Philosophy & Technology (2021) 34:243–263
https://doi.org/10.1007/s13347-019-00381-8

RESEARCH ARTICLE

Data and Temporality in the Spectral City

Nathan A. Olmstead [1]

Received: 29 April 2019 / Accepted: 3 October 2019 / Published online: 13 December 2019

Abstract

Rapid urbanization has meant that cities around the world must deal with problems like traffic congestion, aging infrastructure, affordable housing, and climate change. Increasingly, policymakers are turning to investments in technology and digital infrastructure to address these problems. Yet the move towards so-called smart cities is not simply responsive, and policymakers increasingly advocate for smart city initiatives as a necessary step towards objective, efficient, and rational governance. This understanding of technological interventions as inherently progressive, however, causes many to overlook the erasures, biases, and limitations that emerge from trying to leave the past behind. As the problems associated with this enthusiasm become more apparent, the smart city movement must therefore recalibrate its relationship to not just technology but time itself. Building on deconstructive temporalities emerging out of quantum physics, I argue that cities must begin drawing from alternative temporalities more open to the intersections between past, present, and future. As such, I suggest that the time has come to replace the ideal of the smart city with that of the spectral city – an incomplete city haunted by the ghosts (and composts) of the past.

Keywords Smart cities · Deconstruction · Spectral · Technology · Urban governance · Data and Temporality in the Spectral City

1 Introduction

Investments in technological innovation are a growing part of urban governance. As rapid urbanization forces cities to address problems like traffic congestion, aging infrastructure, and climate change, many policymakers are turning to the promise of artificial intelligence and data-based technologies to improve city services (Shelton et al. 2015; Glasmeier and Christopherson 2015). Whether it is digitally connected

✉ Nathan A. Olmstead
nathanaolmstead@gmail.com

[1] Department of Political Science, University of Toronto, Sidney Smith Hall, Room 3018, 100 St. George Street, Toronto, ON M5S 3G3, USA

streetlights designed to accommodate changing traffic patterns (Shea 2019) or the integration of autonomous vehicles into public transit (Chiusano 2019), cities everywhere are partnering with private tech vendors to solve their public problems. The growing mobility of citizens and businesses alike has meant that cities must also leverage these projects and position themselves as a viable option for the increasingly digital lives of transient citizens. In the United States, for example, Kansas City, Missouri, has used investments in pothole-predicting algorithms and sensor-based parking regulation to declare itself a "living lab" for prospective firms aiming to test new products (Williams 2019).

This movement towards so-called smart cities has been fueled what Mager (2012: 770) calls a "techno-euphoric climate of innovation." Integrated technologies are increasingly seen as an effective way to not only address urbanization but also build competitive and sustainable futures through the optimization of urban governance (Krivý 2018). The result is a collective "global smart city imaginary" that cities eagerly draw from to justify investments and attract opportunities in the present (White 2016: 1). Attaching the "smart city" label to their projects becomes a simple way to appear as frontrunners in the movement towards efficient, convenient, and sustainable living. In turn, as more communities embrace the "smart city" mantel, its utopic connotations breed further pressure to adopt technological solutions and appear contemporary on the global stage. The Government of India is one of many countries to consolidate these efforts into a nationwide "smart cities" initiative – investing over US$14 billion in an effort to develop 100 smart cities across the country (Government of India n.d.). As Hollands (2008: 304) reflects, in a world where cities must compete with one another to attract talent and business, "what city does not want to be smart or intelligent?" Businesses have cultivated and capitalized on this climate. Viewing cities as valuable testing grounds for their products, they have quickly turned urban development into "the next frontier in the digital revolution" (Richards et al. 2019).

Yet, as investments in technology grow more popular, critics of the movement have highlighted a profound dissonance between the idealized smart city – or, more appropriately, Smart City – and the more complicated reality of technocratic interventions. The growing popularity of artificial intelligence, for example, has been heavily criticized for its lack of transparency and the implicit biases often baked into algorithmic decision-making (Vincent 2019; Rieland 2018; Crawford 2016). The unprecedented level of data collection involved in designing, training, and implementing such technology also raises important questions about privacy and data ownership that policymakers are only beginning to address (Van Zoonen 2016; Chandler 2015; Farivar 2018). More generally, interventions on behalf of the smart city have been associated with widespread gentrification, burgeoning inequality, and a growing digital divide between those who can access and understand new platforms and those who cannot (Hollands 2008; Shelton et al. 2015; Maclean 2017). The city of San Francisco, for example, is plagued by unprecedented levels of income inequality and displacement following the rapid influx of high-skilled tech workers hoping to work in the area (Maclean 2017). Finally, some have suggested that the eagerness to embrace technological solutions may be distracting from alternative, more proven solutions to urban problems like traffic congestion and climate change (Saxe 2019).

Though these criticisms are well-founded, however, focusing exclusively on the dissonance between the smart city ideal and the many projects currently underway can be misleading. Without engaging the smart city imaginary directly, it is easy to view problems as the product of poor application rather than a flaw with the vision itself. This has been the common approach among smart city advocates as they scramble to address many of the concerns raised above (Halpern and Günel 2017; Cardullo et al. 2018). The perfect iteration, they contend, is just a matter of time. Current problems are merely wrinkles to be ironed out. Even failed initiatives like Portugal's PlanIT Valley, though they may threaten the apparent imminence of the smart city ideal, are nevertheless recuperated within this iterative progression and reframed as the foundation on which future projects can build (Halpern and Günel 2017). Finally, while I am encouraged by attempts to push back against the homogenizing smart city ideal and highlight the diversity of cities currently pursuing technological initiatives, it is also important to unpack the extent to which the smart city movement collects and evaluates these global cities along a single timeline determined by neoliberal, capitalist, and Western ideas of progress (Cardullo et al. 2018; Mager 2012).

In truth, many of the complications described above can be traced back to the ontological and ideological underpinnings of the movement itself. More specifically, I argue in what follows that the limitations of the smart city movement extend from its utopic framing of the technocratic city and the positioning of this neoliberal, capitalist utopia within an understanding of time as sequential and progressive. This framing overlooks the interconnections between past, present, and future that necessarily shape and limit algorithm-based technologies and urban governance. This operation persists even as new technologies present valuable opportunities for rethinking the relationship between time, technology, and municipal development – potentialities I discuss in more detail below. As such, the path towards equitable cities requires more than just innovative ideas about new technologies or criticisms of the remaining gap between the smart city ideal and "actually existing smart cities" (Shelton et al. 2015: 14). While these can be a useful place to start, cities must also begin drawing from an alternative vision more open to the assemblages of individuals and temporalities currently being paved over by the smart city. Cultivating such an alternative is imperative if municipalities are to make responsible decisions about technology in the present (Cath et al. 2018).

The second half of this paper is therefore driven by a simple normative question: What type of city should we have in mind as we make decisions about urban problems and the possibility of technological solutions? By bringing the current smart city literature into conversation with recent, more critical work on the relationship between time, technology, and responsibility, I lay the groundwork for an alternative model. Turning specifically to the work of Karen Barad, I argue that alternative notions of temporality developed in modern physics provide an imaginative opportunity to reorient urban technology towards more equitable goals. Rather than the instrument by which we attempt to leave the past behind, the technology characteristic of urban development can, in fact, be an opportunity to reflect on our indebtedness to the past, the ever-incomplete nature of municipal development, and the manifestation of these temporalities in unique spaces. It is by embracing such alternative temporalities that we might replace the ideal of the smart city with the more corruptible image of the spectral city – an incomplete city haunted by the ghosts (and composts) of the past.

