
Mediated Bodily Routines as Infrastructure in the Algorhythmic City

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Abstract

This article proceeds from the observation that, in 21st century cities, algorithmic technologies engage people as bodily beings in the production of space in ways that warrant theoretical discussion on urban infrastructure and infrastructural power. While human corporeality is an increasingly prominent issue in critical (media) infrastructure studies, my argument in the article is that the structural role of corporeality in the pervasively computed urban context remains undertheorised. A key starting point demanding reconsideration concerns the ontological separation of human embodiment from the materiality of infrastructure. To overcome this separation, I direct attention to urbanites' mediated bodily habits and routines, stressing their importance in infrastructural constitution. The power-infused interrelational dynamic that these routines enact is addressed in the article by developing a conceptualisation that combines views of classic social and urban thinkers with more recent, particularly nonrepresentational, theorisation. As a methodological bridge towards empirically investigating how mediated bodily routines 'infrastructure', I propose a reworking of Henri Lefebvre's notion of rhythm in terms of the algorithmic qualities of contemporary cities.

Keywords

bodily repetition, computational mediation, habit formation, infrastructuration, media infrastructure studies, mediated bodily routines, urban algorhythmicity, urban media studies

Ontology, whatever else it is, is usually just forgotten infrastructure.
– John Durham Peters, *The Marvelous Clouds* (2015: 38)

At the end of the 2010s, the embedding of code-based algorithmic technologies into built environments, together with the proliferation of ‘smart’ portables, has reconfigured the conditions of urban spatial production. Not only have the physical infrastructures of cities become programmable (e.g. Kitchin, 2011), but city dwellers now relate to urban environments in new ways as corporeal beings, which in turn has transformed the nature of urban infrastructural power, making it fundamentally a process of bodily engagement.

To date, numerous studies have been conducted in different disciplinary fields on the computational mediation of urban structures, logistics and governance. At the same time, a wealth of recent case studies have examined aspects of ‘datafied’ life in cities. However, scholars have devoted less attention to how urbanites contribute, through their smart-equipped bodies, to infrastructural processes. In this article, I address this dimension from an urban media studies perspective and suggest that the topic is also relevant for understanding and analysing the contemporary complexity of infrastructure more generally.

My primary aim in the article is to construct a theoretical argument on the involvement of city dwellers in urban infrastructural constitution and spatial power dynamics through a focus on bodily routines formed around computationally mediated gestures, movements and (inter)actions. Routinised action has arguably always contributed to the urban ‘long now’,¹ but the specific affordances of algorithmic technologies assign to kinaesthetic, proprioceptive, tactile and haptic habituation a significance that reworks and accentuates the infrastructural role of routines. While I am mostly preoccupied with what could be called a material metaphysics of infrastructure, the argument I develop has certain methodological implications that I will touch upon towards the end of this article.

The motivation behind my approach resonates with what the sociologist Evelyn Ruppert and colleagues (2013) state about digital devices: such devices have mediated and reworked ‘not only social and other relations, but also the very assumptions of social science methods and how and what we know about these relations’ (25). For media studies scholars interested in contemporary cities, this observation poses a

challenge to interrogate and self-reflect on how sensitively our concepts capture the deep structural transformation engendered by pervasive computing and networked devices. My starting point in this article is that we must reconsider and refine our thinking tools in this respect.

I will tackle the challenge of theoretical reconsideration by bringing together views from classic social and urban thinkers with more recent, particularly nonrepresentational, theorisation. As part of this discussion, I will develop a dynamic conceptualisation for addressing the mediated complexity of urban infrastructure and infrastructural power. In this way, I also wish to respond to calls for more ambitious concept production in the domain of media studies (Lovink & Rossiter, 2013). The steps I take in my argumentation are as follows.

In the first section, I relate my approach to the state of the art in infrastructure studies by pointing to resonant interfaces in this multidisciplinary, overabundant and rapidly widening field. I note how the role of human embodiment in infrastructural processes is generally conceived, and I stress the importance of conceptual sensitivity in addressing these processes.

In the second section, I focus more strictly on urban space and provide background for the developments that have made the contemporary city highly relevant for media studies as both a context for and an object of research. I examine how the deepening computational mediation of cities is addressed in geography and other disciplines and show how these studies illuminate urbanites' relations as bodily beings with each other and the digitalised environment. I also ask what the infrastructural implications of this situation might be.

Following the two contextualising sections, I then discuss in the third section how infrastructure's infrastructurality is defined in the research literature; i.e. what, according to various scholarly definitions, makes something count as infrastructure. In the overview, I bear in mind the role of human embodiment and later suggest that computational mediation necessitates the inclusion of corporeality in the definition of infrastructural fundamentals.

The fourth section introduces habituation, habits and routines as key, and inherently dynamic, elements of infrastructural stability, particularly so in the pervasively computed urban condition. To address the ontological precariousness and precariousness of bodily routines, I bring together the views of several classic thinkers, most notably those of the pragmatist philosopher John Dewey, with more recent theorising on habit. Nonrepresentational thinking, especially as represented by the geographer Nigel Thrift, is indispensable for grasping how routines formed around repetitive movements, gestures and acts incorporate power in an infrastructural sense. This combination of classic and more recent views allows for capturing the role of urbanites' bodies in terms of a power-infused process of infrastructuration, which in 21st-century cities crucially takes place through computationally mediated habit formation and routines.

In the fifth section, I consider the process of urban infrastructuration more closely at the contemporary street level. While an empirical study of how mediated bodily routines instantiate or enact infrastructure (or, even more dynamically, how they infrastructure) is beyond the focus and scope of my discussion, I do suggest that a fruitful methodological bridge can be built by reworking Henri Lefebvre's ([1992]2004) notion of rhythm regarding the qualities that render contemporary cities 'algorhythmic'. Algorhythmicity is a neologism transferred from the term's initial context in the study of computational cultures (Miyazaki, 2012, 2018) to analyse people's algorithmically managed movements and activities in urban space (Miyazaki, 2013; Coletta & Kitchin, 2017). Despite explicit references to Lefebvre in discussing algorhythmicity, scholars have yet to elaborate on the notion to accommodate the multisensory materiality of human bodies as emphasised in Lefebvre's rhythmanalysis.

I conclude the article by discussing the scholarly and broader societal relevance of rethinking infrastructure as a concept in an ontological register.

Infrastructure studies and human embodiment

As Penelope Harvey and colleagues (2017: 1) note in their introduction to a recent companion of infrastructure studies within social research, infrastructure has become an increasingly popular area of study. Scholars examine multiple diverse issues at this

busy junction, from the dimensions of embedded power relations to the effects of standardisation to scale-making capacities and their connections with social relations, to name but a few (Harvey et al., 2017). This multiplicity means that any one approach in any field of infrastructure studies has several potential meeting points with other approaches. To avoid merely adding to cacophony, it is hence advisable to first identify the interfaces that appear most resonant with one's own research interests.

An important field for addressing infrastructure from an urban media studies perspective is the emerging, and thus far rather loose and shapeless, formation of critical infrastructure studies.² The critical study of media infrastructures comes closest to my own footholds in a disciplinary sense (e.g. Downey, 2014; Farman, 2015, 2018; Frith, 2015, 2019; Horst, 2013; Mattern, 2015, 2016; Parks & Starosielski, 2015; Peters, 2015; Plantin et al., 2016; Plantin & Punathambekar, 2019). As Lisa Parks, a prominent advocate of media infrastructure studies, points out, the history of this new field becomes much longer if we view media infrastructures as a reconceptualisation of earlier telecommunication networks (Parks, 2017; see also Parks, 2015). This move obviously opens up interfaces with the study of 'large technical systems' (LTS), from Thomas Hughes's (1983) landmark study of electrification in the Western countries onwards; such studies currently include research on large-scale information and communication systems that process and transmit data both worldwide and nationally (e.g. Jackson et al., 2007; Bowker et al., 2010). If we consider how urban infrastructures have been studied in the broadly understood LTS tradition, the ground-breaking political-economic work of the geographers Stephen Graham and Simon Marvin (1996, 2001) is particularly relevant in the present context.

Some scholars in the field of media infrastructure studies focus especially on urban space; one example is the fascinating media-archaeological explorations of Shannon Mattern (e.g. 2015, 2016, 2018).³ Other scholars' problematics have clear connections to cities through an interest in specific technologies, such as Jordan Frith's studies (2015, 2019) of radio frequency identification (RFID) chips. What these approaches, and infrastructure studies more generally, appear to have in common is their explicit or implicit view of human bodies as infrastructurally important yet at the same time fundamentally – indeed, ontologically – separate from the materiality of physical infrastructures.

The significance of human bodies for infrastructural processes is acknowledged most clearly in discussions of the labour, skills and practices necessary in the instalment, maintenance and repair of the ‘hard’ physical structures that enable the continuity of social life in different spatial settings. Among media infrastructure scholars, Parks, for example, has used the perspective of corporeality to explore what occurs at the fringes of physical media infrastructures (see Parks, 2009, 2012, 2014). The bodily aspect has gained more prominence in recent years, along with an increasing interest in affect in media studies (e.g. Parks, 2014). Corporeality is also indirectly present in studies that direct attention to ‘soft’ infrastructures, such as the practices and conventions involved in the production, appropriation and use of physical infrastructures.

