stop and linger. It was the topic that overall was talked about the most in the interviews, but what it meant varied from one person to another. Safe streets were described, especially by younger people in FG6, as ones that are well lit at night with enough activity so that they do not stand out or attract unwelcome comments or abuse if they are alone, which corroborates De Vos *et al.*’s (2021) study that investigated the indirect effect of the built environment on travel mode choice. Older people (FG4) also identified lighting as an important safety feature but admitted that it was for the benefit of others and not themselves as they rarely go out at night. For all the viewpoints except ‘access is not optional’, safety relates to the speed of motor traffic, and they saw slow streets as safe streets, which supports Glaser and Krizek’s (2021) findings in their exploration of evidence from 55 US cities that applied emergency Covid-19 response measures. ‘Safety and comfort first’ placed emphasis on streets being designed for slow speed, while three of the viewpoints looked to the considerate behaviour of cyclists and drivers to keep speeds appropriate, and two viewpoints linked speed to regulation and enforcement, with an appreciation for 20 mph speed limits which corroborates ROSPA (2017) and Bornioli *et al*.’s (2020) Bristol study investigating the effects of city-wide 20 mph speed limits on road injuries. Linked to speed and the need for street users to share street space in proximity with motorised vehicles capable of causing immense harm, separation of modes was the safety measure that had the greatest level of consensus across the Q-sort participants, which supports Aldred and Jungnickel's (2014) findings as they made the case of cycling in the UK. The focus group and Q-sort participants were adept at looking at street safety in a holistic way, whereas experts often focused on a particular strand. As the key informants emphasised, highway engineering is important for reducing speeds, and place making design features such as lighting, and land use planning considerations can also help safety by encouraging increased levels of activity on streets, all aspects that Kerr *et al*.'s (2016) IPEN study established as environmental attributes associated with walking and cycling for transport. Focus group participants also expressed that street life is not static and the street environment and culture changes significantly over a 24-hour period or between the working and studying week, and the leisure and shopping activities of the weekend. The term 'street safety' is often to describe measures to keep street users safe from the violence, abuse and unwanted attention of other street users as highlighted by the Safe Streets for All debate in parliament (Hansard HC Deb 2021) in the wake of Sarah Everard's death (Dodd, 2021) in March 2021. The vocabulary of road safety by contrast is used to describe measures to protect people from motorised traffic, especially those who are more at risk of serious injury or death following a collision (Rigby, 2021) and the focus tends to be on regulation such as speed limits as well as highway design. In the UK context the media and politicians tend to handle the dichotomy that the participants brought together, by using this different vocabulary.

Comfortable

Comfortable streets were described by exemplar participants of 'we are the traffic' as ones where they feel physically comfortable to walk, cycle or roll, or by 'safety and comfort first' as ones where they feel emotionally comfortable to be at ease and at home. Huff and Liggett (2014) conclude that in streets that are places where people pass along, physical comfort includes smooth surfaces and gentle gradients, especially appreciated by people who roll, visually impaired walkers and older people which resonated with FG1 (visually impaired people), FG2 (people with mobility difficulties) and FG4 (older people). A distinguishing perspective of the 'we are the traffic' viewpoint was that for pedestrians and more particularly cyclists, continuous priority at junctions improves route comfort, which corroborates Steer, Davies and Gleave's (2018) research on behaviour at continuous footways. Aldred (2015) found that identity is important for some who like to see others doing the same as them, whether that is walking to work or cycling for leisure, another distinguishing perspective of 'we are the traffic'. This sense of feeling at home in the street brings emotional comfort. For those who see streets more as destinations or who are older, characteristics of ‘safety and comfort first’, being able to find certain essential features is critical to both physical and emotional comfort. Toilets and street seating are two examples of essential street features, without which some older people (FG4) would be unable to leave their homes. The focus group and Q-sort participants’ ability to articulate the breadth of issues required in order for everyone to be comfortable, is worthy of note.

Attractive

The ‘designed for all’ viewpoint considered streets as places that should be attractive environments where anyone could feel drawn to walk, cycle or roll. What makes streets attractive to people can vary a lot and given that beauty is subjective, streets that attract one person can be unattractive to another, or they are neutral about the feature. A few participants find streets with distinctive smells such as fresh bread or coffee attractive, something that was more prominent among some visually impaired participants in FG1. Heritage features in streets came up a lot. Some of the focus group participants found heritage features such as metal kerbs, cobbles, steps, and slopes (all common in some older Bristol streets) very attractive, and they thought they helped create the kind of street environment where people like to stop and spend time, something that was most important to ‘safety and comfort first’. However, these people realised that these items can be problematic for others as they can make streets inaccessible, the focus of ‘access is not optional’. Some noted positively where a compromise had been made to mix heritage, access, and comfort by cutting old cobbles in half or laying new paving setts which create a smooth surface, something KI7 described in the context of Bristol, but who pointed out that this procedure was limited due to the expense. One Q-sort participant (P7) said that as a runner she found streets with very steep gradients particularly attractive for hill sessions, but this view was not shared by many. The literature on what makes attractive walking street environments tends to take a cross section through this topic rather than representing the range of environments that people find attractive (CABE *et al*., 2002; Calvert, 2015; Bornioli *et al*., 2018).

6.3.2 Direct, coherent, and inclusive

Of the six most important aspects that emerged, one was direct routes. Two related to coherence: separation between modes and direct routes. Two related to being accessible and inclusive: surface smoothness and mutual respect between users.

Direct

Direct routes for pedestrians and cyclists (Transport for London, 2014; Highways England, 2016; Welsh Assembly Government, 2014) were very important for both the viewpoints 'designed for all' and for 'we are the traffic'. Aldred (2015) suggests that utility journeys are often the focus of policy makers, with commuters singled out above all others. However, the 'designed for all' viewpoint considered streets as places that should be inclusive environments where anyone can walk, cycle or roll, whatever their journey type. The 'safety and comfort first' viewpoint tended to consider streets for leisure or as destinations, and directness was less important than comfort. The 'Access is not optional' viewpoint hints at a preparedness for people to trade directness for streets or routes where they have access and feel more comfortable (e.g., smooth routes).

Coherent

Coherent (which includes legible and connected) streets and logical ways to use them and pass through them was a topic of importance to the research participants, especially those who cycle. The notion of complete walking and cycling networks with clarity of where to go next was important to 'we are the traffic' and corroborates Luukkonen and Vaismaa's work (2015) on the connection between cycling safety and volume. Legible streets that are easy to navigate was important to 'designed for all'. People with low vision in FG1 and Q-sort spoke of the need for well-lit streets and contrast between surfaces of different levels to help them navigate. Some visually impaired pedestrians use the smell and noises from certain shops as ways to navigate along familiar streets. Signage was important to some Q-sort cyclists on unfamiliar routes. There was clearly a difference between what people require on familiar streets compared with unfamiliar ones. In Housman's urban plans that created wide and straight streets that connected points for all modes (Asl, Nouri and Sattarzadeh, 2014) coherence was intrinsic, whereas the experience of many of the focus group and Q-sort participants was that routes between two points can vary by mode, be quite complex and so careful consideration needs to be given to make those routes easily navigable.

Inclusive

Inclusive streets were of most concern to 'designed for all' and 'access is not optional'. The latter were particularly concerned for people who roll, including those who use wheelchairs or mobility scooters, who are reliant on dropped kerbs and level crossings at side roads, something Huff and Liggett (2014) highlighted when calculating bicycle and pedestrian levels of service. Members of FG1 explained how features such as tactile paving can warn of danger or navigation strips can help identify routes to visually impaired people who use a long guidance cane, but others use serendipitous presence of more mundane features for guidance such as walls, corroborating Parkin and Smithies' (2012) findings when accounting for the needs of visually impaired people in public realm design.

6.3.3 Covid-19 and streets conducive to walking and cycling

During the data collection phase of this research the Covid-19 pandemic took hold. Although in many ways a global disaster, for the purposes of this study it was somewhat fortuitous. Surprisingly, the study found that many of the Q-sort participants witnessed the best of streets during the Covid-19 pandemic, and some described experiencing streets conducive to walking and cycling for the first time in their lives, for at least longer than a day or a bank holiday weekend. Their local streets became what they were describing in the study as streets where they would choose to walk, cycle or roll, something De Vos *et al*. (2021) described as the indirect effect of the built environment on travel mode choice.

The Q-sort participants reported that the removal of motorised traffic on local streets led to sudden radical shifts in behaviour, and they observed people using streets in ways they had never done before and there was a far greater diversity of people walking, cycling, and rolling. Whole families were cycling in the carriageway and parents were not afraid to allow their 3-year-olds to cycle down the centre of a road. People young and old, felt safe walking in the carriageway. Children could play in the street as evidenced by chalk drawings and hopscotch.

For streets to permanently be places that are open and available to the diversity of people that exist: women and men, young and old, timid, and brave, black, brown, and white, active, and sedentary, fast or slow, particularly ‘designed for all’ articulated that a transformation of streets would be required. Only then can everyone perceive that walking, cycling, and rolling are viable, realistic options for some utility journeys or for leisure trips on local streets. Many of these people are not obviously marginalised by streets. It is not a missing drop kerb or tactile paving, or even the quality of the cycle provision, rather, it is an environment and culture that has normalised streets as being places where it is only conceivable to travel by car. During the Covid-19 pandemic many streets were transformed and gave a glimpse of streets where anyone can walk, cycle or roll are like. Many people who would never usually see their local streets as places where they could walk or cycle felt empowered to give it a go, or to let their children try.

6.4 The nature of hostile streets

At their worst streets are unsafe, uncomfortable, unattractive, indirect, incoherent, illegible, unconnected, and inaccessible, and are therefore hostile to people who walk, cycle or roll. Q-sort and focus group participants described their experience of all these. There was a lot of overlap with their descriptions for conducive streets as most of the participants had experienced both the positives and the negatives in street environments. Below are additional descriptions that add to what has already been described above.

6.4.1 Unsafe, uncomfortable, and unattractive

Unsafe

Focus group participants and some of the interviews following the Q-sorts described unsafe streets and routes which they avoid if they have an option. Several people described occasions when they were forced into the carriageway, sometimes with little or no visibility, due to inconsiderate parking, lack of pavement, or other obstacles such as temporary works or scaffolding. Parents and carers with small children in buggies or people in wheelchairs were particularly concerned in these situations. Guidance and practice tend to focus on permanent infrastructure and street furniture, but the everyday street experience of these users was that temporary obstacles and clutter are at least as important. This supports Mayers and Glover' s (2019) findings that cars parked on the pavement or in cycle lanes, and temporary works can force users into live traffic on the carriageway, sometimes with no way of knowing if it is safe to do so if visibility around the obstacle is obscured.