2 Temporality and the Smart City Imaginary

I am not the first to suggest that time is important to city life. May and Thrift (2003), for example, suggest that urban life is composed of unique temporal rhythms produced by everything from seasonal and circadian cycles to formal work schedules and religious calendars. Others like Adam (2004) argue that cities are clusters of "temporal relations" such as tempo, sequencing, and scheduling that alter the way that residents navigate daily life (in Kitchin 2019). These rhythms compliment and disrupt one another in unique ways. Weekday commutes are disrupted by construction schedules that are, in turn, the product of seasonal changes and budgetary cycles. My ability to go grocery shopping on a Sunday is hampered by a limited local bus schedule and compressed store hours, leaving me a more limited window in which to run my errands. In short, as Kitchin (2019: 778) writes, "cities and everyday life unfold through cycles of polymorphic and concatenated temporal rhythms that produce a sense of continuity, stability, or disjuncture." These temporalities intertwine with urban spaces to determine who goes where and when, establishing unique spatiotemporal topographies in cities around the world (Massey 1992; Kitchin 2019; Edensor 2012). Engaging the smart city imaginary requires at least a preliminary exploration of the way that technology is being incorporated into these unique rhythms.

To begin, technological innovations build and shape municipal orchestras in unprecedented ways. Developments in information and communication technology have accelerated the pace of city life by increasing the speed, efficiency, and distance at which certain activities can be carried out (Virilio 1997). Tasks which once took hours or days to complete can now be completed quickly, simultaneously, and, in some cases, remotely (Crang and Graham 2007). On the one hand, this includes things like mobile parking applications, digital café kiosks, and online grocery shopping that increase the speed with which city residents can navigate urban living. On the other, things like sensor-based parking meters, mobile transit apps, and predictive policing algorithms increase the speed with which cities themselves can deliver important services. Simply put, "the use of networked technologies is creating a faster and busier world by enabling tasks to be undertaken more efficiently and a state of hyper-activity to exist" (Kitchin 2019: 781). The result is what Datta (2016: 1) calls "fast cities," with technological innovation accelerating the tempo of many instruments in the city orchestra.

Developments in connectivity have also produced more fundamental changes to the rhythms of city life. The significance of traditional timetables to social and professional schedules has faded in a world where people are almost always connected (Hassan 2007; Castells 2011). While the expansion of digital infrastructure has allowed many to work from home, for example, it has also blurred the lines between work and nonwork time such that previously protected timeslots can now be filled by work-related activity (Crang and Graham 2007: 71). The impact is not merely temporal but spatial as well, such that people can now communicate both more quickly and with relative ease regardless of their location. This hyper-connectivity has liberated productivity from the constraints of time zones, such that global businesses can now coordinate around (or, rather, beyond) the clock (Castells 2011). The capacity for instantaneous and delocalized communication has also created "faster and more temporally flexible subjects," such that social gatherings can be organized on the fly by individuals connected to wireless networks (Kitchin 2018: 26). While this has transformed the way that many of us organize our recreational lives, it has also enabled new forms of political organization previously not possible, such as short-notice protesting and flash mobs in authoritarian spaces (Kitchin 2019).

Increasingly, municipalities are entrusting technology to not only contribute to the municipal orchestra but also conduct it. In response to the dyssynchronization and disharmony that arises from the overlapping and competing rhythms of city life, municipal governments are turning to new technologies to “augment and regulate the multiple rhythms of cities, to limit arrhythmia and produce eurythmic systems that maintain a refrain” (Kitchin 2019: 778). This shift has been facilitated by the proliferation of sensors, integrated infrastructure, and data-intensive software. This Internet of things allows municipalities to not only identify and predict the spatiotemporal patterns of the city but, by feeding this information to either human overseers or subsequent technology, consolidate competing rhythms into a single, smooth song (Coletta and Kitchin 2017: Kitchin 2018). In Canada, for example, a recent data-sharing agreement between the city of Toronto and the Waze navigation app aims to mediate the inconvenience of construction schedules on local commuters by ensuring that construction updates are incorporated directly into the algorithmic routing provided by the app itself (D’Amore 2017). On a much larger scale, Rio de Janeiro’s Centro de Operacoes Prefeitura gathers over 32 agencies and 12 private companies into a single control room, wherein the changing conditions of the city can be detected, predicted, or addressed by a centralized and digitized authority (Luque-Ayala and Marvin 2016).

This growing interest in so-called algorithmic governance is part of an overarching shift in the focus of urban governance (Coletta and Kitchin 2017: 4). Governments increasingly view cities as a collection of “constituent parts and processes” that can be measured, modeled, and corralled into balanced and optimized patterns (Kitchin 2018: 20). Cities, in other words, are “a system of systems,” with each system representing another constitutive rhythm to be identified and orchestrated (Kitchin 2018: 20). The goal of this management-based approach is the synchronization of urban life, ensuring that points of dissonance or delay are eliminated and that cities flow smoothly around the clock. As Kitchin (2018: 25) writes:

Urban life pulsates rhythmically, but not always harmoniously. Control rooms work to augment and regulate the rhythms of cities… in such a system, the nature of governmentality shifts from disciplinary form (in which people self-regulate behaviour based on the fear of surveillance and sanction) towards control (wherein people are corralled and compelled to act in certain ways). Control systems work by constantly modulating behaviour to act in a certain way within prescribed comportments; to be nudged and directed rather than self-disciplined.

Whether it is the automated metering of city utilities or the use of digitally connected streetlights to facilitate commute times, new technologies promise not only the unprecedented identification of a city’s patterns but also a capacity for coordination and rapid adjustment with little-to-no human intervention (Krivý 2018). In other words, if the city is a conglomerate of systems, technology is increasingly viewed as a way to consolidate these competing operations within a single, balanced, and increasingly self-sustaining *eco*system (see, e.g., City of Toronto n.d.a, b; Government of India n.d.).

While cities may latch onto ecological imagery, however, their determination to establish balance between municipal systems is also economical. The venture to identify and eliminate dissonant time intersects more broadly with the values of neoliberal capitalism in what Wajcman (2008: 63) calls the "commodification of (clock) time." The facilitation of city rhythms by way of new technologies is designed to not only improve efficiency but also, in doing so, liberate previously unavailable time slots and spaces for productivity. Advocates for development in the Asia Pacific (APAC) region, for example, position investments in managing technologies as a way "to aid in seamless connectivity and collaborations, enhance productivity and automation, as well as address security and privacy concerns" (Wang et al. 2019). The promise to facilitate harmony between city systems is therefore also the promise to eliminate wasted time and make as much time as possible accessible to the forces of capital. To this end, while many believed that new technologies and machinations might free up more time for leisure, travel, and vacation, these times and spaces are increasingly dominated by work-related activities, and formal work hours are busier than ever before (Wajcman 2008; Castells 2011). Within the context of these changes, the ability to disconnect completely from wireless networks has become a luxury reserved for the economic elite (Bowles 2019). In short, Adam (2004: 39) writes, "when time is money, then faster is better." While this means accelerating work-related tasks, it also means ensuring that time away from work is as compressed as possible.