Despite the undeniable and even pronounced role of humans as bodily beings identified in critical infrastructure studies, only recently has this aspect begun to draw serious attention in terms of theorising infrastructure. In fact, one could argue that current research tends to conceive of human corporeality as fundamentally external to what infrastructure is about. While the sociotechnical constitution of infrastructures appears to be widely accepted, we often gloss over their ‘bodytechnical’ aspects. For example, in describing the effects of ‘the new infrastructural turn’, the urban geographer Ash Amin (2014: 137-138) states that after this turn, ‘both the social and the technological are imagined as hybrids of human and nonhuman association, with infrastructure conceptualized as a sociotechnical assemblage’.⁴ Such a framing, albeit apt and perfectly valid, has little to say about the corporeal dimension of recent infrastructural reconfigurations.

Linguistically, the separation of human bodies and the materiality of physical infrastructure appears in references to the multiple ways in which human actors ‘encounter’ infrastructures, i.e. how people devise, build, maintain, repair, experience and use infrastructures. A fundamental difference is also implied in statements of how infrastructural systems underlie, support, enable, normalise, affect and connect individual and collective human activities (and, when they are deficient, broken down or oppressive, hinder the same activities). These discursive markers of ontological separation abound in the media infrastructure studies literature, and a systematic tracing and documentation of these markers would be a task of distinct rhetorical analysis.

Given that bodily habituation is at the core of my argumentation, studies of habit in the fields of human geography (e.g. Dewsbury & Bissell, 2015) and cultural sociology (e.g. Bennett, 2015) present fruitful interfaces with my discussion. Particularly resonant is the interface with the philosophy of habit (for a classic, see Ravaissou, [1838]2008; see also Sparrow & Hutchinson, 2013). While usually not identified as infrastructure studies per se, treatises of habit contain an inherent infrastructural dimension. The most notable resonances would be with those habit studies that include both computational technologies and the urban context in their purview.⁵

The philosophy of habit is also important for the ontological orientation that underlies and shapes the trajectory of my discussion. At the same time, philosophical disposition more generally underscores the intrinsic value of theory development, which often is dismissed in social scientific research due to pressures to rapidly produce results on concrete phenomena. While empirical studies undoubtedly provide invaluable information about how algorithmic technologies mediate and remediate physical infrastructures, conceptual reflection is a precondition for determining in a nuanced manner how this mediation engages humans as bodily beings in infrastructural processes, as well as what the wider implications of this situation are.

My starting point hence is that grasping how computational mediation reconfigures the boundaries between the materiality of physical infrastructures and the materiality of human bodies demands that we pause to interrogate infrastructure as a concept, i.e. as a tool for theoretical and methodological thinking (cf. Bal, 2002; Blumer, 1969). One can even argue that the word ‘infrastructure’ is exceptionally promising in this respect. As the cultural anthropologist Ashley Carse (2017: 35) observes in his definitional article on infrastructure, the term’s usefulness lies in ‘both its conceptual plasticity and the undeniable materiality of its common referents like roads, pipes, rails and cables’. There is also specific potential in how infrastructure as a keyword in Raymond Williams’s (1976) sense is bound up historically with the issues and problems we use this term to address (Carse, 2017: 35). What I wish to do in my own argumentation, however, is to not only extend infrastructure’s field of reference as a keyword but also to probe the word in an ontological register as a sensitising concept (Blumer, 1969; also Bal, 2002).

Before tackling this task, I will make another contextual detour in the next section to a few neighbouring disciplines, most notably geography, to illustrate why computational mediation makes cities and their infrastructure so interesting for media studies scholars.

Urban ‘percolation’ and bodily reorientations

If we consider the scant interest in urban space as a context of media consumption in the tradition of mainstream mass communication research, it is not surprising that media scholars have been slow to notice the relevance of cities for their research interests (see Ridell & Zeller, 2013; Ridell, 2014). This situation has now changed drastically in a very short time because of the rapid proliferation of networked portables. Today, the city is one of the most fascinating spatial contexts in which to explore people’s relations with various media in terms of both representations and technologies. So far, however, media scholars’ fascination with urban mediation is strongly empirical in orientation (as the current mushrooming of case studies attests), while theoretical and methodological considerations appear to be lagging behind (see Ridell, 2014; for an outstanding exception see Gabrys, 2010, 2016).

In the field of geography, in contrast, theoretical discussions of the transformative role of information and communication technologies in cities go back two decades or more (e.g. Batty, 1997; Graham & Marvin, 1996, 2001; Amin & Thrift, 2002; Thrift & French, 2002; Crang & Graham, 2007; Kitchin & Dodge, 2011). The cultural geographer Gillian Rose (2017: 6) divides ‘the rich body of geographical work on digitally mediated cities [...] into three intertwined strands; work that draws on nonrepresentationalist philosophies; work that draws on Actor Network Theory (ANT); and work that draws on Science and Technology Studies (STS)’.⁶

As will become clear, the first strand that Rose (2017) identifies in geographical theorisations is crucial to the construction of my argument in this article; there are some more muted resonances with the other two strands as well. From the perspective of urban media studies, I also find Jerry Kang and Dana Cuff’s (2005) idea of the pervasive computing of urban space to be useful; in their work, they combine their respective starting points in the fields of law studies and architecture to address the

embeddable (and thereby intrinsically infrastructural) character of networked digital technologies in cities. At the same time, the authors' collaboration in exploring urban 'percolation' (sometimes abbreviated as 'PerC') anticipated a crossing of disciplinary boundaries that has since grown ever more important for grasping the complexities of urban computational mediation.

The more recent analyses of urban space as coded, programmable or 'percolated' recall the computer scientist Mark Weiser's (1991: para 1) well-known view of ubiquitous computing, where computers, connective networks and software systems 'weave themselves into the fabric of everyday life until they are indistinguishable from it'. What is particularly noteworthy in this connection is the normatively infrastructural ethos of Weiser's vision. In the words of the computer scientist Paul Dourish and the cultural anthropologist Genevieve Bell (2011: 95), Weiser's goal, in fact, was computation's 'infrastructural disappearance' (but see Galloway, 2004: 405). Today, such an implication reverberates in the industrial and marketing rhetoric on artificial intelligence (AI), prominent in discourses on robotics and the Internet of Things (IoT) and specifically dominant in the urban context within Smart City scenarios. The value commitments of this vision are in stark contrast to those adopted in critical studies of infrastructure, whose proponents continue to stress the necessity of *not* letting computation disappear beyond conscious recognition (e.g. Jackson et al., 2007).

To obtain a firmer grasp of what is at stake with recent urban transformations in infrastructural terms and why this transformation is relevant for media studies, it is useful to look at how information and communication technologies have come to shape urban spatiality ever more deeply. Fifteen years ago, Kang and Cuff (2005) encapsulated the convergence of three trends in urban-computing communications in the notion of pervasive computing ('percolation'): ubiquity, embeddedness and animation. The infrastructural relevance of this development, which has since accelerated even more rapidly than the authors expected, lies in the notion that kneading computation into the physical environment involves urbanites as corporeal beings in the production of space in unprecedented ways. In 'percolated' cities, urban dwellers equipped with smart portables act as nonstop producers and transmitters of data through their bodily activities. These activities interrelate with the two other aspects, embedding and animation. For the former, in addition to being embedded in

physical devices, building materials, walls, street furniture and other urban objects, computational elements such as RFID chips are getting so small that they can be mixed in paint, spray or powder form. This type of distributed embedding renders the city almost literally animated and profoundly changes urbanites' relations to their physical surroundings (Kang & Cuff, 2005: 97; see also Hayles, 2009; Gabrys, 2010). Wireless signal traffic is arguably one of the most important aspects of urban percolation today. The sociologist Adrian Mackenzie (2008, para 2) describes the effect of wireless antennae and algorithmic signal processing aptly as creating 'a contemporary mode of inhabiting places, relating to others, and indeed, having a body'.

With animation, Kang and Cuff (2005: 98-99) refer to the sensing and actuating capacity of computing elements added to micro-electrical-mechanical systems that enable unobtrusive measurement and detection of the physical environment. At their most sophisticated, these elements may even be capable of self-organising and learning (112). A decade later, as the media studies scholar Jennifer Gabrys (2016: 3) has pointed out, such systems were 'collecting data on any number of environmental processes that include managing cities and facilitating logistics, as well as providing and harvesting a range of data to and from smartphone users' (see also Mattern, 2018). Today, increasing numbers of case studies are examining the sensing and monitoring aspects of the computationally animated city, from urban surveillance studies to research on city dashboards to analyses of how city dwellers are involved in datafied self-quantification (e.g. Kitchin et al., 2015; Licoppe, 2016; Coletta & Kitchin, 2017; Pink & Fors, 2017a, 2017b; Tironi & Valderrama, 2018). In these studies, the infrastructural dimension of urbanites' computationally mediated bodily activities is often implicated but is rarely addressed directly.

The process of percolation as described by Kang and Cuff (2005) resonates with what Thrift (2004a) referred to around the same time as the emergence of a new kind of 'background time-spaces'. Thrift talks about 'a new sense of space as folded and animated' and links this development to the intervention of software and the massive increase in computing power that allow the generation of millions of numerical operations continually to be made in the background of any encounter (583-584). Due to advances in computation techniques, quantitative calculations have become so effective and ubiquitous that they function 'qualculatively'; i.e. as 'a means of making

qualitative judgements and working with ambiguity' (584; see also Thrift, 2004b; Thrift and French, 2002).

