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Inhabiting infrastructure: exploring the interactional spaces of urban cycling

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Abstract. Contemporary cities are thick with infrastructure. In recognition of this fact a great deal of recent work within urban studies and urban geography has focused on transformations in the governance and ownership of infrastructural elements within cities. Less attention has been paid to the practices through which urban infrastructures are inhabited by urban dwellers. Yet in all sorts of ways infrastructures are realised through their use and inhabitation. This paper argues for the importance of attending to the ways that infrastructures are reinterpreted through use. Focusing on a case study of commuter cyclists in London, it explores the ways in which cyclists accommodate themselves to (and are in turn accommodated by) the infrastructural orderings of London's streets. Confronted by the obduracy of a road infrastructure designed primarily for motorised traffic, cyclists show a diverse range of approaches to negotiating movement through the city on bikes. The paper describes how this negotiation can be understood in terms of the more or less skilful processes of navigation, rule following, rule making, and rule bending. This involves a polymorphous mix of practices, some common to driving, others to walking, and yet others unique to cycling. In conclusion, the paper suggests that transformations of infrastructures found within cities need to be understood as much through emergent changes between their elements, and that close attention to how infrastructures come to be inhabited offers productive avenues for thinking about ways to improve them.

Keywords: infrastructure, cycling, traffic, rule following, rule breaking, mobility, London

Introduction

To live in contemporary affluent cities is to live in a world thick with infrastructure. The infrastructures of power and water. Of waste and movement. Of communication and information. Of regulation and of order. After years of relative neglect urban geographers and urban studies scholars have over the past decade or so focused a great deal of attention on the infrastructural. Rather than being treated as the background substance within which the real political and social action of the urban takes place, infrastructure has come to be seen as key to the dynamic on-going structuring (and of course restructuring) of urban spaces (Boudreau et al, 2009; Gandy, 2005; Graham, 2010; Graham and Marvin, 2001; Harris, 2013; Hommels 2005; Swyngedouw, 2004).

There are perhaps three principle reasons for this heightened interest in urban infrastructure. Firstly, there is the recognition of the importance of a range of new infrastructural elements within contemporary cities. Think of the significance of the development of high-speed fibre optic telecommunication networks within and between cities, for example (Castells, 1996; Sassen, 2001), or the increasingly prominent role that international airports play in

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urban economies (Guller and Guller, 2003). Secondly, there is a sense that the ways cities are dealing with established infrastructural elements is being transformed. Forms of governance, of ownership, of day-to-day management of such fundamental and seemingly mundane urban elements as the provision of electricity, water, waste disposal, and transportation are being reconfigured in novel and surprising ways (Guy et al, 2011; McFarlane and Rutherford, 2008; Marvin and Guy, 1997). Thirdly, and following from the previous points, there is a recognition that the materiality of infrastructure is far from straightforward. As Graham (2002, page 175) puts it, infrastructure can no longer be viewed as the "purely technical". Urban scholars need to think hard about "the technological materialities of the urban, the various flows this sustains, and the exercising of social and political power" (page 175).

This paper is a written as a contribution to this on-going conversation around the importance of urban infrastructures. The arguments, however, that follow seek to draw attention to a rather different dimension of infrastructure from that found within much of the contemporary work cited above. Rather than approach infrastructure from the perspective of its provision, management, and maintenance we want to look at some ways in which urbanites go about the task of dwelling within, or inhabiting, infrastructural spaces (cf Bissell, 2014; Sheller and Urry, 2003). One of our reasons for taking this approach is pragmatic. We are interested in how the practice of cycling—a marginalised largely superseded technology (or better a technological practice)—might be fostered as a mainstream mode of urban transportation in contemporary cities. Configured appropriately, cycling offers a versatile, flexible, inexpensive, and democratic mode of urban transportation (Aldred, 2013; Furness, 2010; Pucher and Buehler, 2012), that brings with it significant environmental and public health benefits (Banister, 2011; de Hartog et al, 2010; Woodcock et al, 2013). This of course begs the question: if cycling indeed does offer so many obvious advantages then why is it so difficult to encourage people to cycle? There are many different possible answers to this question. The element this paper focuses on is how existing infrastructural configurations are built around certain taken-for-granted notions of how a given infrastructure will be used and who will be using it. When these configurations stabilise they come to constitute a kind of 'infrastructural settlement'. These settlements often accommodate new or novel elements with difficulty, or in ways that place into question the existing settlement. It is this "obduracy" (Hommels, 2005, page 324)—and its relationship to novel practices of inhabitation—that is the central theoretical preoccupation of the following pages. By focusing upon the ways a sample of London cyclists accommodate themselves to the spaces of London's roads this paper aims to: (a) think carefully about this infrastructural obduracy; and (b) understand the ways in which the addition of novel elements to an established infrastructural configuration works to alter how that infrastructure functions.

Thinking about infrastructure

Introducing Stockwell Gyratory and cycling in London

Mary is a lawyer in her early forties. Each weekday she commutes from Mitcham, southwest London, to her central city office on her Brompton folding bicycle. Her route takes her through Stockwell Gyratory.

Stockwell Gyratory lies at the junction between three roads: Clapham Road running southwest to northeast, South Lambeth Road heading north towards the river Thames at Vauxhall Bridge, and Stockwell Road from the south. At its centre is a small park with flowerbeds, benches, a war memorial, and Britain's first public statue of an African-Caribbean woman. Yet for Mary, as for most of the other people who use it, the gyratory is primarily a space of movement. In the morning Mary hits the gyratory moving northeast along Clapham Road. She rides—as cyclists are permitted—in the bus lane. Following and sometimes weaving past stationary buses, she is part of a dense stream of cyclists using this route

into London. Negotiating through the gyratory she is held first at a set of traffic lights at the south western entrance, channelled onto and then held at a further set of traffic signals 100 m further into the gyratory, before being released back onto Clapham Road. Throughout these manoeuvres she is surrounded by any number of buses, cars, vans, motorbikes, trucks, and cyclists with whom she shares the carriageway, to say nothing of the clumps of pedestrians on their way to or from Stockwell Tube station, waiting for buses, or travelling through on foot.

In many ways Stockwell Gyratory is a generic London public space. While it does have its own history and character—the park with its statue and memorial is a nod to that—it is primarily defined by its nodality. Part of a network of main roads funnelling motor traffic in and out of the centre of London, the gyratory itself is a space intricately choreographed by transport engineers and planners. It is a highly delineated space. It works hard to specify where different categories of people travelling (in cars, vans, and trucks, on buses or bikes, on foot, in buggies or wheelchairs) should be moving—or pausing and waiting—via a tissue of signs, lane markings, guardrails, kerbs, and traffic lights. This is a place dominated by its infrastructural obligations; it is the realisation and embodiment of a public of movement (Cresswell, 2010; Sheller and Urry, 2003). The central figures in this movement are quite clearly motor vehicles. This is not simply because there are so many of them, nor even that they are larger, faster, and noisier than the other modes of movement. It is also because the task of getting vehicular traffic in, through, and out again dominates so much of the gyratory. The times at which pedestrians cross the road, the routes available for reaching the small park at its centre, the attractiveness of the area as a place to congregate, are all subordinate to the task of getting motor vehicles quickly and safely through the gyratory.

So, the Stockwell Gyratory is a space: (1) dominated by traffic and particularly motorised vehicular traffic; and (2) where movement through it is clearly delineated and tightly coordinated by a range of infrastructural elements. In short, the gyratory is highly regulated and ordered space. But it is also a space that leaves a great deal of latitude for autonomous interpretation. Mary is largely compliant to the gyratory's organisation. She stops at its traffic signals, uses its cycle lanes, and respects the advanced stop lines provided for her. Following another cyclist through the gyratory, however, Basil, a music teacher in his early twenties, discovered that not all cyclists are so disciplined. Finding his way to Clapham from Elephant and Castle, Basil found it helpful to closely follow the cyclist ahead of him. This worked for a period. Then they hit the Stockwell Gyratory and Basil's 'guide' blew through a red light. Suddenly Basil is faced with the dilemma; to stop or keep following and break the law. How people on bikes like Basil and Mary deal with London's road infrastructure, with its various rules and informal conventions of use, is what this paper is interested in.