It is within the context of this governmental shift that the smart city movement promises technological dominion over the competing spatiotemporalities of urban life. Through the ever-increasing speed and autonomy of managing technologies, the ideal smart city establishes and maintains balance between city systems without delay or interruption (Kitchin 2018). As Kitchin (2018: 21) writes:

the appeal and promise of smart cities is that they constitute 'real-time' cities, composed of systems that work 24/7 and are reactive to unfolding events in order to optimize performance and gain efficiencies. It is this temporal condition that the progressive development of smart urbanism… has been striving to achieve through each iteration of innovation – the instantaneous control of space and spatial relations in real-time.

Within the smart city, each moment is coordinated for optimal productivity. Any potential changes to a city's rhythm, such as an unanticipated traffic accident threatening to delay commuters, are seamlessly brought back into order through immediate adjustments either at the source of disjuncture or elsewhere in the system (Kitchin 2018). The idealized smart city is thus a liberation from the constraints of space and time. Inconvenient dissonances and delays are recuperated into the fold, and wasted time is replaced by convenient, efficient, and seamless movement. As such, adopting the smart city mantel has become an effective way for cities to attract businesses aiming to optimize productivity and minimize wasted time (Datta 2015; Cardullo et al. 2018).

The idealization of the smart city is not only based on its speed but also on the presumed rationality and optimality of its managing technologies. Insofar as urban governance is increasingly predicated on the idea that "optimization, efficiency, and rational decision-making [are] the key bases on which to manage and improve urban living," advocates of the smart city contend that the proliferation of integrated technologies and artificial intelligence is the best way to actualize these goals (Kitchin 2014: 131). By collecting and analyzing data on an unprecedented scale, with progressively little human intervention, urban technologies promise results seemingly free from the political and economic biases of human actors. As Halpern and Günel (2017:

7) write, one of the core assumptions fueling the enthusiastic integration of technology into urban governance is the belief that "increasing computation and data flow in the environment will somehow overcome the problems and limits of human decision-making and control." The progressive elimination of latency between observation and output is seen as the simultaneous elimination of room for subjective influence. In this way, the smart city is a technocratic ideal reminiscent of the transhumanist promise to overcome historical and material limitations with prosthetic technologies (Braidotti 2013). As Beer (2017: 5) writes, the incorporation of data-based technologies into urban governance is a similar, if not derivative, exercise in "the meshing of human and machine agency," wherein new technologies promise unparalleled accuracy and speed in the measurement of, and response to, urban systems.

Insofar as technology is idealized for its presumably rational and objective quality, the divide fueling the movement towards smart cities is not so much between human and machine but, rather, between what Meyer (2018) calls human animality as embodied biological experience and the idealized *human* as rational, objective, calculating, and, ultimately, white and male (also see White 2016). Within the smart city, these values are externalized such that the information and communication technologies characteristic of urban interventions "exteriorize and duplicate electronically the human nervous system" (Braidotti 2013: 90). This valuing of rationality and objectivity is then pushed to its ideological limit insofar as predictive and reactive technologies built on quantified data points and unwavering algorithms promise to remove emotionality and computational limits from the equation altogether (Harding 1994; Datta 2015). Algorithmic governance is not the replacement of human decision-making but, rather, its optimization through the liberation of rational processing from the sociopolitical contexts that might intercede if the movement from input to output was not immediate. In fact, insofar as this decision-making takes place in real time, the rationality promised by the smart city is not processing at all but, rather, perfectly instantaneous and optimized reactivity. The result is that "smart city advocates imagine themselves as creating technologies, techniques, and visions that are scientific, objective, commonsensical, and apolitical" (Kitchin 2014, 132). With enough technology, the smart city promises to make this separation between the human and human animality complete. As Batty et al. (2012: 482) write, "the prospect that a city might become smart, sentient even, is fast becoming the new reality."

Paradoxically, this promise to liberate urban governance from spatiotemporal limitations implicates the smart city movement in the same "tunnel of time" that has historically celebrated science and technology as the vanguard of an enlightened Western civilization (Harding 1994: 23). The difference between disharmony and harmony is recuperated within a simple and corresponding divide between past and future, with interventions in the present justified by the belief that technology will actualize a future in which the limitations of human governance are overcome once and for all. Cities from around the world are then positioned along a single, universal timeline, with those more willing to embrace experimental technologies presumed to be further along in escaping spatiotemporal constraints than those relying on traditional methods of governance. As Datta (2019: 394) writes, "the vision of the future constructs a linear trajectory of progress, which sees history as slow and organic, and the future as an algorithmic spatio-temporality marked by speed and scale of action." Within this progressive narrative, the real-timeness promised by the smart city is not so much a challenge to linear models of temporality as it is its culmination – a future liberation from the current constraints of delay and disorder.

Despite promises to liberate cities from their spatiotemporal constraints, the framing of spacetime underpinning the smart city movement thus remains one of sequential displacement. Moments appear as discrete units along a continuum, such that the future city cannot exist alongside the present. It is, quite literally, "one at a time" (Barad 2018: 210). Just as one moment must replace the other, so too is it "impossible for two bodies [or two cities] to occupy the same space at the same time" (Fabian 2014: 6). Cities are therefore arranged "on a continuous temporal slope, in which some [are] located upstream and others downstream" (Fabian 2014: 6). In turn, progression towards a singular, universal future becomes the justification for the elimination and replacement of urban spaces deemed obsolete or analog: out with the old and in with the new. In Toronto, for example, investments in smart city development are construed as a necessary expense as the city "moves into the twenty-first century" (City of Toronto 2017). The consequences of this displacement and devaluing manifest in several important ways throughout the smart city movement.

For starters, investments in digital management and infrastructure are often justified as part of a strategy to attract businesses and human capital in the future, even as these investments and developments displace those already living within the city. The appeal to future opportunities comes at the expense of those already present. As mentioned in the introduction, for example, the rapid influx of tech companies and their high-wage workers to San Francisco has pushed out long-standing residents who can no longer afford food and housing – with Toronto seemingly on a similar path (Cardullo et al. 2018). The enthusiastic pursuit of technological solutions also distracts from the possibility of other more proven methods and shifts attention away from the underlying causes of many urban problems (Saxe 2019). Evolving traffic control rooms and fancy streetlights fail to reduce the number of private vehicles on the road, for example (Kitchin 2018). In some cases, the choice to pursue technological solutions can actually exacerbate the problem. Many cities are now learning that partnering public transit with ride-sharing platforms like Uber may actually worsen traffic congestion and environmental impact (Bliss 2018; Cecco 2019). The result is what White (2016: 14) calls a "fetishization of technology" insofar as the presumed progressivity of technological interventions leads many to cast aside more practical solutions to urban crises in favor of futuristic projects. The overvaluing of private sector input that this emphasis on technology necessitates (Hollands 2008) also directs important funds and resources away from the public, such that slower, more traditional models of city management are overlooked in order to appear more progressive and welcoming of innovation. As Kitchin (2018: 32) writes, "technocratic forms of governance run counter to democratic politics, with real-time computationally-mediated management excluding meaningful public participation in governance, bypassing the creative, political, and messy role of people in shaping their own environments." In Toronto, city officials and their private sector partners have been eager to expedite public consultation surrounding the Quayside land parcel to ensure that the project moves forward with minimal interference (Wylie 2018a).