Particularly relevant for my discussion is Thrift's (2004a: 584) view of how qualculative development affects the human sensorium. According to Thrift, a qualculative world with its 'machinic prostheses' (594) alters the way the human body experiences itself and senses the environment. For example, the styles and expectations of our sensory coupling to the world through our hands are changing due to 'the migration of many skills and competences into the technical background' (600). At the same time, this change in hand-based orientation instantiates in a corporeally felt state of indeterminate expectation (see Mackenzie, 2010: 85), actualizing, for example, when we touch a smartphone's screen with our fingertips. Over time, these kinds of sensations, based on the responsiveness of the human sensory organism to the qualculative background, contribute to stabilising collectively shared modes of bodily orientation and expectancy – a development with profound implications for understanding urban infrastructure today. Kang and Cuff (2005: 110-111), for example, use the idea of a 'datasense', which provides an 'experience of reality with layers of contextually relevant information'. They also envision software that would allow people to right-click a mobile device to immediately access information about nearby people (110). While this kind of horizontally augmented appearance to others would certainly transform people's experience of privacy and publicness in urban space, as the authors suggest, it would also affect how urbanites relate corporeally to the augmented physical space and to co-present city dwellers.

It is precisely such changes in urbanites' mediated (inter)corporeal sensations and acts – and, above all, the stabilisation of these bodily adaptations and reattunements – that I propose we should take into account to obtain a nuanced grasp of infrastructure and infrastructural power in contemporary cities. I will examine this issue further after, in the next section, looking into how infrastructure is understood in the research literature and locating computationally mediated human corporeality in this definitional horizon.

Infrastructural fundamentals and human corporeality

While no definitive definition of infrastructure exists in the research literature (e.g. Harvey et al., 2017: 5-7), the field has reached a broad consensus over which aspects make infrastructures infrastructural; i.e. that render them the fundamentally enabling and supportive elements without which organised societies would not exist and function. To begin with, essential characteristics include infrastructures' systemicity and largeness. These attributes refer to infrastructures' often wide spatial reach and/or multisitedness, their continuity in time and resilience to change, their inconspicuousness and smoothness/frictionlessness of functioning, and their being built upon earlier, and networking with, other infrastructural systems and sub-systems. Jackson and colleagues (2007: para 5), for example, describe infrastructures as large and networked techno-material ensembles that bring together, integrate and coordinate the techniques, practices, institutions and technologies necessary to support them. Geoffrey Bowker and colleagues (2010: 98) state succinctly that infrastructures are 'pervasive enabling resources in networked form'.

Infrastructure is also typically characterised as simultaneously concrete and abstract. Infrastructures become actualised in tangible forms, yet their largeness and systemic, networked and coordinative qualities easily elude perception. These qualities, in turn, tie in with one central characteristic that is often mentioned in the research literature: the duality of infrastructure (e.g. Larkin, 2013: 329), or what Howe and colleagues (2016: 558) refer to as the paradox of infrastructure in their multidisciplinary discussion. In other words, while we recognise many infrastructures as solid physical objects and structures (electric lines, highways and railroads, for example), they simultaneously function as parts of more fluid structuring mechanisms: electric lines, highways and railroads connecting a geographic area into a nation-state as an assumedly coherent whole (e.g. Dourish & Bell, 2007: 418). One aspect of duality is the implicated presence of vast infrastructural systems even in small artefacts, such as water taps, smartphones and AI-controlled home devices (e.g. Parks, 2012: 69; Peters, 2015: 31; Crawford & Joler, 2018).

Another variation of duality may be found in the view of infrastructure's simultaneous stability or solidness and its inherently evolving nature. As the infrastructure historian

Paul N. Edwards and colleagues (2009: 365) point out, infrastructures are ‘always already there yet always an unfinished work in progress’. A meta-level synthetic approach, in turn, conceives of infrastructure as a triad, which operates simultaneously at the macro, meso and micro scales of temporal and sociospatial organisation, and which, by linking these three scales together, forms ‘the stable foundation of modern social worlds’ (Edwards, 2003: 186).

Most conceptions of infrastructure have included relationality as a rhetorical starting point since the mid-1990s, when Susan Leigh Star and Karen Ruhleder (1996) outlined the basic tenets of the relational view (see also Star, 1999; Bowker & Star, 2000: 35).⁷ In Star’s (1999: 380) summarisation, the idea is to see infrastructure as ‘a fundamentally relational concept, becoming real infrastructure in relation to organized practices’. Hence, ‘analytically infrastructure appears only as a relational property, not as a thing stripped of use’ (Star & Ruhleder, 1996: 113).

Regarding computationally mediated cities, particularly significant among infrastructure’s fundamental features is imperceptibility; i.e. the infrastructure’s residing beyond conscious recognition in both the concrete and cognitive senses. The former points to the condition where a large part of supporting physical urban structures are hidden from our senses, as they are buried in the ground or radiate through the air, for example, becoming perceivable only during times of installation or breakdown (e.g. Graham & Thrift, 2007; Graham, 2010).⁸ The cognitive form of infrastructural invisibility, in turn, refers to the taken-for-granted attitude that human actors adopt through their learning to use infrastructural resources (e.g. Dourish & Bell, 2011: 95).

Physical inconspicuousness is already significant in the case of pervasive computing, if we consider that the materiality of algorithmic technologies is mostly inaccessible to the human sensorium.⁹ Such technologies thus are especially prone to receding into ‘cognitive invisibility’ (Kang & Cuff, 2005: 108). Inaccessibility to perception is strengthened by the fact that ‘in many PerC applications the computing elements are not designed to interface directly with any human user’ (109). In recent years, this ‘deep invisibility’ (109) has acquired additional layers of opacity through AI and learning algorithms. In other words, the fusion of physical and cognitive invisibility tends to be particularly seamless and effective as concerns these technologies.

My suggestion is that in contemporary cities, infrastructural disappearance includes as a dimension people's corporeal adaptation to computationally mediated spatiality and the integration of smart devices into their bodily practices. While at the beginning of this century it was possible to fleetingly notice that 'under some circumstances the human body becomes infrastructure' (Star & Bowker, 2002: 151), today, and particularly in the urban context, the proposition that human bodies are increasingly important elements of infrastructure deserves serious recognition. We should also acknowledge the bodily dimension in the definition of infrastructure, accommodating how algorithmic technologies, due to their reciprocal and responsive characteristics, interrelate with human bodies.

The literary and media theorist N. Katherine Hayles (2006, 2009) uses RFID as an example of how computing has changed the ontological rules of the game by penetrating 'not only into every aspect of biological, social, economic and political realms but also into the construction of reality itself' (2006: 161). Following Hayles, physical objects with an imbedded microchip (whether cars, clothes, mobile phones, credit cards or the like¹⁰) belong simply to the tangible layer of the multiple layers of the computational environment (see 2009: 50-56), or, following the geographers Rob Kitchin and Martin Dodge (2011), of the programmable urban code/space. Human bodies equipped with ever-smarter gadgets are locked with the integrated spatial process, their generation and circulation of data essential to the cybernetic enactment of the actual/virtual world.

Importantly for my argumentation, Hayles (2009: 68) thinks that digital technologies can 'interface with human cognition well below the threshold of aware consciousness through embodied actions such as gesture, posture, and the habitual motions' (see also Mackenzie, 2010: 69). In other words, her call for 'a more processual, relational and accurate view of embodied human action in complex environments' (2009: 48) resonates with the view of human corporeality as integral to urban infrastructural constitution. What is more, the inclusion of urbanites' mediated bodily activities in the recursive loops of the computationally mediated city also involves them intimately in the spatial power dynamics.

Combining Hayles's (2006, 2009) ontological point with an interrelational understanding of urban infrastructure shifts the definitional and, consequently,

methodological focus to the continuous process of infrastructural stabilisation. This shift warrants the use of the word ‘infrastructure’ as a verb rather than seeing it as denoting something (cf. Star, 2002; Star & Bowker, 2002). Among key stabilising factors are urbanites’ bodily repetitions as the basis of corporeal habituation and the subsequent formation of habits and routines. Such routines, I suggest, are an indispensable part of ‘the connective tissue and the circulatory systems’ (Edwards, 2003: 185) that glue urban life together and on which the continuity of society more generally depends.

The prec(ar)iousness of bodily habituation, habits and routines

To capture the central role of human bodies in infrastructural stabilisation, it is useful to take note of how some classic theorists of urban and public life viewed consistencies in how people share physical public space. Relating these views with more recent, particularly nonrepresentational, theorisation can also offer insights into the reconfiguration of infrastructural power in contemporary cities.

Previous notions that touch tangentially to the problematics at hand include, for example, Georg Simmel’s ([1903]2002) notion of the ‘blasé’. Referring to the mental numbness cultivated towards one’s fellow urbanites amidst the overwhelming sensory stimuli in metropolises, the notion implicates a process of bodily habituation. Such a process is also included in Walter Benjamin’s ([1936]2002) view of urbanites’ habitually distracted relations to architecture. Similar implications we find in Lewis Mumford’s ([1937]2011) idea of the city as a stage for collective drama in which the actors’ gestures are intensified. In a more general social science context, Marcel Mauss’s ([1934]1979) notion of ‘body techniques’ addresses corporeal repetition as being structurally significant. Such meso-level notions as George Herbert Mead’s (1934) ‘conversation of gestures’, Herbert Blumer’s (1936) ‘non-symbolic interaction’ and Erving Goffman’s (1963) ‘situational rules of interaction’ all have great potential for theorising urban infrastructural processes at a meso level, as they imply that the spatial orders of social life are enacted inter-corporeally. Goffman in particular is referred to widely in the study of contemporary urban sociality (e.g. Jensen, 2010; Licoppe, 2016), but his views are rarely applied from an explicitly infrastructural perspective.