London is a city that has seen a significant increase in cycling over the past decade. Since the start of the millennium the number of cycling trips within the city has increased by 180% (TfL, 2013, page 4). Cyclists now make up 24% of road traffic within central London during the morning rush hour (London.gov.uk, 2013). Although cycling still remains a minority mode of transportation—citywide only 2% of all journey stages are undertaken by cycle (in contrast to 21% by walking, 44% by public transport, and 33% by private motor car)—at certain times and places cycling has become a commonplace, even mainstream, activity (TfL, 2013, page 20). There are a number of factors driving this increase. The high and rising costs of public transport, the introduction in 2003 of road congestion charging in central London, the fear of public transport generated by the July 2005 bombings, the introduction of a cycle hire scheme in 2009, along with a rising (if limited) commitment to cycling and the provision of appropriate infrastructure by the Mayor of London and some boroughs (Aldred, 2012; Greater London Assembly, 2012).

For this paper, however, what is most interesting is how this growth in cycling has happened within the context of an established network of infrastructural configurations. Cyclists have not had to build an infrastructure of movement de novo, instead they have recolonised the existing street network. In so doing they have encountered, to borrow the term used by Hommels (2005) all sorts of 'obduracies' within this infrastructure. There are a whole range of ways in which the existing streetscape is ill suited to, challenges, or is in conflict with the kind of movement cyclists are trying to practise. At the same time, through inhabiting London's road infrastructure, cyclists are involved in altering and reinterpreting that infrastructure in many small and often subtle ways. London's road infrastructure is built around an established and well-understood settlement between motorised road users and people on foot (Adams, 1995; Aldred and Jungnickel, 2012; Spinney, 2010). Where cyclists fit in such a settlement is unclear.

Defining infrastructure and the infrastructural

Before thinking more about the sense in which infrastructure can be understood as forming a kind of settlement, or indeed what it means to talk about infrastructure being inhabited, it is useful to take a step back and ask just what is meant by infrastructure. Stripped to its most essential, infrastructure is "the basic physical and organizational structures and facilities needed for the operation of a society or enterprise" (OED, 1998, page 937). As such, it is often easy to discount the infrastructural as simply the backdrop or context to where the real action is. This—implicitly at least—was how much of geography treated infrastructure until surprisingly recently.

That infrastructure has emerged as an important focus within contemporary urban research is largely the product of the work of critical urban scholars such as Graham and Marvin (2001), Gandy (2005), Swyngedouw (2004), and others (Boudreau et al, 2009; McFarlane and Rutherford, 2008; Rodgers, 2012). The work of these critical urban scholars has convincingly demonstrated both that infrastructure matters and that infrastructure is more than just brute stuff. However, as Furlong (2011, page 461) has argued, this literature is less convincing in its framing of how infrastructures come to be used and how they evolve thorough time. As she puts it, these works tend "to be well developed in terms of theorizing political, economic, and social factors but tend to interpret the impact, function, and use of technologies as given." Or put another way, in emphasising the degree to which infrastructures are 'embedded', 'invisible', and 'taken for granted' (Graham and Marvin, 2001) critical urban studies tends to overlook the often small-scale, localised, or incremental processes through which infrastructural systems might over time be subtly altered or transformed.

All sociotechnical infrastructures must of course in some sense be planned, designed, engineered, and put into place. They must also be taken up, used, and integrated into existing patterns of life. In the words of Star (1999, page 380):

> "People commonly envision infrastructure as a system of substrates—railroad lines, pipes and plumbing, electrical power plants, and wires. It is ready-to-hand. This image holds up well enough for many purposes—turn on the faucet for a drink of water and you use a vast infrastructure of plumbing and water regulation without usually thinking much about it.
>
> The image becomes more complicated when one begins to investigate large-scale technical systems in the making, or to examine the situations of those who are not served by a particular infrastructure. For a railroad engineer, the rails are not infrastructure but topic. For the person in a wheelchair the stairs and door jamb in front of a building are not subtenders of use, but barriers. One person's infrastructure is another's topic or difficulty."

Thus, rather than drawing directly on critical urbanists to frame the infrastructural, like Furlong, we have found it useful to build upon the work of scholars in science and technology studies (STS) (Bijker et al, 1987; Hommels, 2005; Pinch, 2010; Star, 1999; Star and Bowker, 2006)[(1)] and practice theory (Schatzki, 2002; Shove, 2003; 2012). As with critical urban studies, there is a flourishing body of writing within both of these schools of research concerned with the infrastructural. What is most interesting about this research is how it works at explicating the material and immaterial elements that go into the making, maintaining, and remaking of infrastructure. Both STS and practice theory orientate research towards questions such as: how does something become practised as infrastructure? Through what processes do infrastructural elements become invisible, taken for granted, embedded? Or, in other words, what are the practical effects of technologies becoming more or less invisible?

Framed in this way, infrastructure takes on a more malleable dimension. The central question is less the 'what' of infrastructure (what objects, what networks, what systems) than the 'when' of infrastructure (in what context, in which combination of agents, at what time and place). To quote Star (Star and Ruhleder, 1996, page 113) once more: "Analytically, infrastructure appears only as a relational property, not as a thing stripped of use." Within this framing, cycling in London is interesting precisely because of how it involves the insertion (or more accurately the reinsertion) of a novel set of practices and materials into the existing infrastructural space of the city's roads. And this leads back to the question of the practice of cycling and infrastructural obduracy.

Cycling, infrastructure, and obduracy

Cycling researchers in the English-speaking world have in recent years spent a great deal of time exploring and emphasising the importance of infrastructure to the development and growth of cycling. Both Dill (2009) and Pucher and Buehler (2012), for example, have demonstrated a strong correlation between the provision of dedicated infrastructure such as cycle lanes or segregated paths and the modal share of cycling. While authors such as Parkin et al (2007) and Pooley et al (2013) have in various ways shown how segregated bike paths enhance people's sense of safety, there is relatively little work that looks at how cyclists deal with existing infrastructure configurations (although see Kidder, 2011; Spinney, 2010). That is to say, there is little work that thinks—following Star (1999)—about the ways that cyclists manage to turn existing roads into an infrastructure for *their* movement.

Of course cycling is not new to London (TfL, 2013, section 3.11). The growth of cycling in the city is—to some extent—a kind of return. It is the reassertion or reinvention of a technology that had come to be understood as in some sense outdated or archaic. Indeed, as a practical mode of urban transportation cycling is dependent on many of the same kinds of material and nonmaterial affordances as automobility (Furness, 2010; McShane, 1994). So the growth of cycling to some extent upsets conventional senses of how technologies progress. It also upsets the trajectory of the development of London's roads as infrastructures of movement. Cycling declined as roads came to be understood as spaces for motorised transportation, and motorised transportation only. Within such a system the survival of cycling itself represents a form of obduracy. A further obduracy is that of the infrastructural settlement that has come to define London's roads.

At this point, it is necessary to properly define what is meant by obduracy. For Hommels (2005) obduracy is the inertia and resistance that existing sociomaterial configurations exhibit in the face of efforts to alter them. It is important to stress that obduracy is not an

[(1)] The split between work in critical urban studies and STS is not quite as strict as is perhaps suggested here. Graham and Marvin (2001), for example, drew upon a range of STS scholarship in *Splintering Urbanism*; although see Coutard and Guy (2007).