In sum, even as new technologies transform the way that we navigate and relate to time, the ideal of the smart city recuperates these innovations within a simple, linear narrative of progress. Technological interventions in the present are justified by the idea that they might move cities one step closer to dominion over, and liberation from, the temporal rhythms that flow through cities and produce dissonances within their streets. As I highlight in the next section, however, this vision is a fleeting one. The eagerness to leave behind the limitations of the past leads advocates of the smart city to overlook the many ways in which technology is shaped, and constrained, by the past, present, and future. As such, the smart city imaginary is ill-equipped to address the erasures inherent in its progressive narrative. Municipalities must cast off the old mantel and replace it with a new one – one more open to the idea that divides between past, present, and future are never clear-cut.

3 The Impossibility of the Smart City

Smart city initiatives continue to be shaped and limited by spatiotemporal contexts in several important ways. First, the concept of the smart city is not so innovative as many of its proponents suggest. It has evolved over time, emerging gradually from a series of competing ideas about what constitutes progressive governance (Glasmeier and Christopherson 2015; Shelton et al. 2015; Kitchin 2014). Even now, it remains unclear if technological interventions ought to be oriented towards data collection and analysis (Townsend 2013), connectivity (Bakici et al. 2012), sustainability (Barrionuevo et al. 2012), infrastructure (Harrison et al. 2010), or governance (Cretu 2012). How cities relate to the smart city ideal is therefore shaped by the "social-spatial processes of governance and economic development" in which they are embedded (Kitchin 2014: 132). In other words, the smart city is not an apolitical, objective, or universal ideal towards which cities are progressing at different speeds. Rather, it is a floating signifier loaded with political, economic, and ideological interests that call into question the presumed benevolence of the movement itself. Even the label is a product of these interests – originating in an IBM campaign to implant the company into local government (Harrison et al. 2010). Similarly, the resilience of the movement is due, at least in part, to its ability to accommodate the preexisting economic and political models within which it seeks to operate. In a period of austerity and fiscal conservativism, for example, advocates have latched onto the idea that technological innovation, though expensive upfront, will save money in the long run (White 2016).

Second, and contrary to the archetypal cases that have often defined the smart city movement, urban initiatives are frequently an exercise in retrofitting, renovation, and piecemeal construction. Unlike greenfield projects such as South Korea's Songdo or Masdar in Abu Dhabi, the prototypical technologies of private vendors are often incorporated into preexisting infrastructure and service models (Shelton et al. 2015). Consequently, while digital ventures may promise real-time reactivity, the capacity of these devices is often limited by the bandwidth of existing infrastructure and wireless networks. As Kitchin (2018: 32) argues, while large cities may be able to afford top-of-the-line technologies, even these are subject to "memory buffering, CPU scheduling, and process interruptions." Each technological intervention must also be maintained with constant upgrading, patching, and repair (Kitchin 2018). When technologies fail or crash, cities are often temporarily reverted to the preexisting service platforms they hoped to replace.

Interventions also constrain future possibilities, with current tech becoming the baseline on which future developers must build (Uprichard 2012). This path is as much political as it is technological, with cities inheriting complex and entrenched policy legacies that limit what they can do. Early decisions about data policy, for example, can have significant ramifications for what types of projects that municipal officials can pursue moving forward (Haggart 2018). Simply put, as Shelton et al. (2015: 14) write:

Rather than constructed on *tabula rasa*... smart city interventions are always the outcome of, and awkwardly integrated into, existing social and spatial constellations of urban governance and the environment.

Contrary to the smart city's hyper-rational, seemingly objective quality, the fragmented nature of technological interventions means that the outcomes and reception of new technologies are often unpredictable. An identical technology or intervention might produce drastically different effects in two different contexts, and what was possible in one city may prove more difficult in the next (Kitchin 2014).

Even with so-called greenfield sites, the notion of a "fresh start" is misleading. Presumably unoccupied lands have complex spatiotemporal histories of their own, interwoven with practices of colonialism and displacement (Barad 2018). Toronto's Quayside development, for example, is being built on the traditional territory of the Mississaugas of the Credit and other indigenous peoples (City of Toronto, n.d.). Though the city has incorporated a land acknowledgment into its official proceedings and website, the fact that this new development can be realized without serious consultation suggests that such policies are complicit in the exclusion of indigenous peoples from Canadian policymaking. Similar stories of colonial displacement are undoubtedly part of smart city initiatives across North America. Beyond these colonial legacies, greenfield sites are also part of complex ecological networks, with new developments threatening to disrupt whatever balance may already exist. The progressive and sequential timeline of the smart city movement erases these complex cultural and geopolitical histories, replacing them with a futuristic technocracy unconstrained by the decisions or mistakes of the past. The impact of this construction then reverberates beyond the seemingly unoccupied land. In Toronto, Sidewalk Labs' most recent proposal for the Quayside project proposes that the company benefit from property taxes well beyond the Quayside land parcel insofar as their interventions can be expected to increase surrounding property values (Canadian Broadcasting Corporation 2019).

While many of these problems may cast doubt on the imminence of the ideal smart city, they are frequently recuperated within a linear temporality that paints current shortcomings as part of an iterative progression towards the ideal. The gap between data collection and output, however, exposes a more fundamental flaw in the "real-time" promise of the smart city movement. More specifically, the space (and time) between input and output, no matter how small, renders the past an essential and inescapable part of municipal technologies. As Kitchin (2018, 28) observes:

> What becomes clear when one examines real-time systems closely is that they are never quite in real-time, they always include latencies. This is apparent if one

records a real-time stream of data, wherein it is clear that the data are sampled with a small latency between discrete data points.

Even with seemingly instantaneous technologies, in other words, there is a distancing between observation, interpretation, and action. There is what Derrida calls a “hiatus” or “spacing” between observation, processing, and output such that the algorithm must always occupy the dual role of observer and sense-maker – a duality held in tension by the processing so prone to disruption and latency (Derrida 2000). While this gap can be compressed through advancements in computer processing and broadband infrastructure, it is never done away with completely.

The ability of an algorithm to predict and respond is thus always, necessarily, indebted to its history. While this indebtedness can be relatively benevolent, such as artificial intelligence trained to recognize the difference between dogs and cats based on a dataset of animal pictures (Markoff 2012), it can also produce serious limitations in algorithmic technology. For example, while previous exposure to an individual’s habits can improve a search engine’s ability to autocomplete future searchers and tailor results, predictive algorithms also tend to reinforce previous biases and discipline individuals into specific avenues of behavior (Ananny 2016). Though the consequences of biased news feeds may be subtle, the tendency of predictive policing programs to reinforce harmful racial stereotypes and over-policing based on biased datasets is far more striking (Rieland 2018). Similarly, facial recognition technology trained on predominantly white faces – technology for which law enforcement agencies are also eager buyers – frequently misidentifies people of color (Vincent 2019). Put briefly, algorithms depend on the data they are fed – their inputs shape their outputs. They are what Derrida calls “systems of calculation and repetition,” wherein each output is based on a revisit to the very same past from which real-time technologies promise relief (Derrida 2004: 49). As such, they are also haunted by the oversights and erasures that limit and bias their outputs.