Those classic thinkers who addressed bodily habituation in an ontological register are especially relevant for theorising on human corporeality in infrastructural terms. Most notably, Dewey's ([1922]2007) idea of individual habit formation as a way of securing the consistency of human existence illuminates the fundamentality of bodily habits and routines. For capturing the ontological significance of habits, the anthropologist and cybernetician Gregory Bateson's (1972) musings also offer insight. Both theorists are helpful in grasping how today's mobile media technologies are incorporated into communicative bodily repetitions in urban space, how these repetitions may result in the formation of habits and routines, and what the far-reaching implications are of such mediated corporeal habituation. More recently, Lefebvre's rhythm-analytical ideas are relevant for considering infrastructure at the macro level but equally for addressing the issue at the meso and micro levels as well (see Lefebvre, 2004). The entwinement of corporeality and power in Lefebvre's methodological conception of rhythm also makes his views valuable for addressing the reconfigurations of urban infrastructural power.

The analytical fruitfulness of bodily habituation and habit formation lies, to borrow a formulation from the cultural geographers J. D. Dewsbury and David Bissell (2015: 24), in the fact that 'matters of habit are more extensive than individuals'. Habituation as a corporeal process straddles the boundary lines between the micro, meso and macro dimensions, weaving them dynamically together; habits and particularly routines, in turn, enact infrastructure in a more stabilised form. Tom Sparrow and Adam Hutchinson (2013) present a similar consideration in their overview of habit's trajectories in philosophy (see also Barandiaran & Di Paolo, 2014). In any case (and analogically to other infrastructural fundamentals), the 'long now' of bodily habits and routines actualises in their tying together temporal and spatial scales and their reaching beyond the personal, situational and immediately perceivable.¹¹

In his theoretical treatment of habit, the social anthropologist Paul Connerton (1989) draws on Dewey's work to stress the embodied and non-semiotic aspects of habitual behaviour. Connerton thinks habits are specific, and specifically important, precisely because of these aspects. Following Dewey, he considers all habits to have a strong affective element and power over us because, formed through the frequent repetition

of a number of specific acts, habit is an intimate and fundamental part of ourselves (93-94; Dewey, 2007, part I; also Bateson, 1972: 151-152).

Habit has become a subject of increasing theoretical interest in recent years in the fields of cultural geography, sociology and many other disciplines in ways that resonate with Dewey's take on habit.¹² According to Dewsbury and Bissell (2015: 22), in geography 'habit has become reframed and retheorised in a way that makes it a key concept for our times'. By 'reframing', these scholars mean the way habit is distinguished from 'the routine and patterned activity that the term often pejoratively describes'; they see habit instead as 'the very process through which we gain sense, understanding and awareness' (26).¹³ While separating habit and routine makes sense analytically, we should not dismiss routines from scrutiny because of their assumed dullness or emptiness. Mediated routinised actions – i.e. those aspects of bodily interrelations with ambient technologies and mobile media that have become most automated and self-evident to urbanites – are crucial to take into account if we want to understand the reconfigurations of infrastructure and infrastructural power in computationally mediated cities.

If we wish to grasp the pertinence of bodily habituation and habit and routine formation in contemporary infrastructural processes, then studying the way these notions are addressed in nonrepresentational theorisation is particularly helpful. The geographer Paul Harrison (2000: 503), for one, also refers to Dewey's work in discussing how habituation involves the stabilisation of the continual motion of the body and bodies. In this process, routines instantiate as 'bodily dispositions', 'series of gestures' (508) and the 'serialisation of habits' (510), all of which serve to 'solidify embodiment and thus the flux of everyday life' (509). The ontological profundity lies in that 'without the repetition given in the contraction of habits there is no articulation; no organisation and no subjectification' (505). In other words, the densification and moulding of our everyday movements and gestures into taken-for-granted bodily habits and routines are what enable us to act.

In turn, Thrift (2004b), while encapsulating the ontological pertinence of bodily routines, also reminds us that there is nothing secured in routinised action. Even routines that appear fully formed may – and do – falter, crack and break down. Thrift points to culturally inculcated corporeal automations as constituents of a 'powerful

infrastructural logic which allows the world to show up as confident' and provides 'the stable ground for practices' (2004b: 175-177). This logic is performative in that confident order is both achieved and expressed through bodily repetitions. According to Thrift (2004b), the style of these repetitions pertains at any point in history but also depends on prereflexive modes of intensity. These modes introduce an inescapable element of wildness in the performing of infrastructure (176-177). Hence, there is always an interruption, distraction or interval at the heart of routines – a view that resonates strongly with Lefebvre's (2004: 16) definition of rhythm. This fragility is why repeating the repetitions that routines consist in is so vital; discontinuing the repetitive action would begin an end to stability.

In addition to sensitising us to the infrastructural preciousness and precariousness of bodily habits and routines, nonrepresentational theorisation offers insights into the complex dynamics of power in contemporary cities, where urbanites' bodily routines are thoroughly mediated. The intricacies of how 'power penetrates subjects' very bodies and forms of life' (Amin & Thrift, 2002: 28) are often addressed with such concepts as 'technological unconscious' and the 'automatic production of space' (e.g. Thrift & French, 2002; Thrift, 2004b). The aim of these notions is to capture people's active but rarely self-reflective engagement in the computationally mediated urban spatial constitution. What is at stake is an enactment of spatial power through the performance of infrastructure in personal, even intimate, bodily acts and interactions.

Proceeding from these theorisations, in the next section I will use Lefebvre's (2004) idea of urban rhythms and rhythmicity as a steppingstone for considering closer to the contemporary street level how urbanites' mediated bodily routines today simultaneously actualise infrastructure and incorporate infrastructural power.¹⁴

Mediated urban routines' incorporation of power

Essential in Lefebvre's rhythm-analytical approach in infrastructural terms is, first, that rhythm as he defines it dynamically brings together individual bodies and macro-societal powers – 'the State, money, culture' (Lefebvre, 2004: 44) – that shape urban space. Appearing in monuments, buildings and other public urban objects, these powers also make themselves felt in the rhythms of 'regulated time, governed by

rational laws, but in contact with what is least rational in human being: the lived, the carnal, the body' (18).

The second noteworthy aspect is the connective and coordinative quality of rhythm, which in Lefebvre's view makes the notion suitable for grasping urban life as 'a moving but determinate complexity' (Lefebvre, 2004: 21). In tune with my discussion in the previous section, we can say that the notion of rhythm folds together habit(uation) and routine, capturing the corporeally enacted infrastructural dynamic that keeps gluing the city together (cf. Smith & Hetherington, 2013: 4-5; see also Edensor, 2010).

What Lefebvre could not perceive – either literally or figuratively – from his Parisian window at the end of the 1980s are the impacts of computational mediation on urban space, on human embodiment and on the interrelations of the two. Nor could he have predicted the pressing need, three decades later, due to the ubiquity of ambient technologies and networked portables, to rethink the 'presence-absence' of ordering powers (Lefebvre, 2004: 42, 44) in both sociotechnical and 'bodytechnical' terms. As the artist and urban media researcher Mark Shepard (2009: 212) notes, digital technologies may now be more important than architecture 'for organizing space, time, and the boundaries around the body in public space'.

Among the especially pertinent aspects to acknowledge in the study of urban rhythmicity in the late 2010s are changes in the abstractly material background – or, more precisely, the material 'around' – of city life; i.e. 'the landscape which the body "naturally" adjusts to and which it regards as a normal part of its movement' (Thrift, 2004a: 584). In addition to Thrift's term 'qualculative', the algorithmically dense spatial ambiance can be characterised as 'Herzian' (Shepard, 2009) or even 'telepathic' (Gabrys, 2010). While they are almost impossible to verbalise adequately, the transformations brought about in urban environments by the increasingly sophisticated engineering of electromagnetic radiation, wavelengths, frequencies and wireless signals nonetheless address and engage us corporeally. As Mackenzie (2010: 60) describes, our bodies and sensory systems rub against the urban 'conjunctive envelope' generated by digital signal processing and mediated further by the specific affordances of embedded computation and portable gadgets.

Regarding infrastructural power, Mackenzie (2009: 1300) links his considerations of digital signal processing (DSP) with Graham and Marvin's (2001) critical political-economic perspective by stating that the development of DSP furthers 'the splintering or corrosion of infrastructure'. The designer and urbanist Dan Hill (2008: para 4), in turn, vividly describes how any average high street in contemporary cities 'is immersed in a twitching, pulsing cloud of data', without which the street would feel half dead. At the same time, he points out, the data captured by joggers' smart wearables, cars or traffic-light systems, among other examples, are beamed back to commercial and/or administrative service centres (para 5-6).

In the contemporary urban space, rhythmicity thus is actualised in the convolutions of algorithmic signal traffic, in back-and-forth exchanges and cross-triangulations of data, and in the call-and-response transactions between the 'sentient' landscape, street furniture and other digitally embedded and networked objects and the bodily routines of city dwellers with their smart devices. To examine this algorithmicity¹⁵ empirically is a challenge due to the multilayered 'infrastructural disappearance' of computation. The methodological challenges involved demand a separate discussion,¹⁶ but below I will point out a few meso- and micro-level issues that are pertinent to studying how mediated bodily routines instantiate the power-infused processes of urban infrastructuration, or, more dynamically, how these routines in actual practice infrastructure.

At the infrastructural meso level, one option is to focus on what Thrift (2004c) passingly refers to as 'hybrid kinaesthesia'. In the present context, this notion is useful for capturing urbanites' mediated bodily routines as multispatial communicative acts; in the physical urban space, these acts may be studied in terms of individually and collectively performed 'choreographies' (see Parviainen & Ridell, forthcoming). As mentioned in the second section above, a great deal of empirical research has been conducted on city dwellers' computationally mediated activities from diverse perspectives, although very few studies have focused on hybrid kinaesthesia, let alone approached such kinaesthesia from an explicitly infrastructural perspective. As a partial illustration we can look to the urban media scholar Simone Tosoni's (2015) case study on travellers' forced audience activities as they are integrated into their daily commuting routine in Milan's Cadorna station. While Tosoni's theoretical interest is

elsewhere (notwithstanding his nod towards Lefebvre's rhythmanalysis), the study nonetheless offers a meso-level glimpse into how human bodies contribute to infrastructural processes in the contemporary urban space.