There were examples that especially younger focus group and Q-sort participants who walk provided of abuse and threats on the street from other users, both verbal and physical. On routes where they thought this might occur they either avoided them or used another mode. Some younger participants (FG6) said that they used different routes when out in the evening as compared with the day, as a safe daytime street may feel unsafe at night. Some young people who cycle or run, particularly young women described times when they had been verbally abused or had items thrown at them, seemingly simply because they were cycling or running in the street and for no other apparent reason. They found it difficult to predict where this would occur but would avoid routes where they thought it likely. This corroborates Poulos *et al*'s (2019) Australian study that reported that such perceptions of aggression are a common experience for cyclists and that younger women were more likely to report aggressive encounters from drivers. One of the child focus group participants reported intimidation when riding his bike and gave an example of adults deliberately blocking his way on a shared path (by moving first one way and then the other so that he could not get past). The Australian study also report cases of other road users deliberately blocking the path of cyclists.

Many examples of threats and actual physical harm (violence) that participants in the focus groups and post Q-sort interviews reported, whether they were walking, cycling, or rolling, was from people driving cars. They perceived that this threat was often unintended, but sometimes intended. Voelcker (2007) was critical of the leniency shown by the courts to those that cause physical harm with a motor vehicle and suggested that they are often treated like unfortunate victims in unavoidable accidents rather than people that are in control of potentially lethal weapons. As a result, streets where speeds are high and street users feel that they are too close to passing motor vehicles, are ones that ‘safety and comfort first’ and ‘designed for all’ described as very hostile.

Uncomfortable

Unlike other road users, it is uncomfortable for cyclists to have to keep stopping and starting, hence cyclists avoid having to come to a complete halt (Meng and Mikkelsen, 2015). Q-sort participants that cycled said that they avoided routes where this happened, especially at side road junctions and were typified by ‘we are the traffic’. Some of the post-Q-sort interviewees said that they found steep gradients and crossfalls at driveways uncomfortable when walking. The exemplar participants from ‘access is not optional’ who roll tended to feel uncomfortable on cobbles and most would just avoid them altogether.

Unattractive

Unattractive streets described by some participants were not necessarily ones that did not look nice. ‘Access is not optional’ viewed streets with steps and slopes, or ones with heritage features such as large paving slabs as ones to avoid. In the post Q-sort interviews they described such features in terms of making the street uncomfortable for them to use, or even inaccessible.

6.4.2 Indirect, incoherent, and inaccessible

Indirect

One cause of frustration to some Q-sort participants was when direct routes are not provided around temporary works. There are often compromises in the practice observed by participants in streets, compared to the sound principles of directness that are articulated in design guidance (Transport for London, 2014; Highways England, 2016; Welsh

Assembly Government, 2014). This included lengthy detours and forcing people to cross the road (sometimes multiple times) rather than providing a temporary footway in the carriageway. A similar situation for cyclists is when the works close the cycle provision and there is signage for the cyclist to dismount instead of providing a temporary alternative or enabling the cyclist to safely join the general traffic, a frustration aired by some of those that provided the defining sorts for ‘we are the traffic’.

Incoherent

Incoherent (which includes illegible and unconnected) streets are those that ‘designed for all’ viewed as difficult to navigate, confirming as Mayers and Glover (2019) found that people who cycle in car-centric cities encounter poor infrastructure that is not legible. However, regardless of mode, several focus group and Q-sort participants across all viewpoints described a similar experience and referred to the same place, Broad Quay in Bristol. Ironically, this is an area that has given over more street space to people not using motorised modes and has attempted to separate different modes. However, it is considered a heritage area and the separation takes the form of very subtle markings in the paving, which most people fail to spot. Participants were united in their dislike for this area, whether they walked, cycled, or rolled, and for visually impaired walkers they are totally at a loss as to where they should walk. So, what should be a destination street has become an area that many choose to avoid if they can.

Inaccessible

Inaccessible streets for ‘access is not optional’ meant steps, steep gradients, missing dropped kerbs or a lack of level crossings at junctions, which Q-sort participants said was particularly common away from the main centres. In the focus groups and post-Q-sort interviews people who roll, in wheelchairs and mobility scooters, gave examples of features such as steps that completely excluded them from many streets. However, for many in the focus groups, it was the unpredictable issues on streets that are worse than these features which are permanent and predictable on familiar routes, and so can be avoided. Suddenly encountering an unexpected obstacle in the street was an issue especially for people who roll, but also cited as a real concern by several visually impaired participants. The obstacles blocking footways and reducing useable widths included overgrown hedges, parked cars, and waste wheelie bins.

6.5 Responding to the research questions

Smeed (1949) in his consideration of road safety research concluded that the likely solution lies in how street design, regulation, and street user behaviour combine. This research built on Smeed but went beyond a focus on safety and traffic flow to address the wider issues of street environments. At this point it is worthwhile to reprise the research questions:

> RQ 1: What are the aspects of street user behaviour, design and regulation that are most important to the most marginalised people on foot, cycle or rolling?
>
> RQ2: What is the relative importance of behaviour, design and regulation to a street environment and culture that is conducive to walking, cycling, and rolling?
>
> RQ 3: What are the interactions of street user behaviour, design and regulation that create a network of streets that is conducive to walking, cycling, and rolling?

RQ1, the definition of the aspects, was answered through the input of the key informants and focus groups who, from their experiences, identified 64 different items of street user behaviour, design and regulation that are important to the most marginalised street users. Each Q-sort participant then ranked the items and determined which were the most important for them.

RQ2, an aspect’s relative importance, was revealed by applying shading to the composite Q-sorts for each viewpoint which made it possible to compare them and to reveal the relative importance of behaviour, design, and regulation.

RQ3, about interactions between aspects, was addressed by categorising the most important items for each viewpoint into three categories: internally related, logical related and stated as being related.

6.5.1 RQ1: The most important aspects

The most important aspects identified in the Q-sort rankings were:

1. Separation between the modes,
2. Low speeds,
3. Route width for each individual separated part of the street,
4. Surface smoothness,
5. Direct routes, and
6. Mutual respect between street users.

Each of these in now discussed in turn.

Separation

Overall, the single most important element for creating streets conducive to walking and cycling, was physical separation between the modes. This was a view shared by most participants. Utilitarian walkers and cyclists see this as important for creating fast, direct, wide, and navigable key routes to work, schools, and shops so that these journeys can be completed easily. They want routes that they can use without the threat of others passing too fast or too close, or anything restricting the useable width of their route (permanent or temporary). Cycles are vehicles capable of speed and as Parkin (2018) points out, separated cycle tracks should have a core design speed of 30 km/h to accommodate them and below about 12 km/h stability begins to be compromised (CROW, 2016).

Other participants viewed separation primarily from the perspective of people walking and rolling, who feel intimidated in streets where space must be shared with cyclists or motor vehicles. This was of particular importance to visually impaired people who said that they needed clarity as to where they should be walking and the security of knowing that they will not encounter cars, cycles, or e-scooters in that space.

Some participants viewed separation as the only way that many people who currently would not consider walking or cycling as an option for the school run, commute, or trip to the shops, might be tempted out of their cars and the literature agrees (Marqués *et al*., 2015; Hull and O'Holleran, 2014). Many perceived their local streets as places that are incompatible with safe and comfortable walking, cycling, or rolling, but high-quality separated footways and cycle tracks could transform that. Walking to school was seen as safe enough for children of eight to walk alone in the 1970s (Mackett, 2013) but by 2018 only 3% of primary aged children were doing it (Evans *et al.*, 2018).

One of the most basic forms of separation is a pavement with a kerb separating it from the carriageway. This was seen as important in all viewpoints, corroborating Pucher’s (2000) findings on separated infrastructure. However, some key informants raised the notion of destination streets with some degree of shared space which lessens the need for a pavement. They spoke of possible street reforms including home zones, pedestrian priority streets and low traffic neighbourhoods with point closures, all of which can lessen the role of a pavement if pedestrians are able to safely use the carriageway. This would have been a minority view among participants, but the temporary change to the street environment during the Covid-19 restrictions caused many more Q-sort participants to positively consider these possibilities. Some spoke in less positive terms but commented that due to social distancing (keeping 2m from people outside their household) and narrow footways, they were forced to use the carriageway, even if they felt unsafe doing so. Some participants that exemplified the viewpoint, ‘we are the traffic’ engaged in ‘vehicular cycling’ as described by Forester (2001), but they also acknowledged that for the majority to consider cycling an option, as exemplified by the viewpoint ‘designed for all’, separation between modes was important.

Low speeds

One viewpoint that emerged from the research was a desire for streets designed and regulated for low traffic speeds. People who see streets as destinations where they would like to spend time, go out of their way to use streets designed and regulated for low traffic speeds. In addition, those that walk, cycle, and roll as a way to get to work, school or the shops, avoid routes where people are driving too fast. The excessive speed of motor vehicles is something that deters many people from even considering walking and cycling as a viable option. These reactions are supported by the literature which confirms that many people associate slow speeds with safer streets (Glaser and Krizek, 2021; ROSPA, 2017; Bornioli *et al*., 2020). For many people, drivers or cyclists passing them too close also accentuates differences in speed and makes them feel unsafe to the point where they will avoid areas where this is likely to occur. Interestingly, routes designed to minimise the need to slow, stop or wait (e.g., that allow high walking or cycling speeds, with no or few crossing points or obstacles) were seen as important for time saving by people who consider walking, cycling, or rolling as transport. However, these same routes were seen negatively by people who tend to drive and the thought of people travelling past them fast on foot or cycle would deter them from using these routes.

Route width

The research found that routes that are wide enough to accommodate the flow are seen as important by street users. They are particularly important to those that are more concerned with movement than place. They are also important to those for whom width is not just about comfort, but usability, which includes people using wheelchairs, mobility scooters, prams, buggies, and cycles, as well as for those with a visual impairment or who need to be accompanied (e.g., children and people that are unsteady on their feet). It has been noted in the specific context of narrow shared paths that cyclists prefer the absence of any separation so that they have enough width to pass other cyclists (Delaney *et al*., 2017). Street furniture that reduces the useable width was of concern to those who wish to move quickly and those concerned about access. It is not just the permanent width that matters, but some research participants also highlighted their concern over the temporary blocking or restricting of the width of footways, cycle tracks, drop kerbs or other crossings, or the blocking of the view of people with buggies, in mobility scooters, and children (with parking, bins, A-frames, deliveries, scaffolding, temporary signs, hedges, etc.). For those who principally see streets as destinations rather than routes, this issue has a lesser importance.

Some street users seek improvement for the movement function of streets, while others want improvements for the place function. Jones, Marshall and Boujenko (2008) may have seen these functions as quite distinct, but when the focus moves away from motorised modes, and the speed reduces to cycling speed, the competition between movement and place begins to dissipate. Q-sort participants in their interviews described shopping and residential streets that were both good to spend time in and walk and cycle through, if there was adequate space and separation between the modes. Such streets, especially when removed of what some participants described as rat-running drivers, can be both linear conduits and what Marshall *et al*. (2018) called containers of urban life.