This distancing between observation and action also implies that smart city technologies are not the a-temporal, objective decision-makers they were promised to be. Rather, they are interpretive lenses created by, and traced over, the unique spacetimes in which they operate, categorizing and acting on the information they observe. As Ananny (2016: 108) writes, algorithms are “assemblages of institutionally situated code, practices, and norms with the power to create, sustain, and signify relationships among people and data.” In short, they are an exercise in signification. The hiatus between input and output means that this portrayal of the world is always indirect, mediated by a system that chooses what to measure and what it means (Derrida 2000). The output is always separated from the input, which is to say that the representation provided by algorithmic technologies is always mediated by the algorithm itself. Consequently, outputs are constrained by the normative and ontological frameworks baked into the algorithms, which determine not only what information is collected but also how this information is interpreted and transposed into a corresponding output (Beer 2017; Kitchin 2018). Often, these include neoliberal assumptions about atomistic individuals and their behavior (Mager 2012). These visions of the world are then reinforced by the outcomes provided by the supposedly objective algorithms, as their outputs are presumed to be direct inference into the world that they have observed (Beer 2017). To the contrary, while the smart city promises to measure, categorize, and corral urban life, its capacity to do so is constrained by the fact that algorithmic decisions are always already subjective and that the relationship between urban life and the Internet of things is always mediated by an interpretive lens.

These interconnections suggest that there is no point at which a city might be said to have become smart. As Ananny (2016: 105) reflects, it is difficult "to understand how long a mix of code, people, practices, and norms requires to produce meaningful, trustworthy results." This skepticism can be pushed even further. To the extent that the smart city's engagement with spacetime is always indirect, the objective, rational, and real-time future promised by its advocates cannot materialize no matter how long we wait. The categories and solutions created by artificial intelligence, merely a technological extension of the subjective frameworks through which we make sense of the world, never quite fit the infinitely complex spacetimes over which they govern (Lawlor 2007: 5). Consequently, the refrain created by digital management is always slightly out of sync, with every gap between input and output providing the dissonance needed to drop the orchestra out of key (Coletta and Kitchin 2017).

Of course, the "real-time" promise of the smart city depends precisely on ignoring the impossibility of its vision. Those with a vested interest in the success of the movement have therefore endeavored to maintain a sense of momentum and inevitability. The limitations of present iterations, they contend, are merely hiccups along the way to a perfected smart city (Halpern and Günel 2017: 10). Failures in one location, such as the stalling of development in Songdo and Masdar, are similarly transformed into the groundwork for potential successes elsewhere. This is then mirrored by the symmetrical proposition that even where technological ventures are lacking, they are still better than the alternative. "The development of smart cities," write Halpern and Günel (2017: 2):

> follows a logic of demoing, constant prototyping, testing, and updating; instead of a finished product, infinitely replicable but always preliminary versions are installed in cities around the globe. At the same time, the idea of the smart city is inextricable linked to notions of catastrophe, where the logic of the demo or test-bed becomes a means for responding to the impending environmental, security, and financial destruction by constantly deferring this future from ever arriving.

Even the supposed threat posed by urbanization is part of this venture. Smart city advocates exaggerate the sense that existing infrastructure is "always already strained or aging and therefore insufficient to deal with the stresses of mass urbanization" (White 2016: 7). Moreover, as consequences of rapid urbanization do arise, the smart city movement fails to address, or exacerbates, some of the underlying causes of these demographic shifts – focusing, instead, on an ever-growing list of mitigatory tech (White 2016: 7). The same is true of the smart city movement's evocation of the climate crisis; even as smart city advocates latch onto the language of sustainability and green development, it remains unclear whether a developmental logic so entwined with capitalist economics can provide the type of change necessary (White 2016).

This deferral to the future serves to not only excuse but also distract further from the limitations of the present. As such, while the smart city promises to solve each of these crises, it can never actually do so. It depends precisely on this deferral to future utopias and catastrophes to keep the dream alive and distract from the many limitations inherent in technological interventions (White 2016: 4). Spurred on by their own accelerate or die narrative, smart city advocates fail to account for the many intersections between past, present, and future that shape and limit new technologies. "The emphasis on speed and instant reaction," writes Kitchin (2018: 30), "means there is no time for reflection, contemplation, slow rational deliberation, considered answers, or affect and emotion in decision-making and response." This oversight is maintained by a linear understanding of time in which failures or constraints can be reframed as hiccups along the way to the realization of an ideal smart city. If we are to rehabilitate technology, we must therefore do more than simply highlight the limitations of contemporary tech. We must also move beyond the vision of the smart city and embrace alternative temporalities – alternatives through which we might come to more fully understand, appreciate, and recalibrate the relationship between past, present, and future in the technology that we use.

4 The Spectral City

Just as I am not the first to suggest that time is an important part of city life, I am also not the first to suggest that municipalities embrace an alternative vision of the future city. Some scholars, for example, have called for "a cultural slowdown" to mitigate the exponential acceleration of city rhythms (Wajcman 2008: 61; Virilio 1997). However, even visions of a so-called slow city understate the extent to which time, especially within a city built on algorithmic technologies and data collection, does not unfold along a simple linear path. Time is complicated, and occasionally the path towards a more equitable city may not be forward at all. Urban governance must be more open to these different spatiotemporal patterns and less eager to recuperate the competing rhythms of city life within a simple story of progression. While calls for so-called dumb cities may be closer to what is needed (Saxe 2019), even these provide little guidance for municipal governments aiming to make decisions about the role of technology in urban governance – instead focusing on the problematization of the smart city ideal. As Halpern and Günel (2017: 20) write, if we are to develop a more equitable guideline for decisions about the role of technology in cities:

> We have to open the discussion about what constitutes management and control, and how to add temporal multiplicity, whether it is allowing weeds to grow as a strategy to green cities, or thinking about multiple aesthetics not just spaceships or sleek glass towers.

In short, we need what Kitchin (2018: 33) describes as "an ethics of temporal dissonance." As I suggest in this section, the starting place for this alternative ethic may not be the city at all. Rather, the most useful alternative may emerge from the problematizing work being done in contemporary quantum physics on the relationship between politics, technology, and spatiotemporal rhythms of city life.

In an essay entitled "Troubling Time/s and Ecologies of Nothingness," Karen Barad argues that contemporary quantum physics has complicated traditional conceptions of spacetime and provided rehabilitative possibilities. The linear, sequential model, she argues, no longer holds up. Bringing together contemporary work in the field with her own deconstructive sensibility, Barad highlights the way that research into temporal diffraction, quantum superpositions, and quantum entanglements collectively suggests that "the new and the old – indeed, multiple temporalities – are diffractively threaded through and are inseparable from one another" (Barad 2018: 221). The goal is not to reject linearity per se but to challenge the conventional belief that "moments exist one at a time, everywhere the same, and replace one another in succession" (Barad 2018: 223). Past, present, and future remain interconnected, influencing one another in complicated and unique ways.