In his study, Tosoni (2015: 19-20) approaches the production of what he calls 'a captive audience position' as an interplay of materiality, practices and symbolic meanings. These elements include the architectural qualities of the Cadorna station, its technical equipment and media (turnstiles and electronic screens with their contents) and human corporeality; jointly these elements direct commuters' attention to screens that show advertisements on perpetual rotation. In the 'very complex place ballet' (20) that produces this forced position, the most effective factor are people's bodily movements and stasis. As Tosoni states, 'what really keeps people in front of the screen are the moving bodies of all the other travellers' (2015: 20). While computational technologies are not the focus of Tosoni's study, such technologies clearly partake in the ballet-like choreographies enacted in the station space. These technologies' mediation plays a key role relative to travellers' bodily movements, for example, through the operation of the technical functionalities of the station, such as in managing how the turnstiles move or how the advertisements rotate on the screens. Mobile connectivity, in allowing people who are captured in the audience position to move elsewhere in the digitally extended physical space, adds its own layer to the station's spatial hybridity and commuters' power-infused kinaesthesia.

At the micro-infrastructural level, one option for empirical research is to focus on the mediated routines of the hand. One fruitful notion on the topic is that of 'incorporating practice', which Hayles (1999: 199) borrows from Connerton (1989) to describe how corporeal habits take shape through kinaesthetic, tactile and haptic repetitions. Using typing skills as an illustration, she cites Connerton to stress that 'habit is a knowledge and a remembering in the hands and in the body; and in the cultivation of habit it is our body which "understands"' (200; Connerton, 1989: 95).¹⁷ Importantly in this connection, Hayles (1999) emphasises that micro-level bodily habits, such as learning a specific keyboard layout like QWERTY, not only serve as extensions of our body parts but also have political implications (205; see also Bench, 2014: 43-44). In the urban context, as Amin and Thrift (2002: 86) point out, there is almost no practice in which hands are not richly implicated. The significance of the

hand is heightened in pervasively computed contemporary cities, in that the algorithmic expansion and multiplication of connective relations and the sense of ‘more to come’ flicker constantly at our fingertips (Mackenzie, 2010: 85). More generally, our mediated hand movements, and particularly the repetitions performed by our fingers, are crucial for keeping up ‘the presumed normalcy of life always connected’ (Wilson, 2014: 552).

One intriguing micro-level study in which the hand is implicated infrastructurally is Kenzie Burchell’s (2015) case study of users’ engagement with networked communication tools and platforms at the level of the interface, and how this engagement affects users’ experience and management of time. While Burchell separates human corporeality from infrastructure with references to the latter’s ‘availability’, his treatment of the various bodily activities involved has an infrastructural orientation, as manifest in his stressing of the importance of looking ‘beyond the content of single interactions and toward the rhythms and forms of interpersonal engagement’ (48). Given the ubiquity of mobile interface-level practices, the observations Burchell (2015) makes of his qualitative data are also evocative in terms of mediated urban infrastructuration. According to Burchell, these practices consist of managing ‘quantities and the potential for interaction before addressing any one specific engagement’ (48); they also involve ‘a lot of attention, effort, and arguably even care’ (48-49). While not directly addressed in Burchell’s study, these matters all rely on sophisticated routines of the hand.

In sum, a major methodological consequence of conceiving mediated bodily routines as key elements in urban infrastructuration today is the need to attend empirically to the simultaneous multispatiality and multiscale dynamics of these routines. They form a connective membrane in the interstices of infrastructural scales and serve as performative bundles of infrastructural power. More concretely, as one example we can focus on how the mediated routines of the hand interconnect the large structural and the minuscule technical dimensions at the level of everyday practices. For instance, the geographer Matthew Wilson (2014: 551) implicitly mobilises the macro, meso and micro scales of infrastructure in arguing that continuous connectivity through the handheld devices that today structure interactions ‘was constituted by the computing industry to condition new styles of interaction’. The dance studies scholar Harmony

Bench (2014: 43-44, 47), in turn, emphasises that the micro-level corporeal training demanded by computational interfaces works into human bodies a gestural repertory that weaves them into macro-level global technological relations and economic exchanges. In other words, at whichever infrastructural level we operationalise our empirical research object, we must take into account the other infrastructural dimensions that are always implicated.

Infrastructuring concepts

My point of departure in this article has been the various challenges that the increasingly pervasive computational mediation of cities poses for addressing urban infrastructure and infrastructural power from a media studies perspective. In the course of my discussion, I constructed a two-fold argument that reconceptualises infrastructure as a continuous process of infrastructuration – a move which fundamentally ‘verbs’ the notion of infrastructure. According to the first part of the argument, smart-equipped urbanites perform infrastructure and incorporate infrastructural power through the routines of their moving and (inter)acting bodies. Second, I argue that to capture and subsequently explore empirically the dynamic complexity of this process, mediated bodily routines should be included as a ‘bodytechnical’ fundamental in how we conceive of and define infrastructure.

By way of a provisional conclusion, I will now briefly consider the societal and scholarly relevance of rethinking infrastructure in an ontological register. Such an exercise opens up a perspective from which human corporeality appears to have become, in a gradual process of technological development and a series of socio-material accommodations and adaptations, welded into the computationally mediated urban infrastructure. Interestingly, such an understanding is present in both the globally fashionable Smart City scenarios and their scholarly critiques; while the former views the integration of human bodies into cybernetic urban feedback loops as a goal to be pursued, the latter continues to point to the flipside of this development. One of the most piercing critiques is from Gabrys (2016: 9, 18), who reworks Foucault’s idea of ‘environmentality’ to scrutinise the twin development of making environmental of computation and becoming computational of environments, and how this development includes processes of making citizens. Commenting on Smart City

proposals, Gabrys states that a citizen in these proposals is turned into a data point, 'both a generator of data and a responsive node in a system of feedback' (196). According to Gabrys, the ideal model of participation featured in these visions is an automated citizen sensor, an 'ambivudual' no different from non-human elements in performing various necessary urban functions (201).

Addressing infrastructure in the smart-city context illuminates infrastructure's role as a keyword in Raymond Williams's (1976) sense. Words in general become entangled with sociotechnical transformations, and, as Carse (2017: 31) points out in reference to Williams, keywords in particular even 'index social shifts'. Words with keyword status also have long-term social implications because 'historical problems of meaning are bound up with the contemporary problems we use [keywords] to discuss' (35). In the case of infrastructure, Carse points out, its generic nature has made it 'an inclusive category amenable to a variety of open-ended projects in which the subordinate parts to be integrated were defined incrementally' (31). Thus, one thing that I did in the preceding discussion was to extend infrastructure's field of reference as a keyword by integrating into the term the materiality of human bodies.

In a theoretically more ambitious manner, the redefinition of infrastructure necessitated by computational mediation can be articulated as a shift from a relational to an interrelational view. By 'more ambitious', I refer to taking seriously analytic differences between words and concepts, where the specificity of concepts is, following the literary and cultural theorist Mieke Bal (2002: 33), in concepts' enabling of new distinctions, articulations and ordering of phenomena instead of merely naming or labelling objects as ordinary words do. At the same time, as Bal points out, the working force of concepts is in their allowing (and forcing) us to 'focus interest' (31). It is in this sense that I propose we should understand infrastructure as a concept and a methodological instrument for critical (media) infrastructure studies. Essential for infrastructure's sensitising potential as such an instrument is the prefix *infra* as 'within' rather than as something that merely runs 'underneath' (cf. Carse, 2017: 27). The former meaning is already in Star and Ruhleder's (1996) relational definition, but as I have argued, the specificities of computation and the affordances of networked devices accentuate in novel ways the reciprocity of relations between human-made technical systems and humans as bodily beings in whichever sociospatial contexts and practices

they act. In other words, we are not talking about two ontologically separate entities that relate but about mutually constitutive interrelations. For example, to function and become ever more effective operationally, the algorithmic management of contemporary cities depends on urbanites' corporeal attachment and feedback.

The concrete relevance of considering infrastructure as a keyword is that analysing the sociotechnically charged history of the various definitions of infrastructure increases our knowledge of the world (and the earth) we inhabit, thus enabling us to better understand what explains our present condition and to project alternatives for future development. Optimistically, improving keyword-level literacy of infrastructure might even generate ideas for countermeasures to the devastation that *Homo sapiens* has caused to the planetary ecosystem. The inclusion of the bodytechnical aspect in understanding infrastructure challenges us also to recognise our inextricability from the processes that enable and safeguard (or threaten) the existence of the earth's biosphere, including us humans. For better or worse, this conceptualisation denies human actors an outsider position regarding infrastructural reconfiguration, thus challenging us to acknowledge, take a stand and act on the implications of our conditioned and conditioning living. A related relevance is that debates on the definition of infrastructure make visible the double involvement of researchers, alerting us to explicate how our theories engage us hands-on in infrastructural power by 'focusing interest'.