Surface smoothness

The research found that smooth routes are very important for some people, but not a major consideration for others. For those where it is the difference between a street being useable or not, then smooth routes are critical, as was the case for some older people and people who roll. That aspects such as smooth surfaces are disabling for some is another demonstration of the importance of SEMA as opposed to just SEM.

Direct routes

Street users that walk or cycle as a principal way of getting around, place great importance on direct routes that avoid deviations and are at least as direct as those for motorised traffic. Similarly, direct routes are essential for many people to allow them the possibility of considering walking, cycling, or rolling. Other participants in the research did not consider the directness of routes as particularly important. Directness of routes was addressed more fully earlier in the chapter in Sub-sections 6.3.2 and 6.4.2.

Mutual respect

People who respect and have consideration for the safety and general well-being of other users of the street was considered important by those that are often denied access, like those that roll. Similarly, 'rules matter' that are looking for street reforms thought this was very important. Perhaps they believed that the reformed behaviour of road users could make an otherwise unenticing street environment conducive to movement without a motorised vehicle. Clear communication between drivers, cyclists, and pedestrians (e.g., verbally, using bell or hands, or making eye contact) to give priority, to let people know they are there or that they have been seen, was seen as an important way to encourage those that might not otherwise walk or cycle, to use the street.

Relative importance for different people

When building the concourse of ideas for the Q-sort it was noticeable that the key informants alone generated more than half of the items that could be categorised as regulations. An example off such an item was: *"drivers have read the Highway Code and passed a driving test" (3).* Fewer than half of the regulations listed in were also mentioned by the focus group members, as can be seen in and .

The category of behaviours shows a similar, if less pronounced opposite pattern, with ten of the behaviour items identified by focus group members as being important, but not also identified as such by key informants. An exemplar item illustrating this was: *"drivers and cyclists not indicating" (51)*. This makes intuitive sense as professionals will tend to consider regulations in the street environment as part of their daily work, whereas members of the public (as exemplified by the focus group members) using streets are less likely to have the regulations in mind. Conversely, street users are more likely to consider the behaviour of other street users when immersed in street life than are professionals, whose view of streets is somewhat more objective and detached. The items on infrastructure were generated almost equally by both the key informants and the focus group members, with most of them being identified by both, such as: *"dropped kerb missing or away from desired crossing point" (43)*.

6.5.2 RQ2: The relative importance of behaviour, design, and regulation

The relative importance of behaviour, design and regulation to a street environment and culture that is conducive to walking and cycling for each viewpoint, is illustrated by the composite arrays (see Figure 49 to Figure 53). Table 40 provides a summary and the numbers in parenthesis represent the rankings from the Q-sort, where +6 indicates items that most encouraged people to walk cycle or roll, -6 items that most discouraged and 0 was neutral.

Table 40 - Relative importance of behaviour, design, and regulation

Relative importance of behaviour, design and regulation to a street environment and culture that is conducive to walking, cycling and rolling		
Viewpoint	**How important (+)?**	**How important (-)?**
We are the traffic	• Design - extremely (+6) [design to suit function] • Regulation - a little (+3/4) [enforcement of regulation] • Behaviour - a little (+3/4)	• Behaviour - extremely (-6) [inconsiderate behaviour] • Design - very (-5) [poor design] • Regulation - not at all (0/-1)
Safety and comfort first	• Design - extremely (+6) [design that creates safety] • Regulation - very (+5) • Behaviour - very (+5)	• Design - extremely (-6) • Regulation - extremely (-6) [weak enforcement air quality standards] • Behaviour - very (-5)
Access is not optional	• Design - extremely (+6) [accessible street design] • Behaviour - very (+5) [mutual respect] • Regulation - a little (+3)	• Design - extremely (-6) [inaccessible street design] • Behaviour - a little (-3/4) • Regulation - not at all (0/-2)
Designed for all	• Design - extremely (+6) [well-designed infrastructure] • Behaviour - very (+5) [clear communication] • Regulation - not at all (0/+2)	• Behaviour - extremely (-6) [dangerous behaviour] • Design - very (-5) • Regulation - not at all (0/-2)
Rules matter	• Regulation - extremely (+6) [laws and regulations] • Design - extremely (+6) • Behaviour - very (+5) [consideration of others]	• Behaviour - extremely (-6) [rule-breaking behaviour] • Design - a little (-3/4) • Regulation - not at all (0/-2)
Overall	• Design - extremely • Behaviour - very • Regulation - mixed	• Behaviour - very • Design - very • Regulation - not very

All the five viewpoints generated from the research agree that design is extremely important to make streets conducive to walking and cycling, exemplified by the shared desire for separation: *"physical separation between cyclists and motorised traffic and between pedestrians and cyclists (e.g., kerbs, different levels or bollards)" (Q-sort statement 11)*. Poor design such as *"routes cluttered with street furniture that restricts or obstructs movement" (statement 44)* also has a strong role in creating hostile streets, but the strength of opinions was slightly less, and the viewpoint 'rules matter' was more ambivalent about the role of poor design. Good design, which is variously described as functional, safe, and accessible, has a stronger role in creating streets conducive to walking and cycling than poor design has in creating hostile streets. The literature suggests that addressing safety and accessibility is the most effective way of getting people to walk and cycle (Panter *et al.*, 2019).

Historic and heritage street features such as steps, kerbs and cobbles are somewhat divisive among users. These features make streets attractive to many, but at the same time they can deny access to others, a point emphasised by the viewpoint, 'access is not optional' and voiced by participant P40: *"if steps are present or dropped kerbs missing it means that I just could not access that route"*. However, users agreed that subtle walking and cycling features such as markers in the paving to indicate separation, do not work and should be avoided: *"little sliver markers in the middle of where people want to walk very subtly mark the cycle space. This is tokenism and very dangerous" (P27)*. People walking (including those that are visually impaired), cycling, and rolling agree that subtle heritage marking fails to work and leaves users confused or frustrated. Design should bring clarity and not ambiguity. Parkin and Smithies (2012) confirm that architecturally attractive design can sometimes be very challenging for people with visual impairments.

Behaviour is important to make streets conducive to all street users, but different viewpoints emphasised different aspects of behaviour: 'access is not optional' – mutual respect; 'designed for all' – clear communication between different user groups; 'rules matter' – consideration of others. 'We are the traffic' were more ambivalent about the positive role of behaviour. Bad behaviour such as *"drivers close passing cyclists or cyclists close passing pedestrians and other shared path users" (statement 58)* appears to play the biggest role in creating streets that are not conducive to walking and cycling. However, the 'access is not optional' viewpoint had a counter perspective due to the critical role that bad design plays for people who roll.

The role of regulation in creating conducive streets generated very mixed views, ranging from not at all from 'designed for all' to extremely from 'rules matter'. 'We are the traffic' and 'access is not optional' were more ambivalent. Except for one viewpoint, the others agreed that regulation and its enforcement were not a very important factor in creating street environments that are not conducive to walking and cycling. The exception was perhaps not such an outlier, as the way it was phrased in the study: *"Lack of enforcement by local and national government of air quality standards"* (*statement 37)* could leave it to be interpreted as the bad behaviour of those in authority rather than regulation (enforcement). The viewpoint 'safety and comfort first' did not see any other regulations as significant in creating streets that were not conducive to street users.

6.5.3 RQ3: Interactions between behaviour, design, and regulation

Given the diversity of the 49 Q-sort participants (socio-economically, age range and experience) and the complexity of sorting 64 items, covering street design, regulation, and behaviour, it is worth highlighting that all their opinions significantly correlated (see Table 20).

The Q-sorts identified five viewpoints on typical streets, each with its set of most important items for creating streets that are conducive to walking and cycling, and that contribute to streets that are hostile. These can be used to explore the potential interrelations of behaviour, design, and regulations and classified as internally related, logical related and stated as being related, see Table 39.

Internally related

Of the important items identified by the viewpoints, eight have been classified as internally related. These are items that have an internal interaction within them; for example, an item might be classified as a behaviour, but it is a rule-breaking behaviour which cannot be separated from the regulations that are being broken. Five of the items were rule-breaking behaviours, where each of the described behaviours necessarily links to at least one regulation:

1. Drivers driving too fast or too close to pedestrians,
2. Vehicle users disobeying speed limits or going too fast for the conditions,
3. Blocking or restricting the width of pavements, cycle tracks or drop kerbs,
4. Drivers who close pass cyclists or cyclists close passing pedestrians, and
5. Cycling on the pavement.

Rule-breaking behaviours cannot be separated from the regulations that are being broken and in the post-Q-sort interviews some participants made these connections, for example describing parking on the pavement as both a driver behaviour and an unenforced breach of regulations (driving on the pavement and blocking the highway): *"parking on the pavement is rife around here – in one road I counted 27 cars on a single pavement. There doesn't seem to be any enforcement" (P22)*.

Rule-breaking behaviour is clearly important to street users. Many studies have focused on whether drivers or cyclists are the biggest offenders and the impact of these groups on each other (Danish Road Directorate, 2019; Reid, 2019; Road Network Performance and Research Team, 2007; Lin *et al*., 2017; Huemer, 2018). However, the study findings showed that the more important consideration was that the biggest impact of rule-breaking is on people who walk or roll.

Logically related

Of the important items identified by the viewpoints in Table 39 the third column lists items that are logically related. These are items that can clearly be seen to be related, for example design regulation and behaviour items related to speed. Five other topics highlighted similar logical relationships. Useable width of routes, driving too close adjacent to pedestrians, space allocation and accessibility all linked behaviour and design items. Policies linked behaviour, design, and regulation items.

Studies such as Gårder *et al*. (1998) have demonstrated that good design attracts more people to walk and cycle because routes are seen as safer and more convenient. However, this study showed that good design needs to also be supported by good behaviour. The useable width on streets is an issue for users. There is a logical link between the useable width of walking and cycling infrastructure, and the action (or inaction) of blocking or restricting them by parking, leaving waste bins out, the placement of advertising A-frames and temporary signs, making deliveries, erecting scaffolding, and failing to trim hedges. Some interviewees who use mobility scooters and wheelchairs described how both narrow infrastructure and footways blocked by the behaviour of others had the same result for them, streets that were impassable. In all these cases the width available in practice varied in an unpredictable and temporary way because of the behaviour of others.

Items stated as being related

This sub-section considers combinations of items that the viewpoints explicitly stated as being related. These combinations of items are ones that viewpoints described as tipping points. The tipping point items are viewed as a condition of either use or avoidance of a street or route. Two viewpoints identified a combination of items that suggested interactions of street user behaviour, design and regulation necessary to create a network of streets that is conducive to walking, cycling, and rolling.