"intrinsic property of technologies but can only be understood in the context of its ties to other elements within a network" (Hommels, 2005, page 337). The key point here is that changes in how elements within an urban environment are used and configured are often constrained, restricted, or shaped in often indeterminate and unpredictable ways by previous use. As Hommels (page 649) puts it: "Although cities are considered to be dynamic places, it may be difficult to make significant adjustments in the design of cities: Once built, cities become obdurate, immobile, and fixed." So, to circle back to cycling in London, as people 'return' to cycling, they are doing so in a streetscape that has over many decades come be configured as a space defined by the motor vehicle. More specifically it is a streetscape choreographed around the twin imperatives of: (1) ensuring the smooth and rapid movement of motorised traffic; and (2) keeping people on foot safely away from this traffic (Adams, 1995; Hornsey, 2010; Plowden, 1971). This is what we mean when we refer to the notion of an infrastructural settlement. That there is a dominant, shared, and received as common-sensical notion of how a certain infrastructural network should be used; something that is backed up by an established formal structure of rules and conventions. How do cyclists in London find a space within this settlement? To find out we followed a number of cyclists undertaking routine journeys across the city.

Methodology: how the research material was produced

There are any number of techniques available to the researcher wanting to understand how people use a particular object or space as part of their everyday routines (Fincham et al, 2010; Hitchings, 2013). In this project we were principally concerned with the in situ unfolding of social action. So, following the work of Laurier (2014; Laurier and Lorimer, 2012), Spinney (2010; 2011), Brown et al (2008), and McIlvenny (2013), we decided to use a video-based methodology. As such, this paper originates in the collection and analysis of just under eight hours of video footage recorded during sixteen 'ride-alongs' (Spinney, 2011) with nine cyclists during June and July 2010. The research participants were recruited on the basis that they lived in London and routinely used bikes to get around the city. After a brief introductory interview, each participant was followed on two nonleisure journeys by a researcher wearing a point-of-view camera. These ride-alongs were followed by a further longer interview that reviewed the journey. The accounts in the following sections, however, draw almost exclusively upon the ride-along videos (cf Laurier and Lorimer, 2012).

Once we had completed the ride-along videos and interviews, the interviews were transcribed and coded, while the videos were systematically reviewed and analytically interesting events indexed. Within the videos most indexed events focused on junctions; these tended to be the sites where different elements of traffic came into situations of direct negotiation. From this observation the writing up of the material came to focus on the various ways participants navigated junctions. We also developed a system of diagraming the video material (cf Dittmer, 2010; Latham, 2003, Laurier and Lorimer, 2012). The following section presents four detailed diagrammatic and textual descriptions of cyclists negotiating traffic junctions.

Negotiating junctions in London

So, let us get back to Stockwell Gyratory. There we briefly met two of our participants—Mary and Basil—as they negotiated their different paths through the infrastructural space of the gyratory. This was a space, or, to be more accurate, an ecology of spaces, thoroughly dominated by the functional demands of infrastructure affording mobility. The four interactional vignettes presented in this section offer descriptions of people on bicycles navigating through a range of infrastructural configurations. The first vignette shows two cyclists being confounded by road infrastructure, and then drawing on their skills as pedestrians to navigate through

a junction (Elle and Tara, diagram 1). The second vignette focuses on rule following, rule breaking, and rule making (Dick, diagram 2). It outlines how one of the study's participants uses elements of a junction's infrastructural organisation to generate speed through acting outside of the norms governing motorised traffic. The third vignette is concerned with the ways cyclists are involved in setting up rhythms of movement that may (or may not) play into the overall flow of traffic (Gail, diagram 3). The fourth and final vignette is an account of a cyclist negotiating through a piece of dedicated cycling infrastructure designed to keep her apart from the kind of motor traffic found at junctions like Stockwell Gyratory (Rachel, diagram 4). Each of these vignettes focuses attention on how people cycling in London manage to navigate through a variety of infrastructural configurations, including many that are not obviously inviting to the practice of cycling. They also trace out a range of different ways that cyclists, through their different styles of use, are involved in reinterpreting (and reorganising) existing infrastructural elements.

Diagram 1: Elle and Tara (following the rules of London's infrastructure settlement)
Elle and Tara are approaching a junction in Roehampton, South London (see figures 1 and 2). Cycling west along Medfield Road they aim to turn right onto Roehampton Lane, a busy four-lane arterial road that runs up the edge of Richmond Park towards Hammersmith Bridge (figure 1, panel 1). The approach to the junction is complicated by the presence of a

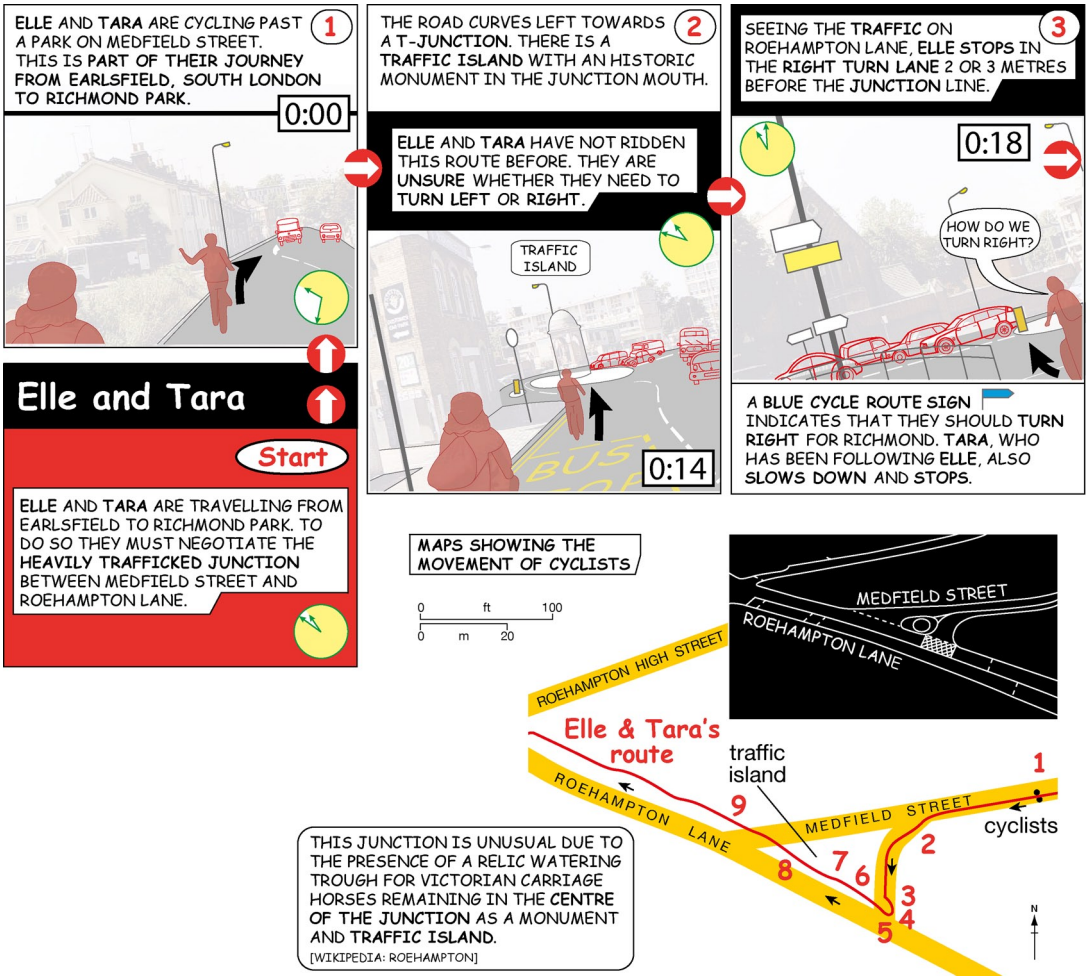

Figure 1. [In colour online.] Diagram 1: Elle and Tara (part 1). The numerals in each diagram show the time that has passed between each panel. For example, 0:00 shows the start of the sequence, 0:14 is 14 seconds later.

historical memorial in the mouth of the junction (panel 2). The junction itself is controlled by a broken white line, which in the United Kingdom means that merging traffic must give way. Therefore the two cyclists will have to negotiate crossing the lane without the assistance of traffic lights. As the women enter the junction proper they are confronted by four rows of slow-moving nose-to-tail motor vehicles, which for them offers no obvious route across. As they try to work out what to do, they stop, planting their feet on the road. Looking both left and right, Elle asks Tara what to do (panel 3). As Elle and Tara puzzle out what to do next—how to "go on" in Wittgenstein's words (Laurier and Lorimer, 2012, page 207)—the motorised traffic flows around them. Approaching them from behind, a bright orange van passes the two women on their right, waits briefly for a break in the south-bound flow of traffic, edges into the north-bound lane, and is let in by a larger red Mercedes van.