One way to sum up the scholarly relevance of probing infrastructure as a concept is to say that it boils down, to paraphrase Star (2000), to politicising infrastructure 'all the way down'. At the same time, though, as Howe and colleagues (2016) point out, it is dubious whether we can ever 'talk about infrastructure "all the way down",' since in the ontological register, 'where does infrastructure end and where does it begin? What are its boundaries [...]?' (557). A parallel challenge is the never-ending methodological navigation between the material and the conceptual dimensions of infrastructure. The non-dischargeable tension created by the reciprocity of the concept and the referent is characteristic of any linguistic construct, but this tension has heightened relevance in the case of infrastructure because of the term's particular keyword history. My suggestion is that instead of treating this tension as an obstacle, we should take it as a

starting point for sharpening the specific potential of infrastructure as a conceptual and methodological instrument.

The most pertinent real-life relevance of rethinking infrastructure in an ontological register is existential. While, as the archaeologist and paleoanthropologist André Leroi-Gourhan (1993) pointed out, early humans and their predecessors did not need reflective thinking, let alone self-reflection, to survive and manage their life on planet earth, as soon as humans came up with tools, subsequently developing machines and technologies, this condition started to change radically. In a short time and with accelerating speed, *Homo sapiens* has woven itself, and all other species, into a machinic web that is now also speeding up the demise of its initiator. In the late 2010s, we live in thoroughly human-created circumstances (particularly so in cities), yet we are unable to escape the embeddedness of human worldliness in contexts and networks that far exceed the boundaries of the world our species has fabricated. The historical entanglement of ever-smarter technologies with the rapid deterioration of the planet Earth's ecosystem calls attention to the specificity and specific limitations of human cognition. Our speedy intellect, and the solutionist and blissfully unthoughtful use of our brainpower (see Arendt, 1958), have propelled us to where we are today, but what we should have done much earlier and definitely need to do now is to deliberately slow down and mobilise, both as individuals and collectively, the unique human capacity to critically self-reflect. Can we? How? This is the ultimate motivation for rethinking and refining such concepts as infrastructure.

References

- Amin, A. (2014) 'Lively Infrastructure', *Theory, Culture & Society* 31(7/8): 137-161.
- Amin, A. & N. Thrift (2002) *Cities: Reimagining the Urban*. Oxford: Blackwell.
- Arendt, H. (1958) *The Human Condition*. Chicago: University of Chicago Press.
- Ash, J., R. Kitchin & A. Leszczynski (2016) 'Digital Turn, Digital Geography?', *Progress in Human Geography* 42(1): 25-43. Accessed as a reprint at: https://eprint.ncl.ac.uk/file_store/production/223990/2FBC2E1A-07A8-4371-9CDC-568E2D6330D3.pdf
- Bal, M. (2002) *Travelling Concepts in the Humanities: A Rough Guide*. Toronto: University of Toronto Press.

-
- Barandiaran, X. & E. Di Paolo (2014) 'A Genealogical Map of the Concept of Habit', *Frontiers in Human Neuroscience* 8, article 522. doi.org/10.3389/fnhum.2014.00522
- Bateson, G. (1972) *Steps to an Ecology of Mind*. Northvale, NJ: Jason Aronson.
- Batty, M. (1997) 'The Computable City', *International Planning Studies* 2(2): 155-173.
- Bench, H. (2014) 'Gestural Choreographies: Embodied Disciplines and Digital Media', in: S. Gopinath and J. Stanyek, eds., *Oxford Handbook of Mobile Music Studies, Volume 2*. Oxford: Oxford University Press, pp. 238-256.
- Benjamin, W. (2002) 'The Work of Art in the Age of Its Technological Reproducibility', in: W. Benjamin, *Selected Writings, Vol. 3, 1935–1938*. Trans. E. Jephcott et al. (orig. 1936). Cambridge, MA: Belknap Press of Harvard University Press, pp. 101-140.
- Bennett, T. (2015) 'Mind the Gap: Towards a Political History of Habit', *tOPICS* 6(3). <http://doi.org/10.4225/35/57a961470f19c>
- Blumer, H. (1936) 'Social Attitudes and Nonsymbolic Interaction', *Educational Sociology* 9: 515-523.
- Blumer, H. (1969) *Social Interactionism: Perspective and Method*. Berkeley: University of California Press.
- Bowker, G. C., K. Baker, F. Millerand & D. Ribes (2010) 'Toward Information Infrastructure Studies: Ways of Knowing in a Networked Environment', in: J. Hunsinger, L. Klastrup and M. Allen, eds., *Handbook of Internet Research*. Dordrecht, Heidelberg, London and New York: Springer + Business Media, pp. 97-117.
- Bowker, G. & S. L. Star (2000) *Sorting Things Out: Classification and Its Consequences*. Cambridge, MA: MIT Press.
- Burchell, K. (2015) 'Tasking the Everyday: Where Mobile and Online Communication Take Time', *Mobile Media & Communication* 3(1): 36-52.
- Carse, A. (2017) 'Keyword: Infrastructure', in: P. Harvey, C. B. Jensen & A. Morita, eds., *Infrastructures and Social Complexity: A Companion*. London & New York: Routledge, pp. 27-39.
- Coletta, C. & R. Kitchin (2017) 'Algorhythmic Governance: Regulating the Heartbeat of a City Using the Internet of Things', *Big Data & Society* July–December: 1-16. <http://journals.sagepub.com/doi/pdf/10.1177/2053951717742418>
- Connerton, P. (1989) *How Societies Remember*. Cambridge, UK: Cambridge University Press.

- Crang, M. & S. Graham (2007) 'Sentient Cities: Ambient Intelligence and the Politics of Urban Space', *Information, Communication & Society* 10(6): 789-817.
- Crawford, K. & V. Joler (2018) 'Anatomy of an AI System'. <https://anatomy.ai>
- Dewey, J. ([1922]2007) *Human Nature and Conduct*. New York: Henry Holt and Company.
- Dewsbury, J. D. & D. Bissell (2015) 'Habit Geographies: The Perilous Zones in the Life of the Individual', *Cultural Geographies* 22(1): 21-28.
- Dourish, P. & G. Bell (2007) 'The Infrastructure of Experience and the Experience of Infrastructure: Meaning and Structure in Everyday Encounters of Space', *Environment and Planning B* 34(3): 414-430.
- Dourish, P. & G. Bell (2011) *Divining a Digital Future: Mess and Mythology in Ubiquitous Computing*. Cambridge, MA: MIT Press.
- Downey, G. J. (2014) 'Making Media Work: Time, Space, Identity, and Labor in the Analysis of Information and Communication Infrastructures', in: T. Gillespie, P. J. Boczkowski and K. A. Foot, eds., *Media Technologies: Essays on Communication, Materiality, and Society*. Cambridge, MA: MIT Press, pp. 141-165.
- Edensor, T. (2010) 'Introduction: Thinking about Rhythm and Space', in: T. Edensor, ed., *Geographies of Rhythm*. Surrey, UK: Ashgate, pp. 1-18.
- Edwards, P. N. (2003) 'Infrastructure and Modernity: Force, Time, and Social Organization in the History of Sociotechnical Systems', in: T. Misa, P. Brey and A. Feenberg, eds., *Modernity and Technology*. Cambridge, MA, & London: MIT Press, pp. 185-225.
- Edwards, P. N., G. C. Bowker, S. J. Jackson & R. Williams (2009) 'Introduction: An Agenda for Infrastructure Studies', *Journal of the Association for Information Systems* 10(5): 365-374.
- Farman, J. (2015) 'Infrastructures of Mobile Social Media', *Social Media + Society* April-June: 1-2. <http://journals.sagepub.com/doi/10.1177/2056305115580343>
- Farman, J. (2018) 'Invisible and Instantaneous: Geographies of Media Infrastructure from Pneumatic Tubes to Fiber Optics', *Media Theory* 2(1): 134-154. <http://journalcontent.mediatheoryjournal.org/index.php/mt/article/view/39/32>
- Frith, J. (2015) 'Communicating Behind the Scenes: A Primer on Radio Frequency Identification (RFID)', *Mobile Media & Communication* 3(1): 91-105.

-
- Frith, J. (2019) *A Billion Little Pieces: RFID and Infrastructures of Identification*. Cambridge, MA: MIT Press.
- Gabrys, J. (2010) 'Telepathically Urban', in: A. Boutros and W. Straw, eds., *Circulation and the City: Essays on Urban Culture*. Montreal & Kingston (ON): McGill–Queen's University Press, pp. 48-63.
- Gabrys, J. (2016) *Program Earth: Environmental Sensing Technology and the Making of a Computational Planet*. Minneapolis & London: University of Minnesota Press.
- Galloway, A. (2004) 'Intimations of Everyday Life: Ubiquitous Computing and the City', *Cultural Studies* 18(2/3): 384-408.
- Gandy, M. (2005) 'Cyborg Urbanization: Complexity and Monstrosity in the Contemporary City', *International Journal of Urban and Regional Research* 29(1): 26-49.
- Goffman, E. (1963) *Behavior in Public Places*. New York: The Free Press.
- Graham, S. (Ed.) (2010) *Disrupted Cities: When Infrastructure Fails*. New York & London: Routledge.
- Graham, S. & S. Marvin (1996) *Telecommunications and the City: Electronic Spaces, Urban Places*. London: Routledge.
- Graham, S. & S. Marvin (2001) *Splintering Urbanism: Networked Infrastructures, Technological Mobilities and the Urban Condition*. London & New York: Routledge.
- Graham, S. & N. Thrift (2007) 'Out of Order: Understanding Repair and Maintenance', *Theory, Culture & Society* 24(3): 1-25.
- Grosz, E. (2013) 'Habit Today: Ravaissou, Bergson, Deleuze and Us', *Body & Society* 19(2-3): 217-239. doi: 10.1177/1357034X12472544
- Harrison, P. (2000) 'Making Sense: Embodiment and the Sensibilities of the Everyday', *Environment and Planning D* 18(4): 497-517.
- Hartmann, M. (2017) 'Circuit(s) of Affective Infrastructuring: Smartphones and Electricity', in: J. Vincent and L. Haddon, eds., *Smartphone Cultures*. London & New York: Routledge, pp. 11-24.
- Harvey, P., J. B. Jensen & A. Morita (2017) 'Introduction: Infrastructural Complications', in: P. Harvey, C. B. Jensen & A. Morita, eds., *Infrastructures and Social Complexity: A Companion*. London & New York: Routledge, pp. 1-22.
- Hayles, N. K. (1999) *How We Became Posthuman*. Chicago & London: University of Chicago Press.