For 'access is not optional', three positive tipping point items were identified which link design and behaviour. Accessibility is the overarching focus of those that align with this viewpoint and so accessible design is a prerequisite for use of a street or route. Physical separation between modes suggests an improved walking and rolling environment which would make a route attractive to use. This corroborates the literature that generally suggests that people using active modes prefer to be separated from other modes (Marqués *et al*., 2015; Hull and O'Holleran, 2014; Bellizzi, Eboli and Forciniti, 2019; Pucher, 2000). However, the link made in this viewpoint goes further by identifying that for accessible design to be truly accessible it needs to be accompanied by actions or behaviours that keep routes open by ensuring that they are clean, cleared of leaves and rubbish and that drains are kept unblocked.

For 'designed for all' seven positive and seven negative tipping point items were identified. This was far more than for any other viewpoint and is an indication of just how sensitive people who identify with this viewpoint are to negative items that would deter them from using active modes. They are easily deterred and difficult to persuade as the view also identifies seven positive items that need to be in place if they are going to consider walking or cycling along a particular street or route. Both sets of items are a mixture of design features and behaviours. The view expressed here suggests that for many people whose default mode is motorised, it is going to take a significant combination of design features, positive behaviours, and related regulations for them to even consider using a street or route to walk or cycle. Walking and cycling routes would need to be direct, with physical separation between modes, wide enough to accommodate the flow and with adequate geometry and visibility for cyclists in their space. The adjacent roads must be designed for low traffic speeds. Drivers, cyclists, and pedestrians need to be speaking to one another, using their bells or hands, or simply making eye contact, to clearly and cordially communicate in order to give priority, to let people know they are there, or that they have seen the other road users. The view acknowledges that this street transformation can only be achieved with the supportive actions of politicians who create policies for walking and cycling, and who publicly support, and promote it by allocating street space and funding.

The discussion has considered the evidence in relation to the SEMA and has found that it is a good model to use. The evidence describes well in five viewpoints the way streets are used and has provided appropriate answers to the three research questions. Having answered those questions, the final chapter brings the thesis to a close by drawing conclusions and making recommendations.

7 CONCLUSION AND RECOMMENDATIONS

7.1 Structure of the chapter

This final chapter draws conclusions and makes recommendations.

Q-methodology has been used to explore street users' viewpoints about the street environment and the extent to which streets are conducive to walking, cycling, and rolling. Focus groups and key informant interviews were used as input to Q-methodology, and factor analysis generated five groupings of viewpoints: 'we are the traffic'; 'designed for all'; 'safety and comfort first'; 'access is not optional'; and 'rules matter'. The Covid-19 pandemic was taking place during the data collection phase, and this was a benefit because it revealed to participants different possibilities for street use.

The research was guided by the postulation of a new theory named the Social Ecological Model of Ability, which combines an adapted version of the Social Ecological Model and the Social Model of Disability. The model defines the dynamic interrelations among various personal and environmental factors with a particular focus on barriers in relation to personal abilities. The model fills the gap between behavioural theories, anthropological theories, and theories of disability.

Section 7.2 draws conclusions from the research findings and links those to the Social Ecological Model of Ability. Section 7.3 addresses some of the limitations of the study. Section 7.4 presents opportunities for further research. Recommendations are made in Section 7.5 for practice and civil society groups.

7.2 Conclusions

Section 7.2.1 summarises the theory, and Section 7.2.2 summarises the findings. Section 7.2.3 then relates the findings to the theory.

7.2.1 The use of the postulated theory

A Social Ecological Model of Ability (SEMA) is the theory postulated in Chapter 4 and arises from an amalgamation and adaptation of the Social Ecological Model (SEM) and the Social Model of Disability (SMD). This combination was necessary to understand how an individual's street use behaviour evolves in a way that is influenced by the multi-levels of the ecosystem of their environment, and how those individuals can be marginalised by the environment they find themselves in.

The SEMA has five levels: individual, micro (interpersonal), meso (immediate community), exo (institutional environment) and macro (political and social structure). Factor analysis within the framework of Q-methodology was used to develop cognate viewpoints about the use of streets. Five viewpoints emerged from the participants. These viewpoints have been used to illuminate the dynamic inter-relations that are going on within and between the different levels in the model.

7.2.2 The Findings

Focus groups were used to understand user views, and key informant interviews were used to understand the actions of designers and policy makers. It was noticeable that key informants only focused very narrowly on the domain closest to their profession, particularly design and regulation, whereas street users thought broadly across all three domains. Q-methodology provided an understanding of the strength of association between different items relevant to making streets conducive to walking, cycling, and rolling. Five viewpoints emerged as follows.

1. 'We are the traffic', a view that streets are places people pass along and that walking, cycling, and using wheeled devices such as mobility scooters, are functional and practical ways of getting from A to B. The street network should be designed for the movement of this traffic. For those that align with this viewpoint they are encouraged to use streets with functional design, where regulations are enforced. They are discouraged by inconsiderate behaviour and poor design.
2. 'Safety and comfort first', a view that streets are places where some want to stop and linger, where older people are catered for, with adequate seating and toilets. Safety and comfort are more important than the ability to move quickly. For those that align with this viewpoint they are encouraged to use streets with good place making design, supported by policy, regulation, and enforcement. They are discouraged by a wide range of issues, from poor maintenance and a failure to uphold air quality standards, to car-centric polices.
3. 'Access is not optional', a view that streets deny access to some. Street design determines whether a street or route is useable by people, especially those that use wheelchairs. People that align with this viewpoint are encouraged by accessible street design and mutual respect but can be denied access by steps and missing dropped kerbs.
4. 'Designed for all', a view that streets should be attractive, diverse environments where anyone can walk, cycle or roll. People who align with this view are

encouraged to use streets that have well-designed infrastructure that is safe and inviting with enough room, supported by clear communication between different users. They are intimidated by dangerous behaviour.

5. 'Rules matter', a view that street rules should prompt those that can harm most to take a greater share of responsibility for others. To make the street environment function for everyone, users need to understand the rules, be considerate and take personal responsibility for the safety and comfort of others. The law and regulation can be effective to moderate bad behaviour, aided by enforcement. People who align with this view are discouraged by rule breaking and inconsiderate behaviour by drivers and riders, particularly inappropriate speed, and proximity.

The five viewpoints provide a broad, appropriate, and valuable perspective on streets; the elements that, if present, encourage people to use them, on foot, cycling or rolling. The views particularly highlight the insights of people who are most marginalised by streets, those who are, or perceive to be, the most at threat from motorised vehicles, other street users and the environment generally.

It is concluded that Q-methodology worked well for the purposes to which it was put. It proved to be adaptable when the Covid-19 pandemic struck during the data collection phase, because the approach was flexible enough to enable a move online. Participants young and old, including people who were visually impaired, were able to engage. The method provided answers to the three research questions. The Q-method was adapted to identify the threshold, at which each participant would be prepared to walk or cycle. The innovations developed in the methodology were useful and provided additional information without compromising the integrity of the approach.

In relation to the research questions, the following may be concluded:

1. What are the elements of street user behaviour, design and regulation that are most important to the most marginalised people on foot, cycle or rolling?

The elements of street user behaviour, design and regulation that are most important to the most marginalised people on foot, cycle or rolling can, from the data collected as part of this research, be summarised as separation of modes, low motor traffic speeds, adequate route width (for each mode), surface smoothness, direct routes, and mutual respect. Overall, the single most important element for creating streets conducive to walking and cycling, was physical separation between the modes.

2. What is the relative importance of these elements to streets conducive to walking and cycling?

All five viewpoints each suggest that functional, safe, and accessible design are the most important factors to make streets conducive to walking, cycling, and rolling. The viewpoints also suggest that behaviour is also important. However, perspectives on the role of regulation varied significantly across the viewpoints. Bad behaviour plays the most important role in creating streets that are hostile. The exception was for people who use a mobility device, for whom inaccessible design is the biggest barrier to use; poor design is also important to other users, but not as critical. Regulation and its enforcement appear to be the least important factor, but many of the 'bad' behaviours are rule-breaking behaviours which are linked to rules and regulations.

3. What are the interactions of these elements that create a network of streets conducive to walking and cycling?

Interrelations were categorised as internally related, logical related and stated as being related. The internally related issues were mainly rule-breaking behaviours which cannot be separated from the regulations that are being broken. They also included an issue that links design to regulation that will affect street user behaviour. Another issue related to enforcement which links regulation and behaviour.

The logically related items showed relationships between two or more items. One example was *'roads that are designed for low traffic speeds'*, a design feature that is logically related to *'20 mph maximum speed limits'*, a regulation. The logically related items covered six topics: useable width; being too close adjacent to pedestrians; speed; space allocation; policies; accessibility.

The items stated as being related were derived from the threshold items identified by each viewpoint. These were combinations of design and behaviour items that, if present, would be enough to persuade people aligned with a particular viewpoint to either use, or not to use that street. The connections between the behaviours and design items were established as the shared view was that the items all had to be present for the threshold to be met.

7.2.3 Summary of the findings as they relate to the theory

SEMA theory was useful in illuminating how citizens have been shaped at every level to accept streets with their car-based norms, and not to challenge the disabling barriers to wider street use participation. There was a tendency for participants in the Q-study to focus on the institutional environment and street design. They highlighted physical separation between the modes as being very important for encouraging people to use streets. The study occurred at a time when authorities in Paris were addressing this issue by creating a network of separated cycle tracks, and 50 km of route was added since the outbreak of Covid-19. In the intervening period temporary provision has been made permanent. Mayor Hidalgo was successfully re-elected on 28th June 2020 on a pro-walking and cycling agenda, providing political and social structure support (macro-level) for the initiative. This is an example that it is possible for political leaders to receive a democratic mandate to support ‘people in streets’ rather than ‘traffic in towns’.

The model was shown to be logically consistent and provides a good explanation of what was observed in the study and the experiences articulated by the participants. The model has good explanatory power because each of the different levels of the model are associated with, and can provide further theoretical illumination of, the viewpoints, emerging from the evidence. There is a logical link between exposure to the street environment and experiences of an individual in a street environment and their subsequent behaviour. The model combines the two theories of the Social Ecological Model (SEM) and the Social Model of Disability (SMD) and opens up the possibility for SEM to be used in a wider range of contexts. In sum, SEMA has the attributes of a good theory to investigate the inter-relationships and viewpoints that relate to street use. There could be, therefore, other applications for this framework in wider transport planning.

7.3 Limitations

Prior to finalising the research questions and adopting Q-methodology, the researcher sought funds from the Horowitz Foundation for Social Policy to finance an experimental design using the Bristol Robotics Laboratory (BRL) driving simulator. This was agreed in principle with BRL, but the funding proposal was not successful and alternative methods were pursued.