For some cyclists the orange van would have provided a solution of how to cross the junction. Such a cyclist would have followed in the lee of the van and used the gap in traffic it created to insinuate themselves into the flow of north-bound Roehampton Lane traffic. But Elle and Tara are neither particularly bold nor experienced at cycling in London. Both women are university students in their early twenties. Their cycling experience is restricted largely to weekend recreational cycling. They do, however, plan to start regularly commuting to central London from their south London house shares. Having stopped in the mouth of the junction the two women seek sanctuary from the traffic in its left-hand gutter. A pedestrian guardrail prevents them from mounting the adjoining sidewalk, so Elle and Tara decide to scoot across

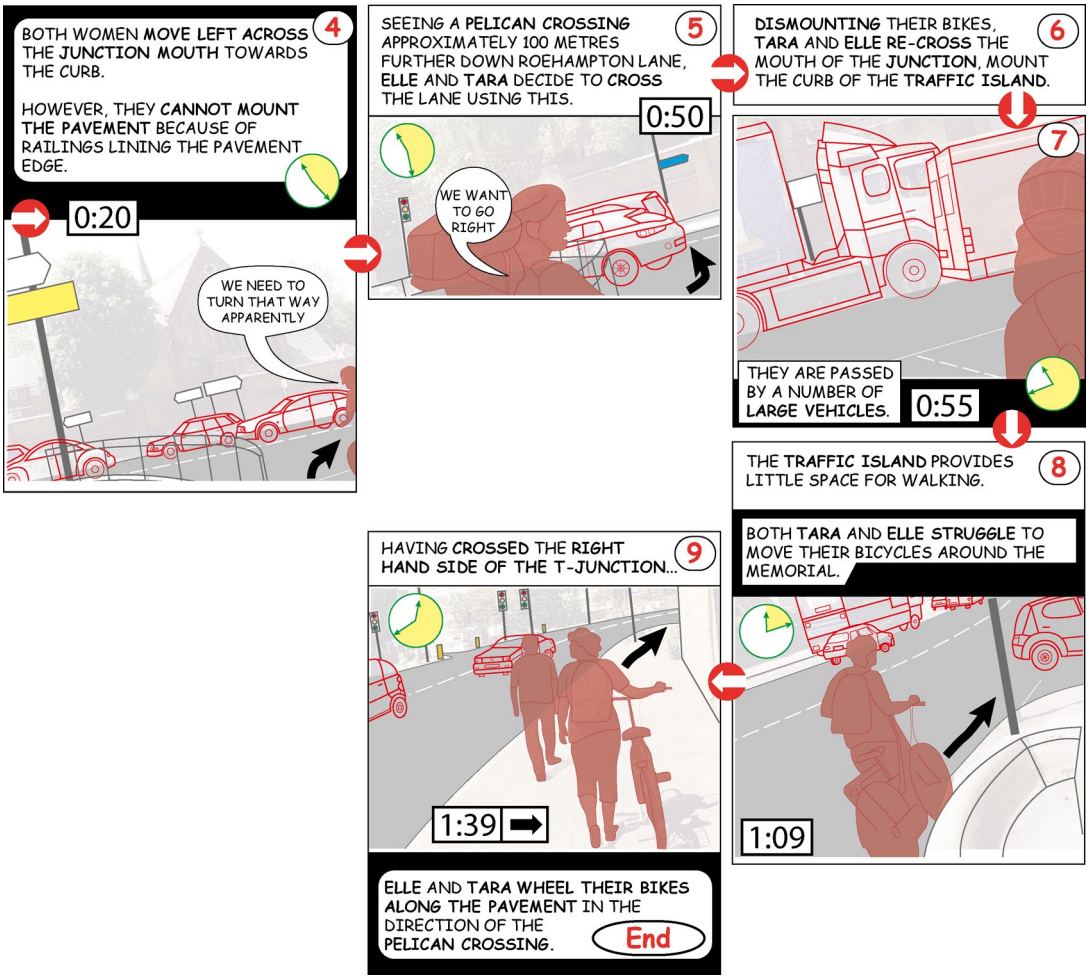

Figure 2. [In colour online.] Diagram 1: Elle and Tara (part 2).

the first half of the junction's mouth (figure 2, panels 4 and 5). They then dismount their bikes, wheeling them up onto the raised curb surrounding the monument at the centre of the junction (panels 6 and 7). Still wheeling their bikes, they step down from the monument's curb crossing the remaining half of the Medfield Street Roehampton Lane junction mouth. They then continue walking with their bikes northwards up the Lane's eastern sidewalk (panel 8). They are now going in the right direction, but on the wrong side of the road to cycle legally (panel 9).

This vignette could be read as a description of the inadequacies of London's road infrastructure for cycling. Elle and Tara cycle hugging to the left-hand curb of the streets and roads they traverse. Eventually being confronted by a junction that exceeds their abilities, they are pushed off the road. Having 'failed' as cyclists they have become a kind of bike-wheeling pedestrian. As has already been argued, London's street traffic is organised largely around an infrastructural settlement predicated upon a strict separation between motorised traffic and pedestrians. Within this context, perhaps it should not be surprising that Elle and Tara, when confronted by a situation that they as cyclists find confounding, fall back onto a reliable repertoire of urban walking practices. They manage to 'go on' with their journey through drawing on their skills as urban walkers and using the readily-at-hand physical infrastructure for people on foot.[2] Having made it to Roehampton Lane's eastern sidewalk Elle and Tara confer briefly and then set out for a push-button-controlled pelican pedestrian crossing approximately 100 m up the lane (panel 9).[3] Reaching the pelican crossing they wait for the traffic signal to halt the Roehampton Lane traffic. As the pedestrian signal turns green, they wheel their bikes across the lane, past the stationary traffic, mount their bikes, and begin cycling northward. So, through use of the sidewalk and the handily placed pelican crossing Elle and Tara have in some sense 'repaired' (Garfinkel, 1967) their earlier failure to cycle through the Medfield Street–Roehampton Lane junction. They have managed to regain their presence on the road as cyclists. Although they do not appear to be particularly adept urban cyclists, one might ask whether this short episode of becoming bike-wheeling pedestrians represents something other than just a failure. Elle and Tara's bike-wheeling might suggest a particular kind of solution to the challenges of cycling through London.