- Hayles, N. K. (2002) 'Flesh and Metal: Reconfiguring the Mindbody in Virtual Environments', *Configurations* 10 (Spring): 297-320.
- Hayles, N. K. (2006) 'Unfinished Work: From Cyborg to Cognisphere', *Theory, Culture & Society* 23(7-8): 159-166.
- Hayles, N. K. (2009) 'RFID: Human Agency and Meaning in Information-Intensive Environments', *Theory, Culture & Society* 26(2-3): 47-72.
- Hill, D. (2008) 'The Street as Platform', *City of Sound*. <http://www.cityofsound.com/blog/2008/02/the-street-as-p.html>
- Horst, H. (2013) 'The Infrastructures of Mobile Media: Towards a Future Research Agenda', *Mobile Media & Communication* 1(1): 147-152.
- Howe, C. et al. (2015) 'Paradoxical Infrastructures: Ruins, Retrofit, and Risk', *Technology & Human Values* 41(3): 547-565. <https://doi.org/10.1177/0162243915620017>
- Hughes, T. P. (1983) *Networks of Power: Electrification in Western Society, 1880–1930*. Baltimore, MD: Johns Hopkins University Press.
- Jackson, S. J., P. N. Edwards, G. C. Bowker & C. P. Knobel (2007) 'Understanding Infrastructure: History, Heuristics, and Cyberinfrastructure Policy', *First Monday* 12(6). <http://firstmonday.org/htbin/cgiwrap/bin/ojs/index.php/fm/article/view/1904/1786>
- Jensen, O. B. (2010) 'Negotiation in Motion: Unpacking a Geography of Mobility', *Space and Culture* 13(4): 389-402.
- Kang, J. & D. Cuff (2005) 'Pervasive Computing: Embedding the Public Sphere', *Washington and Lee Law Review* 65 (paper 04-23): 93-147. <http://dx.doi.org/10.1145/2661435.2661450>
- Kitchin, R. (2011) 'The Programmable City', *Environment and Planning B* 38: 945-951. <https://doi.org/10.1068/b3806com>
- Kitchin, R. & M. Dodge (2011) *Code/Space: Software and Everyday Life*. Cambridge, MA: MIT Press.
- Kitchin, R., T. P. Laurialt & G. McArdle (2015) 'Knowing and Governing Cities through Urban Indicators, City Benchmarking and Real-Time Dashboards', *Regional Studies, Regional Science* 2(1): 6-28.
- Krivý, M. (2016) 'Towards a Critique of Cybernetic Urbanism: The Smart City and the Society of Control', *Planning Theory* 17(1): 1-23. <https://doi.org/10.1177/1473095216645631>

-
- Larkin, B. (2013) 'The Poetics and Politics of Infrastructure', *Annual Review of Anthropology* 42: 327-343.
- Lefebvre, H. (1991) *The Production of Space*. Trans. D. Nicholson-Smith (orig. 1974). Oxford: Blackwell Publishing.
- Lefebvre, H. (2004) *Rhythmanalysis: Space, Time and Everyday Life*. Trans. S. Elden and G. Moore (orig. 1992). London: Bloomsbury.
- Leroi-Gourhan, A. (1993) *Gesture and Speech*. Trans. A. Bostok (orig. 1964). Cambridge, MA: MIT Press.
- Licoppe, C. (2016) 'Mobilities and Urban Encounters in Public Places in the Age of Locative Media'. *Mobilities* 11(1): 99-116. <https://doi.org/10.1080/17450101.2015.1097035>
- Lovink, G. & N. Rossiter (2013) 'In Praise of Concept Production: Formats, Schools and Nonrepresentational Media Studies', in: K. Gates, ed., *The International Encyclopedia of Media Studies, Vol. VI: Media Studies Futures*. Cambridge & Malden, MA: Blackwell.
- Mackenzie, A. (2008) 'Wirelessness as Experience of Transition', *The Fibreculture Journal* (13): article FCJ-085. <http://thirteen.fibreculturejournal.org/fcj-085-wirelessness-as-experience-of-transition/>
- Mackenzie, A. (2009) 'Intensive Movement in Wireless Digital Signal Processing: From Calculation to Envelopment', *Environment and Planning A* 41(6): 1294-1308.
- Mackenzie, A. (2010) *Wirelessness: Radical Empiricism in Network Cultures*. Cambridge, MA: MIT Press.
- Mattern, S. (2015) *Deep Mapping the Media City*. Minneapolis: University of Minnesota Press.
- Mattern, S. (2016) 'Scaffolding, Hard and Soft: Infrastructures as Critical and Generative Structures', *Spheres*, June. <http://spheres-journal.org/scaffolding-hard-and-soft-infrastructures-as-critical-and-generative-structures/>
- Mattern, S. (2018) 'Databodies in Codespace'. *Places*, April. <https://placesjournal.org/article/databodies-in-codespace/>
- Mauss, M. (1979) 'Body Techniques', in: M. Mauss, *Sociology and Psychology: Essays* (orig. 1934). London: Routledge and Kegan Paul, pp. 97-123.
- Mead, G. H. (1934) *Mind, Self and Society*. Chicago: University of Chicago Press.

- Miyazaki, S. (2012) 'Algorhythmics: Understanding Micro-Temporality in Computational Cultures', *Computational Culture*. <http://computationalculture.net/algorhythmics-understanding-micro-temporality-in-computational-cultures/>
- Miyazaki, S. (2013) 'Urban Sounds Unheard-of: A Media Archaeology of Ubiquitous Infospheres', *Continuum* 27(4): 514-522.
- Miyazaki, S. (2018) 'Algorhythmics: A Diffractive Approach for Understanding Computation', in: J. Sayers (ed.), *The Routledge Companion to Media Studies and Digital Humanities*. London & New York: Routledge, pp. 243-249.
- Mumford, L. (2011) 'What Is a City?', in: R. LeGates and F. Stout, eds., *The City Reader* (orig. 1937). London & New York: Routledge, pp. 91-95.
- Parks, L. (2009) 'Around the Antenna Tree: The Politics of Infrastructural Visibility', *Flow Journal*, 6 March. <https://www.flowjournal.org/2009/03/around-the-antenna-tree-the-politics-of-infrastructural-visibilitylisa-parks-uc-santa-barbara/>
- Parks, L. (2012) 'Technostruggles and the Satellite Dish: A Populist Approach to Infrastructure', in: G. Bolin, ed., *Cultural Technologies: The Shaping of Culture in Media and Society*. New York & London: Routledge, pp. 64-84.
- Parks, L. (2014) 'Media Infrastructures and Affect', *Flow Journal*, 19 May. <https://www.flowjournal.org/2014/05/media-infrastructures-and-affect/>
- Parks, L. (2015) "'Stuff You Can Kick": Towards a Theory of Media Infrastructures', in: P. Svensson and D. Goldberg, eds., *Humanities and the Digital*. Cambridge, MA: MIT Press, pp. 255-373.
- Parks, L. (2017) 'Infrastructure', in: L. Ouellette and J. Gray, eds., *Keywords for Media Studies*. New York: New York University Press (Adobe Digital Editions).
- Parks, L. & N. Starosielski (2015) 'Introduction', in: L. Parks and N. Starosielski, eds., *Signal Traffic: Critical Studies of Media Infrastructures*. Urbana: University of Illinois Press, pp. 1-27.
- Parks, L. & N. Starosielski (Eds.) (2015) *Signal Traffic: Critical Studies of Media Infrastructures*. Urbana etc.: University of Illinois Press.
- Parviainen, J. & S. Ridell (forthcoming) 'Infrastructuring Bodies: Choreographies of Power in the Computational City', in: M. Nagenborg, M. González Woge, T. Stone and P. Vermaas, eds., *Technology and the City: Towards a Philosophy of Urban Technologies*. Dordrecht: Springer.