The P-set was a purposeful sample, but inevitably there was some self-selection among the potential research participants as participation was entirely voluntary. Several members of the P-set (research participants) when interviewed stated that it would have been a much easier task to sort the items had they not been a mixture of design, regulation, and behaviour, coupled with the impact of these on people walking, rolling, cycling, and driving. However, Q-methodology enabled them to cope with this challenging task and the level of communality between sorts suggested that there was a high level of rigour to the results. Additionally, the task reflected the complexity of the reality of the street environment for users.

Much of the data collection took place during the initial Covid-19 lockdown or shortly afterwards (from May to September 2020). The pandemic caused major disruptions to the lives of the participants and required rapid adaptations to be made to the data collection process. Two focus groups were cancelled when a care home and a secondary school were closed at short notice near the outset of the pandemic. One of the replacement focus groups only consisted of two people. Although this was far from ideal, it still had the dynamics of a focus group, and it did raise some new insights that produced additional Q-sort statements. To mitigate the impact of Covid-19 on the results, the Q-sort participants were told to complete the Q-sort and ranking exercise as far as possible based on their experiences of streets in non-Covid-19 times but were told that they would be given the opportunity to discuss the impact of Covid-19 on their view of streets in the post-Q-sort interviews.

7.4 Opportunities for further research

The research touched upon three areas that provide an opportunity for further research:

1. ***Q-methodology innovations.*** The adaptation involved adding questions to the post Q-sort interviews to identify the thresholds or tipping points which would cause participants to either choose or avoid a street or route to walk, cycle or roll. The Q-methodology innovation of considering thresholds developed and used in this study could be applied to a different subject matter, to test the robustness and replicability of this methodological enhancement, and to make any refinements as required.
2. ***The Social Ecological Model of Ability (SEMA).*** The SEMA could be assessed for falsifiability by examining the different street use choices of people who have been exposed to similar environments (e.g., siblings). There would be benefit in devising an experiment where the behaviours of siblings are compared in the light of the exposure and experiences of street environments that they have had since childhood. It should be possible to demonstrate if there is a logical link between exposure and subsequent behaviour. The same approach could be applied to people's exposure to barriers in the street environment.
3. ***Patterns of street use.*** Patterns of street use for different typologies of streets could be evaluated. The study findings suggest that the environment and culture of streets influences who uses streets and how they use them. This can be tested by evaluating who uses different types of streets, including key walking and cycling routes, destination streets, and streets with different levels of accessibility and cycle provision. The evaluation should consider people who walk, cycle, use wheeled

mobility devices and pushchairs, visually impaired people, and other demographics (including age, gender, and ethnicity). The evaluation could be used to determine the characteristics of street users in different environments, to establish underrepresented groups, mode use, and what part of the street people are using.

7.5 Recommendations

The five viewpoints on street environment and culture provide a good understanding of the ways that people view the street environment and its culture. The responses that participants provided in the context of developing the five viewpoints also identified a range of comments that are readily turned into practical recommendations. Table 41 summarises these by viewpoint. The first column summarises a broad description of the nature of the change required. The next two columns summarise the practical solution and its consequences.

Table 41 - Practice based solutions arising from the responses of the participants

Recommendations by viewpoint	Practice solutions	Consequences
Development of walking and cycling infrastructure *Movement* *We are the traffic*	• Kerb separated walking from cycling from motor traffic • Direct and navigable • Minimise need to slow, stop, or wait • Wide enough to accommodate flow • Form a network • Slow road traffic • De-clutter footways	• Kerb separate & people will use it • Makes walking, cycling, and rolling genuine utility alternatives to public transport and driving • Every missing and incomplete route will induce motorised traffic • If road traffic is too fast & footways too narrow, people will not walk
Design streets as whole entities *Place* *Safety & comfort first*	• Designed for low traffic speeds and 20 mph speed limits • Physical separation of modes • Surfaces that are smooth • Allocate space and resources to walking and cycling • Good maintenance • Enforce air quality standards • Stop blocking pavements with parking, waste bins, A-frames, etc • Restrict parking and driving	• Design destination streets for low speeds and keep pedestrians and mobility scooters separate from traffic and they will use them • Can revive and save local high streets and retail centres, as they emerge from Covid-19 • Failure to address this could damage the economy and people's health and well-being
Enhance design detail and construction quality *Access* *Access is not optional*	• Route surfaces that are smooth • Physical separation of modes • Clean, cleared of leaves and rubbish and drains kept unblocked • Wide enough for double buggies and mobility scooters to pass • Remove barriers such as steps, non-level crossings, steep gradients, and cross falls • Remove street furniture clutter	• People will use smooth separated routes if kept clear • Rights issue – ensure no-one is excluded from streets • Remove barriers between homes and streets or transport • Reduces motorised traffic • Positive effect on health and well-being
Significant re-building of virtually all aspects of the street environment *Place and access* *Designed for all*	• Direct, wide, separated routes • Space & funding for walking & cycling • Roads designed for low-speed traffic • Tackle intimidating speeding & close passing behaviour and inappropriate interaction with strangers • Install missing dropped kerbs • Limit steep gradients and cross falls	• When all items are in place those who drive by default can consider mode change • Driving for local journeys must be made more difficult • When active modes are the obvious choice on local streets people will start to change
Development of methods to enhance rule compliance *Movement and access* *Rules matter*	• Separation between modes ideal • Routes wide enough for all users • Reform Highway Code to generate mutual respect and consideration for the safety and well-being of other street users • Slow speeds so drivers, cyclists, and pedestrians can talk to each other and hear electric cars, e-scooters, cycles, or mobility scooters approaching	• Where and when separation is not possible, streets can be reformed so they are safe and attractive for all users • Reform can start at street level, cross-city or at national level as Covid-19 demonstrated • Pedestrian and cycling priority streets

From the many detailed proposals in the table above, the viewpoints conveyed a few priorities which are articulated in the following six overarching recommendations for practice:

1. **Quality walking and cycling networks should be created**. Quality routes should include physical separation between cyclists and motorised traffic, and between pedestrians and cyclists, that are wide enough for the flow, direct, and with a smooth surface. Networks should connect homes with shops, schools, leisure venues, and workplaces.
2. **Streets should be designed for low motor traffic speeds so that people can walk, cycle, stop or linger**. Streets open to walking and cycling should provide facilities that include toilets and seating and should utilise features and regulations that will nurture mutual respect between users of different modes.
3. **More street space and adequate resources should be allocated to enable walking and cycling.** Simultaneously space dedicated to parking and driving, and resources allocated to road schemes should be reduced.
4. **All walking routes should be designed so that they are accessible to wheeled mobility devices.** They should be kept open through regular maintenance, cleaning, and removal of standing water.
5. **Footways and cycle tracks should be kept free of obstacles that block or reduce their effective useable width.** Effective policy, along with good management of licences and services should be used to achieve this.
6. **Intimidating behaviour that renders streets hostile to users should be addressed.** Rule-breaking that includes speeding and close passing, along with inappropriate interactions with strangers should be tackled through design, wider public campaigns, and enforcement.

Three major topics addressed in this research were the Highway Code, the socio-technological transformations that may lead to the 'smart cities' of the future, and design guidance. A further three recommendations for practice emanating from the viewpoints are made and applied to each of these topics:

7. **Laws should be changed so that people who walk, cycle and roll are afforded similar legal rights and protection as people who use motor vehicles.** The Highway Code relating to active travel should be upgraded from guidance denoted by "*should*" to legal requirements denoted by *"MUST"*.

8. **Future design and regulation changes to address the socio-technological transformation of the transport system should create a framework for technology that serves people in streets.** Walking, cycling, and rolling behaviour should not be required to adapt to accommodate the electrification of infrastructure, smart technology, and the transition towards electric and automated vehicles or whatever forms future traffic in towns may take.
9. **Consideration should be given in design guidance to a range of factors**, as listed below.
    a. **Place and movement functions should be reframed to be from an active travel perspective because some streets can perform both functions well.** Speed and space allocation are key and LTNs could play a valuable role in creating residential streets and destination streets that perform both a movement and place function for active travel.
    b. **The Highway Code user hierarchy should always be considered when developing an active travel network that provides full separation of modes.** The hierarchy would suggest that walking routes should be prioritised with a first claim on space, ensuring that journey delay and user risk are minimised.
    c. **People using mobility devices should always be given access.** That access should extend beyond the main centres and destination streets and include historic residential areas. Guidance should not assume that people with mobility impairments can or want to arrive by car.
    d. **Guidance should not leave inappropriate options open for designers.** Guidance should avoid clauses such as 'wherever possible' for designs that benefit active travel, without at least identifying when that could be the case, and considering the implications. Exceptions often lead to breaks in the active travel network which will limit options for many people.

Finally, civil society has a role to play. As Sheller (2018) noted, the whole world must answer the question of how we transition to more environmentally sustainable and socially just mobilities and described a triple mobility crisis. Disability, walking, and cycling civil society groups should be aware of the signs that the political and social discourse is moving from 'traffic in towns' to 'people in streets'. The five viewpoints provide a useful way of understanding the barriers to participation that different segments of society face. The viewpoints can enable civil society to better campaign for walking and cycling environments that work for everyone, in support of the recommendations above.

Undoubtedly there will be some contestation from drivers outside of these civil society groups, and this is likely to be based on their perception that they have something to lose in a process of transition. However, civil society ought to speak out in the face of injustice as brought into sharper relief as a result of the recent changes in the Highway Code (Department for Transport, 2022) that have established a hierarchy of street users that places people who walk, cycle, and roll at the top.

The research recommendations, if enacted, would be a step towards the levelling of the playing field that has been heavily weighted towards driving at least since the 1960s. They would allow a transition from ‘traffic in towns’ to ‘people in streets’.

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9 APPENDICES

9.1 Appendix A: Focus group topic guide

How Streets are Used – Focus Group

Facilitator’s Guide

Welcome & Introduction (15 minutes)

Ask participants to write their full name on list

Thank you for taking part

Introduce myself, any other team members and their roles (if present)

Housekeeping: toilets & fire escape

- The purpose of the focus group meeting is to have a friendly informal discussion on how the behaviour of others, infrastructure design and regulation interact to create typical streets that are conducive to movement on foot, cycle or other human-scale modes. Aim to identify behaviours, infrastructure designs and regulations either make important contributions towards this, or which seriously detract from this. I will facilitate the discussion this morning/afternoon/evening. Overall, we expect to finish in about an hour and 15 minutes

Provide brief presentation on the research topic area:

- Use a combination of topic information sheet and PowerPoint presentation to introduce the topic
- Purpose of audio-recording, use of data including personal data, withdrawal etc. Follow the Info Sheet to explain everything.

I would like to give you some more details about this focus group.