For Barad, the individual cannot leave this embeddedness behind. They remain situated in, and constituted through, the complex entanglements of "multiple time beings" interwoven with histories of colonialism, erasure, and violence (Barad 2018: 241). In fact, the very ability of the subject to conceive of themselves as *here* and *now* depends on their capacity to identify these other moments as *there* and *then*. In this sense, the constitution of the self as present depends on the paradoxical rendering of those times, places, and peoples anew such that, as Derrida writes, "to follow is to similarly exist alongside" (2002: 379). Idealizing a present and future unconstrained by the past renders these complex entanglements invisible, and it is here that notions of progressivity are most damaging. Accordingly, the path towards more equitable development must begin with something akin to Derrida's aporetic temporality – a hauntology in which the ghosts of the past and phantoms of the future are allowed to flow through the present and time itself can be "out of joint" (Wood 2018: 37; Derrida 2006).

Opening ourselves up to this indebtedness is a difficult task. It requires a preliminary acknowledgment of the violence and erasure on which neoliberal understandings of time, and our position within it, have for so long depended on. It means calling into question the destruction that has been allowed to persist under the name of progress and "[coming] to terms with the infinite depths of our inhumanity" (Barad 2018: 242). Within the context of urban governance, it means replacing the ideal of the smart city – along with its quest to leave the past behind – with that of the *spectral city*, wherein the multiple and overlapping temporalities of urban spaces are acknowledged rather than rejected and the roots connecting current developments to the past are cultivated rather than paved over. As I highlight in the remainder of what follows, this image of the spectral city provides a valuable framework for interrogating the ways that the past is being reiterated and reformed in both city policy and new technology.

From the outset, embracing the spectral begins with an acknowledgment of the many ways in which urban technologies are haunted by what they do not know. Facial recognition trained on exclusively white faces is unable to differentiate people of color (Rieland 2018). A sector dominated by white, affluent men has, unsurprisingly, reinforced many of the structural and institutional inequalities that produced these exclusions in the first place (Crawford 2016). As Barad (2018: 229) writes, "attempts at erasure always leave material traces: what is erased is preserved in the entanglements, in the diffraction patterns of being/becoming." While the ideal of the smart city has often overlooked the consequences of such erasures in its eagerness to advertise new technologies as inherently progressive, a more spectral imaginary suggests that urban technology might be improved by a more attentive approach to the erasures and oversights that have fueled the technologization of cities. By revisiting the past, those previously overlooked can be "recognized as part of the ongoing re-worlding of the world" (Barad 2018: 241). In the case of the spectral city, this call to revisit the past is not only merely a moral one but also an instrumental one, as the oversights of the past continue to haunt the technological outputs of the present.

Thus, the spectral city is *not* the one that adopts new and more pervasive technology in a bid to leave behind the limitations of spacetime. Rather, it is built around practices of remembering or, as Barad (2018: 229) writes, "re-membering." Remembering, Barad (2018: 242) writes, is:

> re-turning – turning it over and over again – decomposition, composting, turning over the humus, undoing the notion of the human founded on the poisoned soil of human exceptionalism. Not to privilege all other beings over the human, in some perverse reversal, but to begin to come to terms with the infinite depths of our inhumanity, and out of the resulting devastation, to nourish the infinitely rich ground of possibilities for living and dying otherwise.

Simply put, our understanding of the present can be improved by identifying the traces left by our erasures of, or entanglements with, the past. This act of remembering takes seriously the histories of colonialism, racism, and speciesism that underpin notions of objectivity, rationality, and technology so central to the smart city movement. It emphasizes the interconnections between people, places, times, and nonhuman beings that have been ignored for the sake of Eurocentric privilege. It is, in short, a "work of mourning" for all those left behind, harmed, or destroyed by the negligence of urban development (Barad 2018: 242).

Unlike the smart city, which seeks the culmination of urban development in its realization of the real-time city, mourning under the guise of the spectral is always incomplete (Barad 2018: 241). There are always more to be remembered in more detail, and each iteration or output of new technologies, even those aspiring to rectify previous oversights or erasures, nevertheless leaves others unaccounted for. There are those who can no longer be counted, whose cultures, livelihoods, peoples, or species are gone forever (Colebrook 2018). As such, it is impossible to ever rectify our mistakes completely. Yet committing ourselves to remembering means we try all the same (Barad 2018: 241). It is akin to what Donna Haraway calls "staying with the trouble": investing ourselves in a work of revisiting, reconfiguring, and reconciling with those around us that are messy, complicated, and unfinished (Haraway 2016: 4). The spectral city is thus, in truth, a spectral-city-to-come, haunted as much by a future that is always already out of reach as it is by the past. Within the context of urban development, this means also recognizing the extent to which technological decision in the present will extend into, and constrain, the future. There is no guarantee that the technology that we choose to implement today will not become obsolete (or problematic) at some point in the future (Saxe 2019). As such, while we are responsible to the cities and peoples of the past, we will also be held to account by those whose lives will be shaped by the decisions that we make in the present (Peterson 2018). In short, the spectral city is a practice in indefinite mourning and perpetual obsoletion.

5 Biodegradable Data in the Spectral City

How are we supposed to understand the world of data and algorithmic streetlights during a time in which time itself is uncertain and the past promises to return? On a more practical level, what types of data should be collected in the spectral city and who should control it? To answer these questions, it is useful to briefly explore data through Derrida's understanding of *biodegradability* as the processes through which individuals are dispersed and repeated throughout spatiotemporal networks. "To be biodegradable," writes Derrida, "means at least two things: on the one hand, the annihilation of identity; on the other, the chance to pass into the general milieu of culture, into the life of culture while enriching it with anonymous but nourishing substances" (Derrida 1989: 837–838). The key, then, is a balance between decomposing entirely – becoming unrecognizable – and being unrecognized from the outset:

> The best way to survive would seem to entail not being assimilated pure and simple, like the nonbiodegradable, but 'assimilated as inassimilable' – that is, 'kept in reserve, unforgettable because irreceivable, capable of inducing meaning without being exhausted by meaning, incomprehensibly elliptical, secret (Derrida 1989: 845; in Naas 2018: 200)

In the context of urban technology, this means understanding the ways in which datafication allows individuals to be repeated in increasingly complex and interconnected ways, such that even the dead have a say in each iteration or output based on data provided long ago. Data-based technologies are thus the embodiment of "a time said to be contemporary that [is] anything but contemporary" (Derrida 2005: 76). They are, with each output and oversight, "the phantom of a friend returning" (Derrida 2005: 75).

On the one hand, then, the spectral city must be vigilant for, and active against, the erasures that come from failing to account for individuals in the cultural milieu. This means "bringing minority discourses, overlooked or repressed texts or currents, to the surface in order to highlight their significance" (Naas 2018: 198). The spectral city therefore takes marginalized voices seriously when they speak out against new technologies. It also ensures that the datasets algorithms are trained on and the data that they are exposed to in the field are as representative as possible. In my own Canadian context, this may be an argument for a national data strategy. By not developing an intentional approach to data collection, the Canadian government has ensured that marginalized voices are either unaccounted for or whitewashed by datasets that treat marginalized peoples and the powerful indiscriminately (Andrew-Gee and Grant 2019). Even as it pushes for more data collection, however, the remembering characteristic of the spectral city is balanced with the recognition that individuals are unique, complex, and irreplaceable. The spectral city therefore sets about interrogating simplistic categorizations and algorithmic models of causality to explore correlations at evermore tailored levels. As Chandler (2015: 847) writes, "given enough data and computing power, the reductionist categorizations upon which causal decision-making was made – for example in election campaign targeting, upon traditional variables of race, gender, class, and location – disappear from the picture."