-
- Peters, J. D. (2015) *The Marvelous Clouds: Toward a Philosophy of Elemental Media*. Chicago: University of Chicago Press.
- Pink, S. & V. Fors (2017a) 'Being in a Mediated World: Self-Tracking and the Mind-Body-Environment', *Cultural Geographies* 24(3): 375-388. <http://journals.sagepub.com/doi/pdf/10.1177/1474474016684127>
- Pink, S & V. Fors (2017b) 'Self-Tracking and Mobile Media: New Digital Materialities', *Mobile Media & Communication* 5(3): 219-238. <https://doi.org/10.1177/2050157917695578>
- Pink, S., J. Sinanan, L. Hjorth & H. Horst (2016) 'Tactile Digital Ethnography: Researching Mobile Media through the Hand', *Mobile Media & Communication* 4(2): 237-251.
- Plantin, J-C., C. Lagoze, P. N. Edwards & C. Sandvig (2016) 'Infrastructure Studies Meet Platform Studies in the Age of Google and Facebook', *New Media & Society* 20(1): 293-310. <https://doi.org/10.1177/1461444816661553>
- Plantin, J-C. & A. Punathambekar (2019) 'Digital Media Infrastructures: Pipes, Platforms, and Politics', *Media, Culture & Society* 41(2): 163-174. <https://doi.org/10.1177/0163443718818376>
- Ravaisson, F. (2008) *Of Habit*. Trans. C. Carlisle and M. Sinclair (orig. 1838). London & New York: Continuum.
- Ribes, D. & T. Finholt (2009) 'The Long Now of Technology Infrastructure: Articulating Tensions in Development', *Journal of the Association for Information Systems* 10(5): article 2.
- Ridell, S. (2014) 'Exploring Audience Activities in the Digitalised City: Diversity and Routinisation of People's Media Relations in Contemporary Urban Environments', in F. Zeller, C. Ponte and B. O'Neill, eds., *Revitalising Audiences: Innovations in European Audience Research*. London: Routledge, pp. 236-260.
- Ridell, S. & F. Zeller (2013) 'Mediated Urbanism: Navigating an Interdisciplinary Terrain', *The International Communication Gazette* 75(5-6): 437-451.
- Rose, G. (2017) 'Posthuman Agency in the Digitally Mediated City: Exteriorisation, Individuation, Reinvention'. *Annals of the American Association of Geographers* 107(4): 779-793. Accessed as a manuscript in Open University's repository of research publications. <http://oro.open.ac.uk/48448/>

- Ruppert, E., J. Law & M. Savage (2013) 'Reassembling Social Science Methods: The Challenge of Digital Devices', *Theory, Culture & Society* 30(4): 22-46.
- Sandvig, C. (2013) 'The Internet as Infrastructure', in: W. H. Dutton, ed., *The Oxford Handbook of Internet Studies*, Oxford: Oxford University Press, pp. 86-106.
- Shaw, B. (2014) 'Streets for Cyborgs: The Electronic Flâneur and the Posthuman City', *Space and Culture* 18(3): 230-242. <https://doi.org/10.1177/1206331214560105>
- Shepard, M. (2009) 'Toward an Architecture of Hertzian Space', *ACADIA 09: reForm()*: 209-215. http://papers.cumincad.org/data/works/att/acadia09_209_content.pdf
- Simmel, G. (2002) 'The Metropolis and Mental Life', in: G. Bridge and S. Watson, eds., *The Blackwell City Reader* (orig. 1903). Oxford & Malden, MA: Wiley-Blackwell, pp. 11-19.
- Smith, R. J. & K. Hetherington (2013) 'Urban Rhythms: Mobilities, Space and Interactions in the Contemporary City', in: R. J. Smith and K. Hetherington, eds., *Urban Rhythms: Mobilities, Space and Interaction in the Contemporary City*. Oxford, UK: Wiley-Blackwell, pp. 4-16.
- Sparrow, T. & A. Hutchinson (2013) 'Introduction', in: T. Sparrow and A. Hutchinson, eds., *A History of Habit: From Aristotle to Bourdieu*. Lanham, MD: Lexington Books, pp. 5-18.
- Star, S. L. (1999) 'The Ethnography of Infrastructure', *American Behavioral Scientist* 43(3): 377-391.
- Star, S. L. (2000) 'It's Infrastructure All the Way Down', *DL '00: Proceedings of the 5th ACM Conference on Digital Libraries*. <https://dl.acm.org/citation.cfm?doid=336597.336698>
- Star, S. L. (2002) 'Infrastructure and Ethnographic Practice: Working on the Fringes'. *Scandinavian Journal of Information Systems* 14(2): 107-122.
- Star, S. L. & G. C. Bowker (2002) 'How to Infrastructure', in: L. A. Lievrouw and S. Livingstone, eds., *Handbook of New Media*. London: Sage, pp. 151-162.
- Star, S. L. & K. Ruhleder (1996) 'Steps Toward an Ecology of Infrastructure: Design and Access for Large Information Spaces', *Information Systems Research* 7(1): 111-134.
- Starosielski, N. (2012) "'Warning: Do Not Dig": Negotiating Visibility of Critical Infrastructures', *Journal of Visual Culture* 11(1): 38-57.

- Thrift, N. (2004a) 'Movement-Space: The Changing Domain of Thinking Resulting from the Development of New Kinds of Spatial Awareness', *Economy and Society* 33(4): 582-604.
- Thrift, N. (2004b) 'Remembering the Technological Unconscious by Foregrounding Knowledges of Position', *Environment and Planning D* 22(1): 175-190.
- Thrift, N. (2004c) 'Driving in the City', *Theory, Culture Society* 21(4/5): 41-59.
- Thrift, N. & S. French (2002) 'The Automatic Production of Space', *Transactions of the Institute of British Geographers* 27(3): 309-25.
- Tironi, M. & M. Valderrama (2018) 'Unpacking a Citizen Self-Tracking Device: Smartness and Idiocy in the Accumulation of Cycling Mobility Data', *Environment and Planning D* 36(2): 294-312. doi: 10.1177/0263775817744781
- Tosoni, S. (2015) 'Addressing "Captive Audience Positions" in Urban Space', *Sociologica* 3: 1-28. <https://www.rivisteweb.it/doi/10.2383/82480>
- Wegenstein, B. (2006) *Getting Under the Skin: Body and Media Theory*. Cambridge, MA. & London: MIT Press.
- Weiser, M. (1991) 'The Computer for the 21st Century', *Scientific American*, September 1991: 94-104.
- Williams, R. (1976) *Keywords*. New York: Oxford University Press.
- Wilson, M. W. (2014) 'Continuous Connectivity, Handheld Computers, and Mobile Spatial Knowledge', *Environment and Planning D* 32(3): 535-555.

Notes

¹ For this infrastructural notion in the study of large technical systems (LTS), see Jackson et al. (2007); Ribes and Finholt (2009); Bowker et al. (2010).

² See, for instance, <https://cistudies.org/>

³ See <http://wordsinspace.net/shannon/>

⁴ On the 'turn to infrastructure' in the social and human sciences, see Harvey et al. (2017); on a similar turn in media and communication studies, see Plantin and Punathambekar (2019).

⁵ Placing the primary emphasis on 'bodily' in 'bodily habituation' would open up a highly resonant interface with studies that address the cyborg qualities of human corporeality in the urban context (e.g. Gandy, 2005; Shaw, 2014; Krivý, 2016). At this interface, an initial question to address is the difficulty of defining the 'body' and the analytical difference between the notions of 'body' and 'embodiment' (e.g. Hayles, 1999: 194-199; also Hayles, 2002; Wegenstein, 2006). But as I focus on the habituation of movements and interactions of human bodies, I will leave this particular interface for future discussions.

⁶ For a more general overview of addressing the issue of digitalisation in geography, see Ash et al., 2016.

⁷ The emergence of the relational view also marks the point after which distinguishing analytically between the study of infrastructures and infrastructure studies begins to make sense (cf. Carse, 2017; also Sandvig, 2013).

- ⁸ As the media studies scholar Nicole Starosielski (2012) points out, however, even many strategic physical infrastructures, such as undersea cables, are often hidden in plain sight.
- ⁹ Exceptions to the rule are those people that radio waves and electric fields make sick, a physiological phenomenon Mackenzie refers to as a symptom of ‘antenna awareness’ (2008: para 32).
- ¹⁰ This list increasingly includes human bodies as well, as microchips are now being implanted, for example, under the skin of voluntary employees for identification purposes (e.g. <http://www.bbc.com/news/technology-31042477>; <https://www.privateinternetaccess.com/blog/2017/05/train-tickets-rfid-tags-europe/>; <http://www.csoonline.com/article/3210485/security/us-company-says-it-will-be-the-first-to-microchip-employees.html>). So-called enhancement technologies, such as the most recent techniques of gene manipulation, take this development further, thereby accentuating (or even reconfiguring) the ontological reconfiguration.
- ¹¹ A consideration of the infrastructural ‘long now’ in this corporeal sense could be extended to the evolution of the human species in the spirit of André Leroi-Gourhan ([1964]1993) in his major work *Gesture and Speech*, although this is a discussion I cannot go into in this article because of space restrictions.
- ¹² According to the social and cultural theorist Tony Bennett (2015), habit is an increasingly prominent topic in affect theory, sociological accounts of reflexivity, the neurosciences, cultural geography, actor network theory, aesthetics and philosophy, among other contexts.
- ¹³ The theoretical background of reframing habit includes the translation into English in 2008 of the French philosopher Félix Ravaisson’s (1838) treatise *Of Habit* (see the editors’ excellent introduction to the translation; see also Dewsbury & Bissell, 2015; Grosz, 2013; Barandiaran & Di Paolo, 2014).
- ¹⁴ In *The Production of Space*, Lefebvre ([1974]1991) also addresses rhythm in several connections, but I will concentrate here on his *Rhythmanalysis* because of this posthumous essay’s explicitly methodological take on rhythm (see Lefebvre, 2004: 15).
- ¹⁵ For the application of the notions of the algorithm and algorithmicity in the contemporary urban context, see Miyazaki (2013); also Coletta and Kitchin (2017).
- ¹⁶ For urban media studies, one internal interface for furthering methodological discussion is in media ethnography. In this field, Maren Hartmann (2017) compares ‘domestication’ (a notion that is highly resonant with habituation) and ‘infrastructuring’.
- ¹⁷ Interestingly, Sarah Pink and colleagues (2016), who seek to develop a ‘tactile digital ethnography’ around the hand, do not relate their approach to studies that discuss the habituation of hand motions and other bodily movements.

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