- Has anyone been involved in a focus group discussion before?
- Explain what a focus group is:
    - Purpose is to have a friendly discussion on topics I will provide through questions
    - No right or wrong answers, please feel to ask questions yourselves and stop discussion if there is anything you don’t understand
    - We’re not seeking consensus
    - Respect diversity and difference of opinions
    - Allow everyone to express their views
    - I will need to steer discussion if people go off the tangent

- Any questions?
- **Informed consent: participants to complete**
- Collect informed consent forms

Questions/topics (1 hour)

Start recording!

- Round the table introduction:
  - First name, something about you, how do you get around for local journeys (less than 2 miles)?

Firstly, I would like to understand your gut feelings and top of mind thoughts about your local streets, the ones you are most familiar with.

- Think about your local streets (the ones around where you live or other streets in the city where you could make journeys on foot/cycle/mobility scooter/wheelchair):
  - Are they easy/comfortable to walk along?
  - Are they attractive to walk along?
  - Are they safe to walk along?
  - Is the same true if you are pushing a buggy or using a wheelchair/mobility scooter?
  - What about a double buggy?
- Think about the same streets:
  - Are they easy/comfortable to cycle along?
  - Are they attractive to cycle along?
  - Are they safe to cycle along?

Questions for people that push buggies

- When you are pushing a buggy along a pavement what makes that easier?
    - Think about the physical environment
    - Think about the behaviour of other people in the street, who might be walking, pushing a buggy like you, using a mobility scooter, cycling, driving, running a business or carrying out works
    - Think about rules, regulations and laws on that street and how they are enforced (eg where you can park/leave your rubbish, how far from the edge of a kerb a bollard has to be, who is allowed to use the pavement, etc)
- When you are pushing a buggy along a pavement what makes that harder?
- What would make using that pavement with a buggy more attractive?
    - Think about the physical environment
    - Think about the behaviour of other people in the street, who might be walking, pushing a buggy like you, using a mobility scooter, cycling, driving, running a business or carrying out works
    - Think about rules, regulations and laws on that street and how they are enforced
- What would make using that pavement with a buggy less attractive?
- What would make using that pavement with a buggy safer?
    - Think about the physical environment
    - Think about the behaviour of other people in the street, who might be walking, pushing a buggy like you, using a mobility scooter, cycling, driving, running a business or carrying out works
    - Think about rules, regulations and laws on that street and how they are enforced
- What would make using that pavement with a buggy more dangerous?
- Consider when you have to cross a side road with your buggy, what makes that easier/harder?
- What makes a side road more/less attractive to cross with your buggy?
- Consider when you have to cross a side road with your buggy, what makes that safer/less safe?
- Are there any streets that you avoid with your buggy? Why?
- Are there any streets that you would go out of your way to use with your buggy? What is it about that street that makes you do that?

Questions for people that use manual wheelchairs/mobility scooters

- When you are travelling in your wheelchair/scooter along a pavement what makes that easier?
    - Think about the physical environment
    - Think about the behaviour of other people in the street, who might be walking, pushing a buggy, using a wheelchair/mobility scooter like you, cycling, driving, running a business or carrying out works
    - Think about rules, regulations and laws on that street and how they are enforced (eg where you can park/leave your rubbish, how far from the edge of a kerb a bollard has to be, who is allowed to use the pavement, etc)
- When you are travelling in your wheelchair/scooter along a pavement what makes that harder?
- What would make using that pavement with a wheelchair/scooter more attractive?
    - Think about the physical environment
    - Think about the behaviour of other people in the street, who might be walking, pushing a buggy, using a wheelchair/mobility scooter like you, cycling, driving, running a business or carrying out works
    - Think about rules, regulations and laws on that street and how they are enforced
- What would make travelling along a pavement in your wheelchair/scooter less attractive?
- What would make travelling along a pavement in your wheelchair/scooter safer?
    - Think about the physical environment
    - Think about the behaviour of other people in the street, who might be walking, pushing a buggy, using a wheelchair/mobility scooter like you, cycling, driving, running a business or carrying out works
    - Think about rules, regulations and laws on that street and how they are enforced
- What would make travelling along a pavement in your wheelchair/scooter more dangerous?
- Consider when you have to cross a side road in your wheelchair/scooter, what makes that easier/harder?
- What makes a side road more/less attractive to cross in your wheelchair/scooter?
- Consider when you have to cross a side road in your wheelchair/scooter, what makes that safer/less safe?
- Are there any streets that you avoid in your wheelchair/scooter? Why?
- Are there any streets that you would go out of your way to use in your wheelchair/scooter? What is it about that street that makes you do that?

Questions for people that are Visually Impaired

- When you are walking along a pavement using a cane, residual vision of a dog, what makes that easier?
    - Think about the physical environment
    - Think about the behaviour of other people in the street, who might be walking, pushing a buggy, using a wheelchair/mobility scooter, cycling, driving, running a business or carrying out works
    - Think about rules, regulations and laws on that street and how they are enforced (eg where you can park/leave your rubbish, how far from the edge of a kerb a bollard has to be, who is allowed to use the pavement, etc)
- When you are walking along a pavement what makes that harder?
- What would make using that pavement with a visual impairment more attractive?
    - Think about the physical environment
    - Think about the behaviour of other people in the street, who might be walking, pushing a buggy, using a wheelchair/mobility scooter, cycling, driving, running a business or carrying out works
    - Think about rules, regulations and laws on that street and how they are enforced
- What would make walking along a pavement less attractive for you?
- What would make walking along a pavement with a visual impairment safer?
    - Think about the physical environment (including tactiles)
    - Think about the behaviour of other people in the street, who might be walking, pushing a buggy, using a wheelchair/mobility scooter, cycling, driving, running a business or carrying out works
    - Think about rules, regulations and laws on that street and how they are enforced
- What would make walking along a pavement more dangerous?
- Consider when you have to cross a side road, what makes that easier/harder?
- What makes a side road more/less attractive to cross if you are visually impaired?
- Consider when you have to cross a side road, what makes that safer/less safe?
- Are there any streets that you avoid? Why?
- Are there any streets that you would go out of your way to use? What is it about that street that makes you do that?

Questions for cyclists:

- Where do you cycle most? Why?
- Do you ever cycle on local streets? If not why not?
- What are you favourite cycle streets? Why, what is it about those streets that makes them:
    - Easy/comfortable to use?
    - Attractive to use?
    - Safe to use?
    - Think about the physical environment (eg quality of surface, lanes/tracks/shared path)
    - Think about the behaviour of other people in the street, who might be walking, pushing a buggy, using a mobility scooter, cycling like you, driving, running a business or carrying out works
    - Think about rules, regulations and laws on that street and how they are enforced (eg where you can cycle, how fast you can go, etc)
- When you are cycling along a street what makes that harder/less attractive/more dangerous?
- Consider when you have to cross a side road on your bike, what makes that easier/harder?
    - More/less attractive?
    - Safer/more dangerous?
- Are there any streets that you avoid with your bike? Why?
- Are there any streets that your parents/carers/other adults stop you using? Why? What are those streets like?

[Note: timings for the discussions with 12-year-old cyclists may need to be reduced to fit with length of lessons and potentially shorter attention spans]

Questions for car drivers:

- Think about the local journeys you make by car and the streets you drive along.
- What would make the pavements on those streets easy/comfortable to walk along?
    - Think about the physical environment
    - Think about the behaviour of other people in the street, who might be walking, pushing a buggy, using a mobility scooter, cycling, driving like you, running a business or carrying out works
    - Think about the rules, regulations and laws on that street and how they are enforced (eg where you can park/leave your rubbish, how fast you can drive, are there restrictions such as bus lanes, etc)
- What makes it difficult for people on foot?
- What would make walking in those streets more attractive?
    - Think about the physical environment
    - Think about the behaviour of other people in the street, who might be walking, pushing a buggy, using a mobility scooter, cycling, driving like you, running a business or carrying out works
    - Think about rules, regulations and laws on that street and how they are enforced
- What would make walking in those streets less attractive?
- What would make walking in those streets safer?
    - Think about the physical environment
    - Think about the behaviour of other people in the street, who might be walking, pushing a buggy, using a mobility scooter, cycling, driving like you, running a business or carrying out works
    - Think about rules, regulations and laws on that street and how they are enforced
- What would make walking in those streets more dangerous?
- Consider when you turn in and out of side roads, what makes crossing those side roads easier/harder for people on foot, or in a mobility scooter?
- What makes a side road more/less attractive to cross on foot?
- What makes a side road more/less safe to cross on foot?
- What about for cyclists – what makes those streets easy/comfortable, attractive or safe to use?
- Are there any streets that you would never walk along? Why?
- What are the streets like that you would be prepared to walk on?

Additional questions for everyone

- Thinking of the local journeys that you make
  - Are there some features of the routes that you take for local journeys that make them particularly easy or comfortable/attractive/safe for walking, using a mobility scooter/wheelchair or cycling?
  - Or features that that make them particularly difficult/unattractive/dangerous for walking, using a mobility scooter/wheelchair or cycling?
- Has this discussion been useful to you? In what way?
- Do you think it is good to involve the general public in decisions around improving urban areas for walking, cycling and using wheelchairs/mobility scooters? How?
- Any more questions and comments that you wish to add?
- Please leave any further feedback on the post it notes (anonymously) – categories on flip charts
- Are you willing to be contacted again to take part in the next stage of this research?
- Do you know any others (list categories) who might be interested in taking part?