On the other hand, visions of the spectral city provide unique ways for thinking about privacy and surveillance. Though approaching data as biodegradable – as an individual's reverberations across space and time – suggests that we ought to be more vigilant against erasures, it also suggests that the dissolution of the individual into the collective is not just unavoidable but, to a certain extent, desirable. Biodegradability is "the effacement of identity… but then, also, and through this annihilation of identity, a survival – albeit an anonymous survival – in the culture more generally" (Naas 2018: 196). Data and algorithms are, through this lens, a collective resource, while the outputs of new technologies are of collective consequence. As such, the ideal of the spectral city takes concerns over data privacy and ownership seriously. In some cases, this may involve the establishment of "data trusts" to ensure that residents can not only benefit from the heaps of compost already collected but also see how their own dissolution into the collective is taken care of (Wylie 2018b). Indeed, though I hesitate to implicate the spectral city in anything so specific as anonymization-at-source legislature, I believe that taking biodegradability and these alternative temporalities seriously nevertheless leads to an emphasis on public involvement as decisions over data governance are made. Cities must shift focus from the capacity for businesses to understand citizens, or the capacity of government to control citizens, to the capacity for residents to understand themselves – and their polis – more deeply (Chandler 2015; Krivý 2018).

In sum, the spectral city is defined not by the enthusiasm with which it engages new technologies but by, rather, the care with which it ensures all are accounted for. Through the more deliberate and transparent development of data-based technologies, it seeks to "render our neighbours and those who came before us contemporary with us in ways that challenge the politics of time" (Slade 2018: 359). In this way, the spectral city is akin to the Metabolist movement in architecture, with its emphasis on "decomposition and growth at the same time" (Halpern and Günel 2017: 19). Within the context of urban development, this means abandoning the idealized escape from spatiotemporal limitations and, instead, using new technologies to more accurately understand the way that the past continues to reverberate throughout the present and shape the future. In some cases, this may include making amends for previous erasures and biases and acknowledging the way that this history continues to have consequences today. It is only with this shift in perspective that we might finally understand, beneath the glow of a streetlight, who we are and who we are following.

6 Conclusion

Technology is becoming an ever-present force in urban governance. Municipalities are increasingly turning to integrated tech and artificial intelligence to manage the overlapping and dissonant rhythms of urban life. Within the context of these competing temporalities, the ideal of the smart city has emerged alongside promises of "real-time" reactivity and liberation from the constraints of these spatiotemporal dissonances. Paradoxically, while the smart city promises this escape, it nevertheless recuperates technological interventions within a more simply narrative of progress in which investments in new technologies move cities closer to the realization of a utopic and futuristic ideal. As I have argued in this paper, this framing of innovation as inherently progressive has caused policymakers to overlook the ways that new technologies can be limited by their relationship to the past. More specifically, latencies between input and output mean that the technologies characteristic of smart city interventions remain necessarily indebted to past observations and subject to the interpretive lenses of their creators. These technologies are therefore haunted by biases and erasures, and the ideal of the real-time smart city is fleeting.

Insofar as the problems characteristic of the smart city movement extend from its inherent assumption that the past can be replaced anew by progressive technologies, the response to this problem is not necessarily less technology but, instead, an alternative understanding of time itself. Building on the deconstructive work of Karen Barad, I have argued that alternative temporal models proposed by contemporary quantum physics shed light on the way that complex histories are diffracted through the present in ways that both inform and constrain possibility. Whereas the smart city has tried to distance itself from this inheritance, urban governance is in need of a more intentional and transparent acknowledgment of these interconnections and the dissonance that they create in urban living. Rather than hiding from the ghosts of the past, policymakers must account for them. I have argued that this includes replacing the ideal of the smart city with that of a spectral city – a city more welcoming of the ghosts and ghouls on which it is built.

Several important questions remain. For starters, while I have suggested a framing of data as biodegradable within the spectral city, I have only breached the surface of concerns pertaining to data privacy, ownership, and management. Subsequent scholarship will undoubtedly benefit from more serious engagement with the way that recent policy developments, such as the GDPR, either support or detract from the spectral city. Second, while I have suggested that the notion of a spectral city is not a rejection of algorithmic governance outright, the question remains whether some technologies will prove too problematic to be accommodated. I have provided minimal guidance on how to deal with specific technologies, suggesting only that such decisions should be made more transparent and accountable to the residents that they will impact. In this regard, I am supportive of recent movements in San Francisco, Boston, and Oakland to ban the use of facial recognition outright, even if more intensive training processes and equitable data collection may rectify some of the racial biases that have plagued the technology. In cases such as these, ensuring all are accounted for may entail listening to concerns rather than expanding the reach of technology. Third, though I have suggested throughout this paper that space and time are inseparable dimensions – operating with concepts like spacetime and spatiotemporality – I have admittedly emphasized one at the expense of the other. For the sake of concision, I have largely avoided tangents into the implications of shifting temporal models on our understanding of spatiality and embodiment. Future research must take these steps and explore the relationship between the spectral city and space (see, e.g., Massey 1992; Edensor 2012). This includes considerations of the spectral city's place within colonial contexts and more extensive engagement with indigenous scholarship. Such conversations will undoubtedly reveal that, like the smart city before it, the idea of the spectral city is not so new as it may seem and urban development scholars may have a lot to learn from indigenous authors.

Lastly, I do not propose the spectral city as a homogenous ideal. Whereas the smart city movement has emphasized a decontextualized and technological model believed to be equally applicable regardless of location, the emphasis of the spectral city is on the unique temporalities and overlapping rhythms that intersect in urban spaces around the world. There is no one municipal song, and cities must be cognizant of the unique spatiotemporal context in which they are developing. Future research should therefore focus on the "actually existing" spectral cities of the world and the way that the more equitable goals of spectral development ought to be operationalized within these local contexts. If urban governance is akin to ghost hunting, then scholars must recognize that the ghosts of each house are different. Only by listening for unique points of dissonance can scholars ensure that each instrument is accounted for in the municipal orchestra.

References

Adam, B. (2004). *Time*. Cambridge: Polity Press.

Ananny, M. (2016). Toward an ethics of algorithms: convening, observation, probability, and timeliness. *Science, Technology, and Human Values, 41*(1), 93–117.

Andrew-Gee, E., Grant, T. (2019). In the dark: the cost of Canada's data deficit. *The Globe and Mail.* Accessed April 26, 2019.

Bakici, T., Almirall, E., & Wareham, J. (2012). A smart city initiative: the case of Barcelona. *Journal of the Knowledge Economy. Special Issue: Smart Cities and the Future Internet in Europe*, 135–148.

Barad, K. (2018). Troubling time/s and ecologies of nothingness: on the im/possibilities of living and dying in the void. In M. Fritsch, P. Lynes, & D. Wood (Eds.), *Eco-Deconstruction: Derrida and environmental philosophy* (pp. 160–186). Fordham University Press.

Barrionuevo, J. M., Berrone, P., & Ricart, J. E. (2012). Smart cities, sustainable progress. *IESE Insight, 14*(14), 50–57.