Returning to the commute of Mary, the lawyer introduced in the earlier Stockwell Gyratory section, while she is a confident and experienced cyclist, another part of her journey involves her walking with her bike through a pedestrian underpass. She does this because it shortens her journey. Similarly, Gail, an accountant in her late fifties who commutes between Holborn, central London, and Rotherhithe in the southeast of the city, uses walking as a fundamental part of her style of cycling. This is not inexperience. She has been commuting on a bike across London for over thirty years. Traversing streets clogged with rush-hour traffic she simply dismounts from her bike and walks. This frees her to move faster than the congested traffic (even if she is only moving at walking speed). At certain points walking also gives her access to back alleys and other short cuts available only to people on foot. In this context, Elle and Tara's way of crossing Roehampton Lane might be seen as an element of a potential style of cycling which is partially organised around a series of tactics for avoiding conflict with motor traffic. The manoeuvre allows them to go on with their journey whilst feeling safe and without disobeying the written rules of the road. In this sense it seems a rather clever way of negotiating through London's long-term street traffic infrastructural settlement if one happens to be on a bike. Of course, it might well be that Elle and Tara simply lack the

[2] We are not suggesting that their ad hoc usage of a less-than-perfect pedestrian infrastructure is an aspirational way of navigating the city. The pedestrian infrastructure could be improved in all sorts of ways.

[3] A pelican crossing is a signal-controlled pedestrian crossing.

necessary practical skills to negotiate the junction in any other way. Indeed, other cyclists might find dismounting their bikes an unsatisfactory way to go through the junction. Their style of cycling might hinge more profoundly on a sense of keeping one's feet off the ground and seat in the saddle. Or perhaps they are more relaxed about rule breaking, like the music teacher Basil's red-light jumping guide.

Diagram 2: Dick (making and breaking rules)

Dick is another university student in his mid-twenties with a daily commute from south to central London. His style of cycling is finely attuned to the local infrastructure settlement along the route of his daily commute, whilst being simultaneously selective about when this settlement should be honoured. Governmental technologies such as the highway code instruct road users on how they are to behave when traversing road space and also offer a guide for navigating the actions of others (Barry, 2001; Merriman, 2007; Norton, 2008). In essence, they represent a kind of social contract through which the potentially chaotic space of urban traffic is not simply ordered, but ordered through some sense of logic and fairness. These regularities do not just allow traffic to flow. They also open up all sorts of opportunities for those who do not feel bound to the underlying social contract yet understand something of its structure (cf Kidder, 2011; Spinney, 2010). In the previous vignette Elle and Tara ended up following the pedestrian rules pretty much as set out within the highway code (Driving Standards Agency 2007) to forge a route through the road infrastructure that had overwhelmed them as seat-in-saddle cyclists. Remember they use the push-button-controlled pelican pedestrian crossing to force a break in the Roehampton Lane traffic to rejoin the flow of motor vehicles on the carriageway. Dick's attentiveness to the workings of the road infrastructure, however, focuses less on the rules he should be following and much more on the rules motorised vehicles are obliged to obey.

In diagram 2 Dick is pedalling along a bus lane towards St Georges Circus; he is legally allowed in the lane (figure 3, panel 1). Strictly speaking, the circus is no longer a 'circus' as traffic can no longer freely circulate all the way around it. A series of ad hoc traffic engineering build-outs have reconfigured the original space into a series of traffic-light-controlled junctions along a multilane one-way road. Arriving at his junction Dick finds himself on a red signal with a stream of cars and trucks from the three lanes of Westminster Bridge Road flowing in front of him. Coasting a little over the stop line, Dick comes to a halt, still in his saddle, balancing with the help of a pedestrian guardrail (panels 2–4). This stopping ahead of the stop line is something done by many London cyclists. Even the most conscientious cyclist in this study, Alex, a manager in an information technology company in her late twenties, tended to do it. However, whereas Alex does it only to put herself ahead of motorised traffic, for Dick his positioning is the beginning of a more morally ambiguous manoeuvre. When the Westminster Bridge Road traffic upstream of the circus is held by a traffic light, Dick and another man positioned slightly ahead of him set off—despite the traffic light controlling them remaining on red (panels 5–7). A third cyclist notices Dick and the other cyclist go, pauses a second, and then also follows (panel 8). Accelerating quickly Dick cycles up the centre of the northbound Waterloo Road towards Waterloo Bridge (panels 9 and 10).

Through the kind of rule breaking described above, Dick is effective in keeping himself in motion. Whereas Elle and Tara encounter a road infrastructure in which they appear to be out of sync with other road users, Dick encounters a road space that affords him rapid and confident movement. He is a fit, physically confident cyclist on a lightweight single-speed road bike capable of accelerating rapidly from a standing start (panels 8–9). For the majority of his journey Dick follows the formal rules and conventions of the roads he is on. He does not cycle on sidewalks. He cycles in the right direction, in the allowed lane, on the main carriageway. He gives way to other vehicles. He stops at pedestrian crossings;

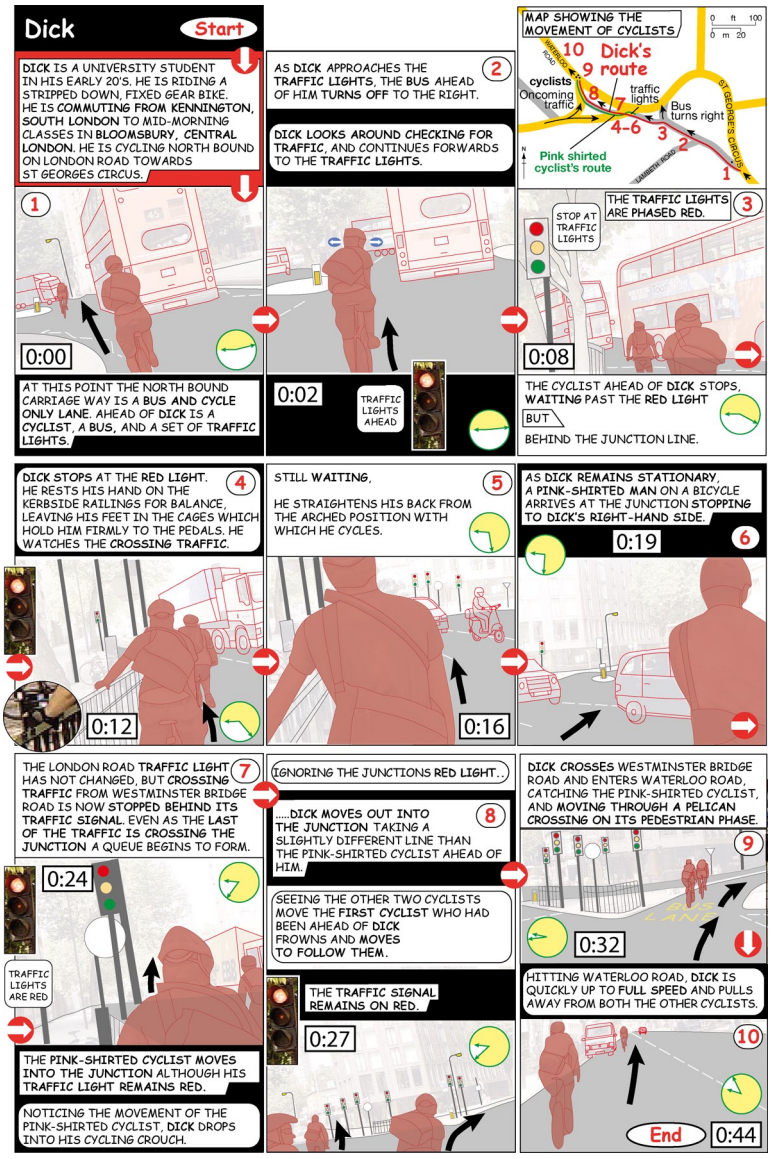

Figure 3. [In colour online.] Diagram 2: Dick.

although only so long as someone is using the crossing. In a sense his rule breaking can be understood as a kind of rule making, a rule making that is parasitic on the formal orderly behaviour of both the road infrastructure (the traffic signals and so forth) and the other motorised users of the carriageway. His ability to create (whether through his own cunning or through imitating the actions of other cyclists) an alternative set of extralegal rules and norms through which he navigates certain junctions is dependent on other road users obeying the formal rules of the road. Without the regular breaks in traffic created by the traffic lights along Westminster Bridge Road (panel 7), *and* the red light still holding vehicles behind him (panels 4–8), Dick would not be able cross the junction with the speed and confidence that he does [panels 9–10 (cf Kidder, 2011)].