THANK YOU FOR YOUR TIME

9.2 Appendix B: Q-sort items

The final 64 items used in the study:

1. 20mph maximum speed limits
2. Warning signs or road markings
3. Drivers have read the Highway Code and passed a driving test
4. Laws regulating use such as the Highways Act (1980)/Road Traffic Act (1988)/Traffic Management Act (2004)
5. Local authority civil enforcement of bus lanes and parking restrictions (e.g., resident parking zones and double yellow lines near junctions)
6. Police enforcement of speed limits, close passing of cyclists, drink driving, using a mobile phone while driving, cycling on the pavement, pavement parking, and other traffic offences
7. Direct routes which for pedestrians avoid deviations, and for cyclists are at least as direct as those for motorised traffic
8. Routes that are designed to minimise the need to slow, stop or wait (e.g. they allow high walking or cycling speeds, and no or few crossing points and obstacles)
9. Routes that are wide enough to accommodate the flow: pedestrian routes that can accommodate double buggies and allow mobility scooters to pass, and cycle tracks that enable overtaking
10. Adequate geometry, visibility and space for cyclists to avoid running into the path of motor traffic or pedestrians, allowing for errors and evasive manoeuvres
11. Physical separation between cyclists and motorised traffic, and between pedestrians and cyclists (e.g. by using kerbs, different levels or bollards)
12. Route surfaces that are smooth
13. Roads that are designed for low traffic speeds (e.g. physical measures that make it difficult to drive fast, visual appearance that causes drivers to slow down)
14. Routes that are overlooked (e.g. by the fronts of houses or shops)
15. Street design that is attractive or interesting (e.g. plantings, architecture and artwork)
16. Contrast in the look of footways, cycle tracks, carriageways and changes in level, including colour contrast
17. Consistency of design approaches (e.g. within a street, within a town or nationally)
18. Zebra crossings at side roads (or both a zebra crossing and a cycle crossing in parallel if there is a cycle track)

19. Seating, both formal and informal (e.g. bench or wall or planter with a wide rim)
20. Useable cycle parking facilities (e.g. Sheffield stand), suitable for different cycle types
21. Routes that provide some shelter and shade from wind, rain and sun (e.g. shelter and seating at bus stops, adequate space for waiting that enables safe circulation)
22. Routes are navigable because of clear wayfinding and direction signs or markings, including guidance on pavement and track surfaces)
23. Routes that engage the senses: pleasant, localised smells (e.g. bread, coffee, flowers), ambient sound (e.g. music, bird song, church bells), and tactile surfaces
24. Cycle routes and adequately wide footways including dropped kerbs around temporary works that minimise diversions and do not restrict free movement
25. Drivers and cyclists turning in or out of a side road who stop for crossing pedestrians and cyclists (if there is a cycle track) whether or not there is a zebra or informal crossing point
26. People who respect and have consideration for the safety and general well-being of other users of the street
27. Politicians (local and national) who create policies for walking and cycling, and who publicly support, and promote it, (e.g. by allocating more space and resources)
28. People who use and respect infrastructure that has been provided, and who use it as intended (pavement, cycle track/lane and road)
29. Routes that are clean, cleared of leaves and rubbish and drains that are kept unblocked
30. Clear and appropriate communication between drivers, cyclists and pedestrians to give priority, to let people know they are there, or that they have seen other road users (e.g. verbally, using bell or hands, or making eye contact)
31. Other people that are doing the same as me (e.g., walking, cycling, or moving in the same direction)
32. Shops or businesses that are open and/or there is other activity on the street
33. “Cycling dismount” (or similarly constraining) signs
34. Cycle tracks closed to wheelchairs or mobility scooters and other wheeled vehicles such as e-scooters
35. Lack of public information films and adverts to reinforce understanding of rules (including changes to rules) and good street behaviour
36. Each local authority has its own design guidance (no UK-wide walking and cycling standards)

37. Lack of enforcement by local and national government of air quality standards
38. Large gradients, slopes and cross falls
39. Steps
40. Lack of pavement
41. Wide mouths to side road junctions
42. Incorrect or missing tactile paving
43. Dropped kerbs that are missing or away from the desired crossing point
44. Routes that are cluttered with street furniture that restricts or obstructs movement (guard rails, lighting columns, sign poles, litter bins, seats, unused telephone boxes, etc.)
45. Routes that are poorly lit (not lit, too dim, lit in wrong places, there are places to hide in shadows, etc.)
46. Overhanging trees and branches or untrimmed hedges (and other head hazards)
47. Routes that are poorly-maintained (e.g. fading paint markings, roots and potholes)
48. Route surfaces that are slippery, especially when wet or icy (and ungritted)
49. Noise caused by others using the street (e.g. vehicle noise, shouting or using heavy machinery)
50. Vehicle users disobeying speed limits or going too fast for the conditions
51. Vehicle users who do not indicate a turn they are about to make
52. Uninvited, unwelcome, inappropriate interaction with strangers (e.g. pedestrians deliberately blocking the path of cyclists on a shared path or unwelcome or abusive comments from a passer-by)
53. Blocking or restricting the width of pavements, cycle tracks, drop kerbs or other crossings, or blocking the view of people with buggies, in mobility scooters, children, etc. (with parking, waste bins, advertising A-frames, deliveries, scaffolding, temporary signs, hedges, etc.)
54. Cycling on the pavement
55. Cyclists or mobility scooter users who approach other users assuming that they will move aside
56. Distracted people who do not look where they are going or are not aware of their surroundings (e.g. looking at phones, chatting to friends, listening to music)
57. Drivers who splash users of footways or cycle tracks
58. Drivers who close pass cyclists or cyclists close passing pedestrians and other shared path users

59. Drivers driving too fast or too close to pedestrians, especially when footways are narrow (e.g. resulting in threat or perceived threat of being hit by a wing mirror)
60. Approaching others (especially) from behind in (almost) silent vehicles (electric cars, cycles or mobility scooters) without any audible warning
61. Politicians (local and national) who stand up for parking and driving, supported by policies (e.g. allocating or protecting space and resources)
62. Opening car doors, especially across footways and cycle tracks/lanes, without first checking that it is safe and convenient to do so
63. Antisocial behaviour (e.g. dealing drugs, drunkenness)
64. Too many people choosing to drive for the location

Examples of the pictures used with participants to illustrate the items:

Drivers have read the Highway Code and passed a driving test

Direct routes which for pedestrians avoid deviations, and for cyclists are at least as direct as those for motorised traffic

Uninvited, unwelcome, inappropriate interaction with strangers (e.g. pedestrians deliberately blocking the path of cyclists on a shared path or unwelcome or abusive comments from a passer-by)

8

Each local authority has its own design guidance (no UK-wide walking and cycling standards)

9

Street design that is attractive or interesting (e.g. plantings, architecture and artwork)

15

Contrast in the look of footways, cycle tracks, carriageways and changes in level, including colour contrast

16

9.3 Appendix C: Key informant interview guide

How Streets are Used - Key Informants

Semi-structured Interview Guide

Introduction

- Outline of the project – briefly run through key aspects of the research, including anything emerging from the Focus Groups

- Ethics: are you happy for the interview to be recorded? Please could you read this consent form and sign it if you are happy to proceed.

- You have the opportunity to remain anonymous in both the data and reporting OR to be identifiable (through job title or profession for example). In the latter case, you will have the opportunity to review a transcript of the interview/quotes and remove anything which you would prefer, with hindsight, to be withdrawn.

- In this interview, we are seeking your views on the street environment and culture from the perspective of your profession and job role. In particular, we are interested in discovering and exploring any areas where there may be different opinions that you are aware of either within your profession, or between your profession and other professions involved in how streets are designed, used and managed.

- The interview will take approximately ***40*** minutes.

[Start recording!]

[NB order questions according to professional priority, eg police, regulations first, but still ask infrastructure and behaviour questions]

Opening question

- Firstly, please could you outline your main areas of responsibility within X (organisation)

1. The importance of infrastructure design for walking, cycling and other human-scale modes

- What design features make it easy/comfortable, attractive and safe to walk along city/town streets?
  Prompts:
- *Are easy/comfortable, attractive and safe mutually reinforcing or exclusive?*
- *Consider pushing buggies, including double buggies, wheelchairs and mobility scooters*

- *Consider cycling*
- *Consider the opposite – features that make it difficult, unattractive and dangerous*
- *Consider crossing side roads*
- *Consider heritage features including paving and 'subtle markings'*

- Are design features always used as intended and if not why and what needs to change? *Prompts:*
- Consider desire lines, cycling on footways, loading in a mandatory cycle lane, turning at speed into side roads
- Consider temporary works (maintenance, improvements, utilities and building)

- Are design features always completed as intended and if not why and what needs to change? *Prompts:*
- *Consider contractors, funding, monitoring and evaluation*
- *Consider whether design intent is maintained over time (eg uncluttered footways)*
- *Consider network or complete local journeys v individual streets*

2. **The importance of regulation for walking, cycling and other human-scale modes**

- What laws and regulations make it easy/comfortable, attractive and safe to walk along city/town streets?
  Prompts:
- *Consider road markings, traffic regulations, the Highway Code*
- *Are easy/comfortable, attractive and safe mutually reinforcing or exclusive?*
- *Consider pushing buggies, including double buggies, wheelchairs and mobility scooters*
- *Consider cycling*
- *Consider the opposite – regulations that make it difficult, unattractive and dangerous*
- *Consider crossing side roads*

- Are regulations always followed as intended and if not why and what needs to change? *Prompts:*
- *Consider enforcement, knowledge/public information*
- *Consider support or otherwise from infrastructure design*
- *Consider what is modelled/practised by different road-user groups*

- Are current laws and regulations fit for purpose? *Prompts:*
- *Consider gaps (eg cyclists on shared paths crossing side roads, movements that are not accounted for such as cyclists moving from the carriageway to shared space at signals)*
- *Consider other countries (stronger/clearer give way on turning laws, permitting cyclists to proceed when clear through red signals)*
- *Consider over complicated (eg road markings)*

3. **The importance of road-user behaviour for walking, cycling and other human-scale modes questions**

- What road-user behaviours make it easy/comfortable, attractive and safe to walk along city/town streets?
  Prompts:
  - *Consider pushing buggies, including double buggies, wheelchairs and mobility scooters*
  - *Consider cycling*
  - *Consider the opposite – behaviours that make it difficult, unattractive and dangerous*
  - *Consider crossing side roads*
- What is an appropriate response to common and perhaps understandable rule breaking, that would contribute to making it easy/comfortable, attractive and safe to walk, cycle and use other human-scale modes along city/town streets?
  Prompts:
  - *Consider cycling on pavements, crossing at signalised crossings without a green invitation to cross, cyclists turning left on a red signal, using an e-scooter on the highway*

4. **Concluding questions**

- (Show items that have emerged from the Focus Groups for the Q-study) Please consider these items and consider if they represent the breadth of road-user behaviours, regulations and infrastructure design features that most contribute to or detract from creating streets that are easy/comfortable, attractive and safe for movement on foot, cycle or other human-scale modes?
  Prompts:
  - *Consider if they make sense*
  - *Consider what you would add, change or take away*
- Is there anything you would like to add?

Thank you very much for your helping with our research.

9.4 Appendix D: Ethical approval

Appendix D has been removed for personal information reasons.

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9.5 Appendix E: Research schedules

Key Informant Interviews

All of the key informant interviews were conducted face to face from 18 February to 12 March 2020; four took place in London and three in Bristol. Follow up correspondence was used to validate the Q-sort items.

Seven key informant interviews were conducted, following a semi-structured interview format:

1. KI1 - Phil Jones, Transport Planner, Founder and Chair PJA; British Museum, London, 18 February 2020,
2. KI2 - Head of Traffic Signs and Street Design Policy; Department of Transport, London, 18 February 2020,
3. KI3 - Wendy Linham, Traffic Management Assistant, Avon and Somerset Constabulary; Arnolfini, Bristol, Tuesday 3rd March 2020,
4. KI4 - Mark Philpotts, Walking and Cycling Design Specialist, SWECO, London, 10 March 2020,
5. KI5 - Ruth Cadbury MP, Co-Chair APPG Cycling and Walking/Member of Transport Select Committee, Houses of Parliament, London, 10 March 2020,
6. KI6 - Edward Ostrehan, Speed Enforcement Officer, Avon and Somerset Constabulary, UWE Frenchay Campus, Bristol, 11 March 2020, and
7. KI7 - Sam Kirby, Project Manager Bristol City Council, Arnolfini, Bristol, 12 March 2020.

Q-sorts

There were 49 participants who took part in the Q-sort, each followed by a short semi-structures interview. They were all conducted virtually, either using Skype for Business or on the telephone, from May to September 2020.

Summary of participant schedules

Table 42 - Summary of research participant schedules

Method	Start date	End date	No. f-2-f	No. virtual
Key informant interviews	18 February 2020	12 March 2020	4, London 3, Bristol	0
Focus groups	6 March 2020	28 April 2020	2, Bristol	4
Q-sorts	May 2020	September 2020	0	49
Follow up interviews to Q-sorts	May 2020	September 2020	0	49

9.6 Appendix F: Participant quotes from Covid-19 thematic analysis

Table 43 - Covid-19 analysis showing participant quotes

Themes	Quotes
Street design and environment	
Limitations of walking and cycling provision	It has made me realise our **streets need to be better for pedestrians** and walking. Social distancing is simply not possible in a lot of areas because the **pavements are not wide enough**. Streets have been designed with cars in mind and not pedestrians and cyclists. It emphasised that streets are not fit for purpose. Covid has demonstrated this (**lack of toilet provision**) even more with most toilets being closed which has meant that some people have not been able to get out. The idea of having **pavements wide enough for social distancing** is really important so people can keep 1m or 2m distance.
Changes to infrastructure	The council have **extended pavements into the road** and I have been using that. I am pretty good in familiar environments and so could cope with the step off the kerb onto the road. On a positive note, I was in the city centre recently and saw that they had put out proper **cycling routes with poles to separate** them from narrowed car lanes. Some of the Covid changes (to encourage walking and cycling) are really good. Others are bizarre, like the one on Bristol Bridge where it says it is closed along with Baldwin St. It is marked Bus Gate, but nothing has changed, and cars are still using it. The **pavement widening does not seem to have worked** and it makes it hard to drive down the street. I have seen the city council's walking and cycling interactive map where **people have been sharing ideas**. Two bits of that High Street are particularly narrow, but ironically, they are the two sections that have not been part of the Covid emergency widening. Now would be a good opportunity to permanently remove some parking, put in a cycle lane and widen the pavement. The current crisis would have been an **opportunity to widen pavements** where necessary (right across the country) especially in shopping areas. This would not just be a benefit for wheelchairs, as it generally good for everyone.
Noise	Lovely to have it **so quiet**. I live in South Bristol and it was a joy with **no planes**. First time in a city in my life to experience these things for more than just a Bank holiday or a weekend. Now the traffic noise has restarted.
Air quality	From a pollution point of view, it has been great. I don't want to take in the **bad air created by car fumes**, as I am more aware than ever that this **makes the coronavirus worse**. Quality of air was already an issue for children with smaller (growing and more vulnerable) lungs, but now we need to add to that **concerns for our parents and grandparents and their risk from coronavirus**.
Behaviour	
Reduced motor traffic	Fewer cars made it so pleasant. It was absolutely **wonderful with no cars**. The street I live on is quieter too with **less rat running**. At the moment road **crossing is a doddle**. It felt safe for people to move around. There was a sense of more space for pedestrians and cyclists. Made it easier as there was less traffic and **encouraged me to cycle more**. **Large numbers of people** have experienced quieter roads and **enjoyed their surrounding better** because the roads have been less busy. I love it. Perhaps that's a very selfish way of thinking… In my neighbourhoods all the **kids were out on streets playing socially distanced games**, like hopscotch. The streets were covered in chalk, covered in kids games. Now it **has gone because the cars are back**.
Streets less busy	The traffic levels are still not back up to levels pre-corona virus levels. Overwhelming feeling was how nice the streets are when they are empty. The streets were tidier with less clutter than normal. Not as much people around. A lot quieter and **a lot more space**.
More tolerant and considerate	People walking but they seem more tolerant to cycling. Generally people seem more considerate to each other. My road, Cromwell Road, is not a friendly road - no street parties, but we did **start a WhatsApp group during lockdown**. **Drivers** that had to be out were much more **relaxed** as they had more space. They seemed **less aggressive** and **more cycle friendly**. Now drivers are going faster once again and are more aggressive. I'm having to get used to being cut up on my bike with drivers overtaking me. Some car drivers seem much more aggressive since lockdown. Now the cars have returned and **people now seem so angry**. **Drivers seem so impatient** now – they seem to be rushing to do 'important' things like shopping, and they have a total disregard for pedestrians.

Behaviour (continued)	
Walking and cycling a pleasure	Cyclists were having the most wonderful time and for us pedestrians going out was absolutely magnificent. It was a real eye opener. My daily walks in those first 6-8 weeks were a delight as there was no-one going out to exercise. It just went to show how nice it could be. I loved the lockdown. It was wonderful for walking and cycling. Everyone was so relaxed as they walked around. I hope we all hold onto that memory and don't just carry on as usual. As a pedestrian, yes. I feel much less relaxed shopping on Gloucester Road. I now wear a mask when out walking and no longer go into town. That in turn makes people anxious, especially if they are walking.
More diversity	Lovely seeing families out cycling with small children. Yeh, I let my child (9) ride in the middle of road (side by side with me). For a while I felt safe with kids. Many more children than ever before were around in the streets. I have seen more families and children cycling on the streets and they are still there so I hope they remain.
More active traffic	Has led to a lot more people on bikes and people walking. So many more people walking. I always **run** a lot, but have time to do **a bit more**. Runs look for new routes, try and get out of the city to find trails, not too far, but able to run from home. Seeing lots more people doing it is such a positive influencer for others to do more walking and cycling. At the start of lock down when public transport became a no no, I was really pleased. I thought it was an **opportunity for people to get cycling**. I have started to **do more leisure cycling**, up to 30 miles with friends as I **no longer have the opportunity to commute** (by bike). When out walking the number of people out and in the way has increased and the cycle paths are a bit busier now. I now chose less busy routes. During lockdown I **enjoyed being able to cycle in the bus lane on the Portway**, but now I am just aware of the size of the trucks.. Some places like Harbourside there are so many pedestrians that it is causing congestion. Some areas such as East Street that I previously saw as pedestrian friendly, but now I avoid as they **now feel too busy with people walking or waiting**, especially when you have a pram. Nice having a lot more walking meetings, rather than in an office. Although I no longer drive, during the Covid lockdown I **haven't been in a car** as I have not wanted to take a lift or a taxi. Haven't been out of my house and garden for more than three months as I am at risk. However, have had (Zoom) meetings with other groups. **Only go for short 'walks'** (mobility scooter user) these days. **I haven't been driving while schools were in lockdown** – car not in use as much. Car use is creeping up now as I am back at work. But during lockdown we **stayed local with no leisure trips**. Did not drive much before, we **might now opt to go in the car to avoid people**. We even **drive to the park to go for a walk** because of this, whereas we never did before. It has all meant that I now **change the routes that I use**. I have **hardly been into the centre of town for four months** because of crowds. I have far fewer meetings therefore ironically during this corona virus period I am **actually cycling less**. Yes, I have been **cycling slightly more** because you can do it without coming into close contact with people. So for health reasons really. I am **walking much less** as I have been only going to the shops once a week. There has been such a difference cycling around, but unfortunately is has now gone back to nearly normal.
Change of habits	Made me want to go where there is a bit more space. Avoiding crowds, walking at different times and in different places. Haven't been to the city centre since I don't know when. **seats closed**, including at the dentist which caused me to drive instead of walk. I **still walk, but it is less part of my daily routine** and more something that I have to choose to do. So it is different how I walk now. The council and homeowners have been lax in cutting back branches and hedges during this time. I've been stuck indoors for 88 days.
Pedestrians taking priority	Some people with traffic quiet step in the road which is nice. Found myself **brazenly walking in bus lanes** (after checking that there was no bus). I live near Church Road and now often do this there. I now **regularly walk in road if I can to social distance**. Gave the feeling that you can almost walk off the pavement and into the road without looking.
Social changes	Difficult to enforce social distancing when people are in a hurry. More difficult for visually impaired people to socially distance. We have to rely on others. We have not walked into a building since lockdown. When people were going around carefully to keep social distances it felt a bit of a chore and I **kept having to change sides of the road**.

Behaviour (continued)	
Social changes	Thinking about **<u>keeping socially distanced</u>** has made me think about how it is **<u>hard for some</u>**. Makes narrow streets much more obvious. People want to walk, but pedestrians are finding it difficult to get by each other and maintain social distance. Now **<u>I always put on a mask and visor</u>** as there are so many people on the pavements (who can no longer safely step into the road) that there is no room to keep distance from people. Have to consider best and safest place to overtake people on foot. Sometimes have to wait.
Using public transport	Bus before, now walk a lot more. Avoiding public transport. **<u>Walked to eye hospital rather than bus even though it is a long walk</u>**, but I did come back on the bus last week. I haven't been as keen on using public transport. Use (public) transport less. **<u>I haven't used the bus at all</u>**, but I used to do this daily. How do we encourage people to use public transport with the pandemic? There seems to be much more traffic as people aren't using buses. I used to use public transport, but now can't. I do walk a lot, but I do need to go further afield and so I am **<u>looking forward to traveling on buses and trains again with my two small children</u>**.
Regulation and policy	
Rules	Found it a lot safer and easier to walk through lockdown. More **<u>cyclists</u>**, but because they are all doing the same thing they **<u>follow the rules</u>**. 85% seem willing and want to social distance, but it is difficult. At the beginning of social distancing, people were good at doing the dance. Now they are not. Especially young people, there are lots of people sitting and gathering. Not able to go out as much. **<u>I did follow the guidelines</u>**. **<u>What I mean in Bedminster is that there is supposed</u>** to be a one-way system on the pavements, **<u>but it is not followed</u>**. The signage (markings) have started to rub off.
Policy Change	**<u>Now is the time if any to make reforms</u>**. Virus has opened up new lines of thinking in many areas of life. Those in power might have experienced quieter streets and other ways of moving about and helped them see how other people see streets and bring about changes. It seems like the time to make strategic decisions on how the roads are managed. Huge changes. We have had a glimpse at what I've always wanted. It was a dream and then suddenly it happened for a bit. The community caught a glimpse of the possibilities. We are **<u>now more actively campaigning that it will stay this way</u>**. It **<u>showed just what is possible</u>**. As a long-term local resident (of 30 years) it showed the transformation that is attainable. **<u>Maybe our time has come!</u>** The Council talked about how it would support measures to encourage cycling and keep people safe. I am so disappointed that they have done nothing. Nothing to make it safe for cycling; no safe routes to schools. Their response has been rubbish. Other councils have acted. All I have seen from the council is talk of pedestrianisation in the city centre. I am so disappointed and I literally think that the council don't care. Of course some officers care.