This rule breaking and rule making might be understood as definitive of fast and confident cycling. That would be too simplistic a description. John, a cyclist in his early thirties, who commutes 13 miles in and out of London every weekday is—like Dick—a fast cyclist. The road infrastructure along his route presents many opportunities to engage in the kind of rule breaking outlined in Dick's diagram. John refuses to take them. Instead he is notably

compliant to the rules of the road infrastructure he inhabits. John manages his velocity through a combination of bike choice, physical fitness, and his skill as an urban cyclist. He rides a light and slim-wheeled tourer, quickly accelerates to a high speed, and commutes along a more winding route that avoids the larger signal-controlled junctions (like those encountered by Dick at St George's Circus). Much of the efficiency of John's cycling—his ability to in effect "produce speed' (Lugo, 2013, page 204; cf Kidder, 2011, page 77)—comes from his ability to fit into and through spaces that motor vehicles cannot. His journey frequently finds him overtaking queues of stationary traffic on the right, or undertaking lanes of slow-moving traffic when the opportunity presents itself. But if London's infrastructural settlement affords certain styles of high-tempo cycling, this does not mean that those who cycle slowly are necessarily lacking in skill.

Diagram 3: Gail (being together and being left behind)

Tooley Street, running parallel to the south bank of the river Thames, is one of the main arterial routes out of central London. Gail, the accountant introduced in Elle and Tara's vignette, is approaching the intersection of Tooley Street and Tower Bridge Road (figure 4, panel 1). Travelling southwards along Tooley Street on her foldable Brompton bike she filters along the inside of a short queue of stationary traffic being held by a red traffic signal. Reaching the intersection she continues past the advanced stop line for cyclists and positions herself on the far-left hand curb of the junction. She does this in part because a BMW station wagon has stopped directly behind the advanced stop line and is occupying all of the space that should be reserved for cyclists. By the time her traffic light turns green she has been joined by a number of other cyclists and motorcyclists positioned ahead of the BMW and more or less beside her. There is something interesting about this moment of waiting. At least for that moment, the people driving cars and vans, riding motorbikes, and those on bicycles are held together by an anticipatory attention to the traffic signal opposite. Unlike Dick and the other cyclists at the St Georges Circus intersection who are involved in breaking from the control of the red signal when it suites them individually as cyclists, at Tooley Street this togetherness remains honoured up to the point the light changes.

As soon as the light turns green the togetherness disperses. On green the leading cyclists accelerate powerfully across the junction, yet are overtaken as they do so by two motorcyclists and the BMW. Gail too moves out across the junction. She is continuously overtaken by other motor vehicles and cyclists as she does so (panel 2). Having crossed the junction she enters a bus lane; this is also open to cyclists and taxis. Despite the density of traffic the bus lane immediately ahead of her is clear of vehicles with the exception of a double decker bus stopped for passengers to alight and disembark (panel 3). The cyclists who have overtaken Gail remain in the outer lane anticipating the need to negotiate the stationary bus. There are enough cyclists and they are moving fast enough that motorised traffic is forced to treat them as they would other motor vehicles in a similar situation. Reaching the bus Gail moves into the left-hand edge of the centre lane, passes the bus, and swings sharply back into the bus lane. As she negotiates this manoeuvre Gail is overtaken by three male cyclists, all of who position themselves more centrally within the centre lane (panels 4–6). And as Gail realigns herself with the curb of the road the male cyclists continue to pull away, still clustered together as a group, still occupying the edge of the central lane, and still hindering the following cars from overtaking them (panel 7).

So Gail is left behind by the other cyclists on Tooley Street. Just as she is left behind by the motorcycles, cars, and vans. The slower speed of Gail's cycling, and the different path she traces around obstacles, means that she is only brought into proximity with the majority of other faster cyclists for short moments (panels 4–5). As the other cyclists travel away en mass from the junction and past the bus they produce a sense of being together that is

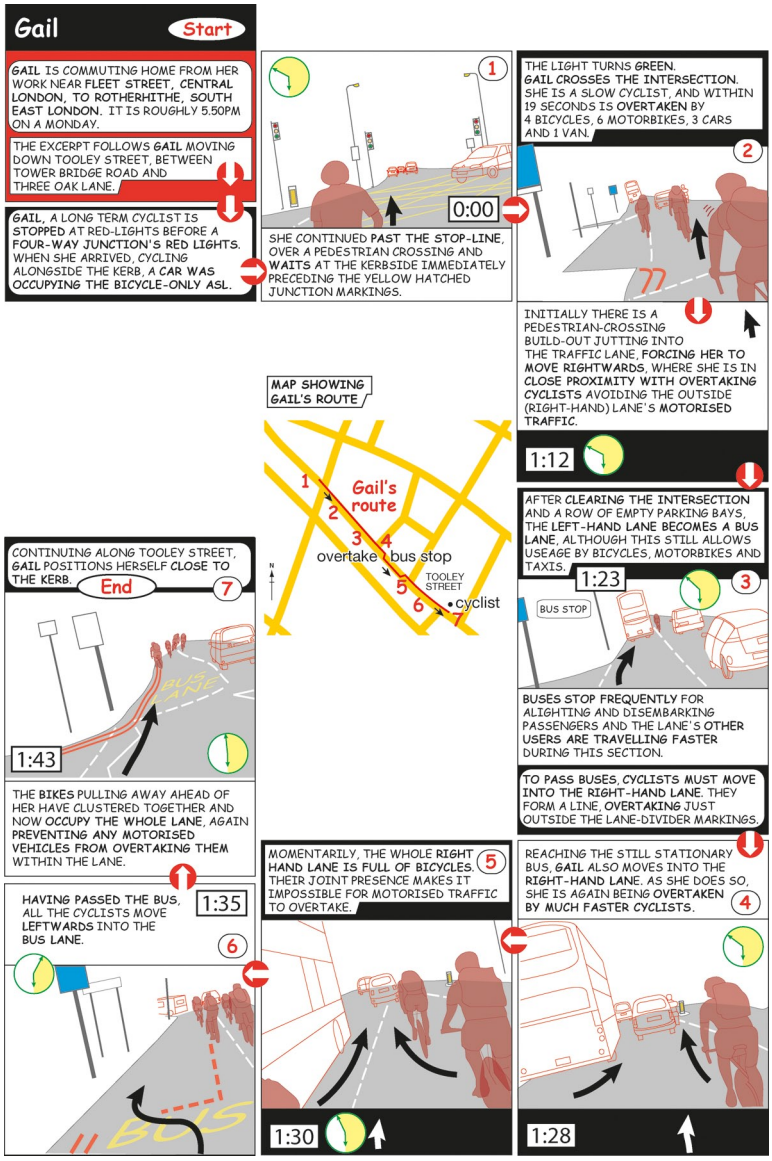

Figure 4. [In colour online.] Diagram 3: Gail.

not just a product of being copresent individuals. Rather, their grouped togetherness is a synchronisation of similar styles of movement; a synchronisation that has notable effects on other vehicles travelling on the road. Mary describes a parallel phenomenon of travelling "as a bloc" (to use her words) of cyclists during her morning commute along the bus lanes leading to Stockwell Gyratory. This coming together requires its own skilled-ness. Further along the same stretch of road Mary uses, Basil found himself traveling together with a small group of cyclists. He loses them as he is caught behind a stationary bus the other cyclists successfully manoeuvre around. With Gail it is not that she lacks the skills to join the other cyclists (although her age, physical capacities, and choice of bike work against that); it is that Gail has over her many years of commuting developed a very different style (and speed) of cycling. This is a style that is actually very effective in keeping her in motion. And it is a style that rests on a rather different set of skills than that used by faster riders. Gail is notably skilful at finding her own rhythm in the face of the dominant rhythm of the traffic around her. This is quite an achievement. But it is one unsupported by other cyclists.

Diagram 4: Rachel (finding a way through, being redefined through infrastructure)
Having shown people being confounded by road infrastructure (Elle and Tara, diagram 1), using elements of that infrastructure to gain speed through negotiating outside of the norms governing motorised traffic (Dick, diagram 2), showing cyclists setting up rhythms of movement that may (or may not) play into the overall flow of traffic (Gail, diagram 3), the final vignette focuses on an infrastructural attempt to make a space for cyclists as cyclists. Slowing for the red light that marks the southern entrance to Vauxhall Cross Gyratory, Rachel, a conference organiser in her early thirties, has a number of options (figure 5, panel 1). She needs to get across the gyratory and onto Vauxhall Bridge; which will take her over the Thames into central London. She could do this through entering the gyratory's one-way system with its four to six lanes of signal-controlled traffic. Within the gyratory—which at its peak has the equivalent of 6400 cars passing through it per hour (TfL, 2010, page 10)—the only obvious on-road concessions to the vulnerabilities of people on bikes are the advanced stop lines installed before most, but not all, sets of traffic lights. Fortunately for Rachel the gyratory's traffic engineers have thought to provide another route (panel 2). Hitting the junction, Rachael crosses over the stop line holding back the accompanying motorised traffic, veers right, coasts across the attached bike reserve, and joins the walkers crossing the 'Toucan' pedestrian crossing ahead of the motorised traffic from which she has just separated (panel 3).[(4)] This route brings her onto an island between the traffic travelling along parallel one-way routes; westbound up Harleyford Road and eastbound down Kennington Lane. It allows nonmotorised traffic to cross this junction in a clockwise or anticlockwise direction, but requires that they negotiate a highly constrained space and take two crossing phases to do so (panels 4).

Something interesting happens as Rachel crosses from the carriageway onto the toucan crossing. She ceases being a kind of slow-moving vehicle; that is, slower and more physically vulnerable than motor vehicles but one more or less beholden to the same rules

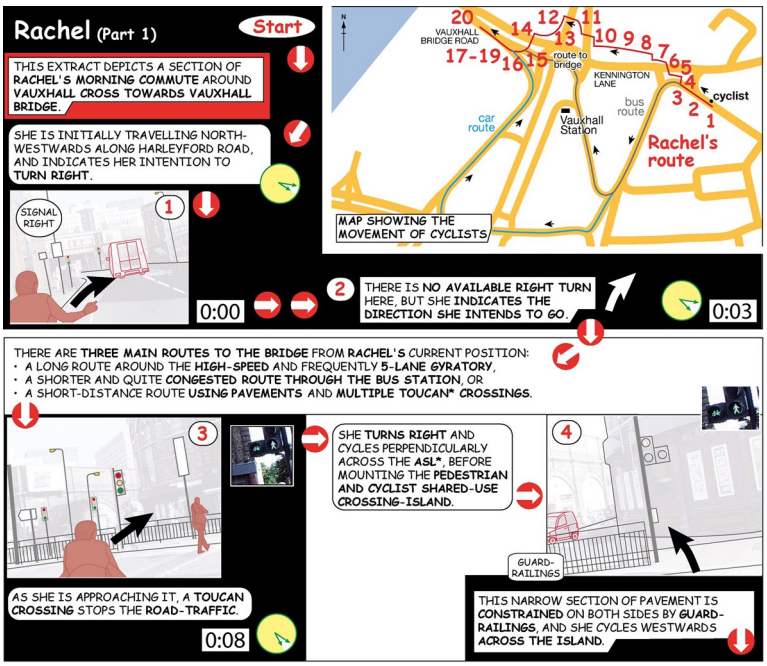

Figure 5. [In colour online.] Diagram 4: Rachel (part 1).

[(4)] Toucan crossings allow pedestrians and mounted cyclists to cross together, the name being a pun on 'two can'.

and conventions (Pinch, 2010; Pucher and Buelher, 2012; Shove, 2012). Moving onto the crossing she transforms into a kind of vehicular pedestrian. Elle and Tara need to dismount to make (legal) use of the affordances offered by the sidewalk and pelican crossing they used to get across Roehampton Lane. And this too is what Gail does when she decides to use the sidewalks on her route. In contrast, the infrastructure provided at the gyratory allows Rachel to stay in her saddle (figure 6, panels 5–13). It is as if, when faced by the size of Vauxhall Gyratory, the transport engineers have thrown up their hands and decided that actually people on bikes are rather more like people on foot than they are people in cars. The infrastructural price of Rachel's separation from motorised traffic within the gyratory is that she must defer to that traffic as she negotiates her diversion (as the pedestrians accompanying her on her route must also do). Over the course of her route through to Vauxhall Bridge she has to negotiate four toucan crossings. And it takes her over three minutes to cover a little over 200 m as the crow flies (figure 7, panels 14–20).

The way in which Rachel is separated from motor traffic points to the fuzzyness that sits at the heart of the practice of inhabiting London's road infrastructure as a cyclist. Cyclists are neither pedestrians nor motorists. Instead, confusingly, within this settlement they are in a sense both. Most of the time people on bikes are understood to be a kind of slow-moving vehicle not that different to cars or motor cycles. People on bikes are expected—in fact, are required by law—to ride on the carriageway, obeying the same injunctions that motorised users are subject to (Driving Standards Agency, 2007). Yet, as soon as a cyclist dismounts her bike she becomes a pedestrian and she and her bike are free to move around like pedestrians. In Rachel's vignette we see that mounted cyclists can—and occasionally are encouraged by transport planners to—mix with pedestrians. It is the bicycle's nimbleness and lightness that allow Dick to feel that jumping lights is a justifiable behaviour (because—in his judgment—as a cyclist it is not dangerous to himself or any other road users). And it is the qualified recognition of this lightness that has opened up the opportunity for Rachel to legally travel on the sidewalk throughout the Vauxhall diversion.

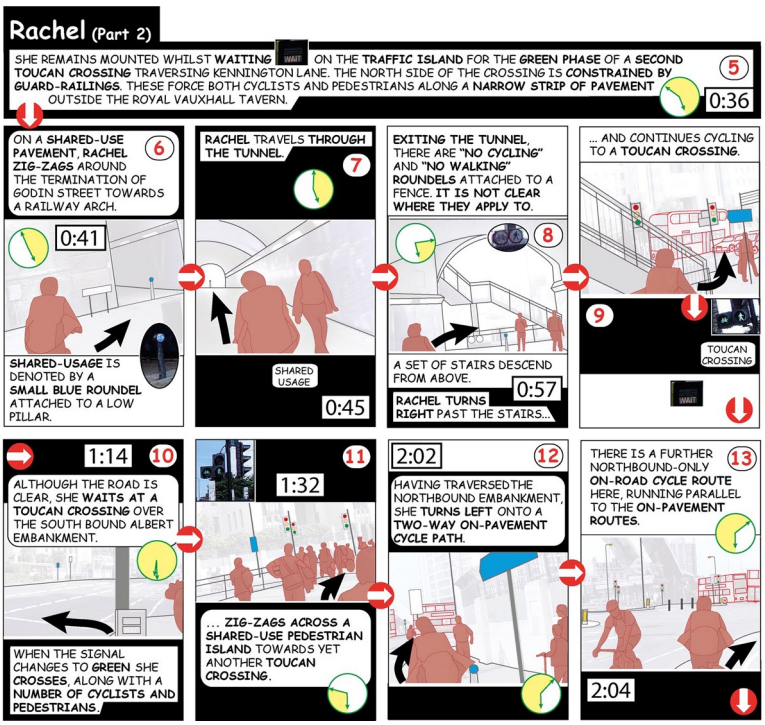

Figure 6. [In colour online.] Diagram 4: Rachel (part 2).

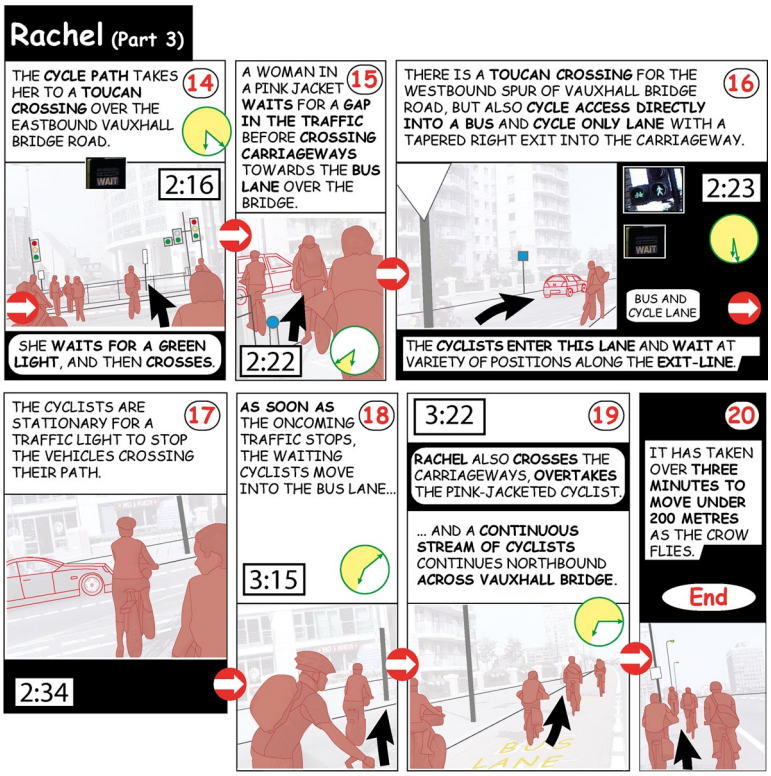

Figure 7. [In colour online.] Diagram 4: Rachel (part 3).

Conclusion

The previous section has paid a great deal of attention to describing how some people on bikes go about inhabiting London's road infrastructure. Or, more specifically, following Star (1999), describing how some people on bikes use London's roads as infrastructures for their movement. This paper began with the proposition that when attending to infrastructure contemporary urban scholarship does not pay enough notice to the practices through which urban dwellers use and inhabit infrastructural spaces. And so it is worth asking: what has the close attention to the practices of cycling in London taught us? We want to highlight three points.

First, looking closely at how people cycle on London's roads shows how infrastructures are simultaneously obdurate whilst also presenting all sorts of opportunities for reinterpretation and reuse. This reuse changes something of what this infrastructure is. Cyclists—at least those followed in this paper—do not navigate London's roads in the same way that motorised vehicles do. Bikes are walked and wheeled through short cuts and to avoid tricky situations. People on bikes filter through gaps and jump traffic queues. They sometimes hug close to curbs, and at others throw themselves into the centre of traffic. They position their bikes ahead of stop lines at junctions. Traffic signals are used to trick bikes through intersections. Bikes cluster together to magnify mass and velocity. And all this is done on a road infrastructure that cannot work out what kind of a vehicle they are. When allowed, people on bikes ride on sidewalks and cross pedestrian crossings. They share bus lanes with buses and Hackney cabs. London's roads are both inviting and intimidating for people on bicycles. Configured primarily for motorised traffic they afford the movement of cyclists in ways that can be simultaneously effective (they allow cyclists to travel rapidly and for the most parts safely) and ambiguous (they leave open the question of how precisely people on bikes are meant to navigate them). In an infrastructural settlement calibrated primarily around a division

between motorised and pedestrian traffic, the alternative capacities of people on bikes are often disruptively assimilated into existing infrastructure provisions.

This leads to a second point. The different styles of cycling employed by the people on bikes followed in this study could be seen as a kind of counterpower; sets of tactics that allow a relatively marginalised group within London's road traffic population to appropriate infrastructural spaces to their own ends (Aldred, 2013; Kidder, 2011; cf de Certeau, 1984; Simone, 2010). That is certainly true to an extent. However, most of the time our cyclists were compliant with the rules of the road. This suggests another way of approaching the kinds of rule breaking, rule making, and rule bending described in the four junction vignettes. Instead of being a counterpower, they could be read as indicators of infrastructural tension or pressure. They point to situations where people on bikes encounter existing infrastructural configurations not as affordances, but rather as 'barriers' or 'difficulties'; something to be worked around, solved, or overcome. This may also point to fundamentally different understandings of the situation at hand amongst different infrastructural users. To take the extreme example, flagrantly rule-breaking cyclists like Dick can have elaborate and logically plausible justifications for their actions. These justifications are not just about how their individual rule breaking benefits them personally, nor is it an idiosyncratic response to a one-off infrastructural configuration. They also involve some sense of how either: (a) the existing set of rules are unfair or unreasonable for cyclists; or (b) that their rule breaking (and hence rule making) is involved in inventing styles or techniques for cycling that make them safer and more efficient road users. That is to say, their justification involves some reference to a wider common good (cf Boltanski and Thévenot, 2006). These kinds of justificatory arguments might also point towards ways existing infrastructure might be made more accommodating to cyclists; why not let them cross junctions during the pedestrian phase, or turn left on red lights (as just two examples)? Paying close attention to how people navigate London by bike has the potential to open out these kinds of questions to more careful public (and thus policy) debate and consideration.

This talk about justification carries us to the third concluding point. The growth in cycling in London has been supported by a range of incremental innovations to the city's road infrastructure targeted at supporting cycling; advanced stop lines, bike lanes, allowing people on bikes into bus lanes, toucan crossings, and so forth. The four vignettes have shown how some of these elements have been incorporated into people's cycling styles. Yet despite these additions, as an overall system London's prevailing road infrastructural settlement remains remarkably obdurate to change—embedded as it is in a decades-old 'installed base' of material configurations, conventions of design and use, and existing communities of practice (Star and Bowker, 2006; Star and Ruhleder, 1996; Star, 1999). Introducing new individual infrastructural elements to support cycling does not necessarily upset this established constitution. The success, for example, of the Vauxhall Gyratory diversion navigated by Rachel rests on the ability to temporarily turn people on bikes into legalised vehicular pedestrians. Or, to put the matter another way, the operability of the diversion rests on the designers' ability to temporarily move people on bikes from the motor vehicular side of the infrastructural settlement onto the pedestrian side. Crucially, this leaves the structure and coherency of the current settlement unchallenged. Asking how this settlement could be more fundamentally challenged brings the discussion back to the worlds of politics and the kinds of infrastructural accounts found in much critical urban studies (Graham and Marvin, 2001; Macfarlane and Rutherford, 2008; Rodgers, 2012). But it might also bring us back to the various styles of cycling that cyclists have developed to cycle in London, and the effects they enact through practice. How might it be possible to think about bikes not as some kind of anomaly within the motor vehicle–pedestrian divide (a mode that oscillates between the

two master categories), but as a wholly different entity of movement? Through attending in greater detail to existing patterns of infrastructural inhabitation, it is our hope that it might be possible to inform the development of infrastructural innovations that more self-consciously challenge that settlement.

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