Batty, M., Axhausen, K. W., Giannotti, F., Pozdnoukhov, A., Bazzani, A., Wachowicz, M., Ouzounis, G., & Portugali, Y. (2012). Smart cities of the future. *The European Physical Journal Special Topics, 214*(1), 481–518.

Beer, D. (2017). The social power of algorithms. *Information, Communication, and Society, 20*(1), 1–13.

Bliss, L. (2018). *Uber and Lyft could do a lot more for the planet*. CityLab.com. Accessed 13 Aug 2019.

Bowles, N. (2019). *Human contact is now a luxury good*. New York Times. Accessed August 14, 2019.

Braidotti, R. (2013). *The posthuman*. Polity Press.

Canadian Broadcasting Corporation. (2019). *Sidewalk wants cut of property taxes and development fees for Quayside project*. CBC.ca. Accessed August 13, 2019.

Cardullo, P., Kitchin, R., & Di Feliciantonio, C. (2018). Living labs and vacancy in the neoliberal city. *Cities, 73*(1), 44–50.

Castells, M. (2011). *The rise of the network society* (Vol. 12). John Wiley & Sons Press.

Cath, C., Wachter, S., Mittelstadt, B., Taddeo, M., & Floridi, L. (2018). Artificial intelligence and the 'good society': the US, EU, and UK approach. *Science and Engineering Ethics, 24*(2), 505–528.

Cecco, L. (2019). *The Innisfil experiment: the town that replaced public transit with Uber*. The Guardian. Accessed August 13, 2019.

Chandler, D. (2015). A world without causation: big data and the coming of age of posthumanism. *Millennium, 43*(3), 833–851.

Chiusano, M. (2019). *Autonomous cars come to Brooklyn*. AM New York. Accessed August 13, 2019.

City of Toronto (2017). *City of Toronto pilots new smart traffic signal technology to monitor traffic flow in real time*. News Releases and Media Advisories. Accessed April 26, 2019.

City of Toronto (n.d.a). *Land acknowledgement (website)*. Accessed 26 April 2019.

City of Toronto (n.d.b). *Smart cities initiatives (website)*. Accessed August 14, 2019.

Colebrook, C. (2018). Extinguishing ability: how we became post-extinction persons. In M. Fritsch, P. Lynes, & D. Wood (Eds.), *Eco-Deconstruction: Derrida and environmental philosophy* (pp. 261–278). Fordham University Press.

Coletta, C., & Kitchin, R. (2017). Algorithmic governance: regulating the 'heartbeat' of a city using the Internet of things. *Big Data & Society, 4*(2), 1–16.

Crang, M., & Graham, S. (2007). Sentient cities ambient intelligence and the politics of urban space. *Information, Communication & Society, 10*(6), 789–817.

Crawford, K. (2016). *Artificial intelligence's white guy problem*. The New York Times. Accessed April 26, 2019.

Cretu, L. G. (2012). Smart cities design using event-driven paradigm and semantic web. *Informatica Economica, 16*(4), 57.

D'Amore, R. (2017). *City partnership with Waze will help drivers navigate construction, new traffic measures*. CTV News. Accessed August 14, 2019.

Datta, A. (2015). New urban utopias of postcolonial India: entrepreneurial urbanization in Dholera smart city, Gujarat. *Dialogues in Human Geography, 5*(1), 3–22.

Datta, A. (2016). Introduction: fast cities in an urban age. *In Mega-Urbanization in the Global South. Routledge*, 13–40.

Datta, A. (2019). Postcolonial urban futures: imagining and governing India's smart urban age. *Environment and Planning D: Society and Space, 37*(3), 393–410.

Derrida, J. (1989). Biodegradables: seven diary fragments (trans. Kamuf, P.). *Critical Inquiry, 13*(4), 812–837.

Derrida, J. (2000). *Le toucher*. Editions Galilée: Jean-Luc Nancy.

Derrida, J. (2002). The animal that therefore I am (more to follow) (trans. Willis, D.). *Critical Inquiry, 28*(2), 369–418.

Derrida, J. (2004). *For what tomorrow (trans. Fort, J.)*. Stanford University Press.

Derrida, J. (2005). *Politics of friendship (Volume 5)*. Verso.

Derrida, J. (2006). *Specters of Marx: the state of the debt, the work of mourning, and the new international (trans. Kamuf, P.)*. New York: Routledge.

Edensor, T. (2012). *Geographies of rhythm: nature, place, mobilities and bodies*. Ashgate Publishing, Ltd.

Fabian, J. (2014). *Time and the other: how anthropology makes its object*. Columbia University Press.

Farivar, C. (2018). *Habeas data: privacy vs. the rise of surveillance tech*. Melville House.

Glasmeier, A., & Christopherson, S. (2015). Thinking about smart cities. *Cambridge Journal of Regions, Economy, and Society, 8*(1), 3–12.

Government of India. (n.d.) *Smart Cities Mission, Ministry of Housing and Urban Affairs*. Government Website. Accessed August 13, 2019.

Haggart, B. (2018). *The government's role in constructing the data-driven economy*. Centre for International Governance Innovation. Accessed April 26, 2019.

Halpern, O., & Günel, G. (2017). Demoing unto death: smart cities, environment, and 'apocalyptic hope'. *The Fibreculture Journal*.

Haraway, D. (2016). *Staying with the trouble: making kin in the Chthulucene*. Duke University Press.

Harding, S. G. (1994). *Is science multicultural? Postcolonialisms, feminisms, and epistemologies*. Indiana University Press.

Harrison, C., Eckman, B., Hamilton, R., Hartswick, P., Kalagnanam, J., Paraszczak, J., & Williams, P. (2010). Foundations for smarter cities. *IBM Journal of Research and Development, 54*(4).

Hassan, R. (2007). *24/7: time and temporality in the network society*. Stanford University Press.

Hollands, R. G. (2008). Will the real smart city please stand up? Intelligent, progressive or entrepreneurial? *City, 12*(3), 303–320.

Kitchin, R. (2014). The real-time city? Big data and smart urbanism. *GeoJournal, 79*(1), 1–14.

Kitchin, R. (2018). The realtimeness of smart cities. *Technoscienza: Italian Journal of Science & Technology Studies, 8*(2), 19–42.

Kitchin, R. (2019). The timescape of smart cities. *Annals of the American Association of Geographers, 109*(3), 775–790.

Krivý, M. (2018). Towards a critique of cybernetic urbanism: the smart city and the society of control. *Planning Theory, 17*(1), 8–30.

Lawlor, L. (2007). *This is not sufficient: an essay on animality and human nature in Derrida*. Columbia University Press.

Luque-Ayala, A., & Marvin, S. (2016). The maintenance of urban circulation: an operational logic of infrastructural control. *Environment and Planning D: society and space, 34*(2), 191–208.

Maclean, J. (2017). *Unaffordable: is high tech turning Toronto into another San Francisco?* Cantech Letter. Accessed April 26, 2019.

Mager, A. (2012). Algorithmic ideology: how capitalist society shapes search engines. *Information, Communication & Society, 15*(5), 769–787.

Markoff, J. (2012). *How many computers to identify a cat? 16,000*. The New York Times. Accessed April 26, 2019.

Massey, D. (1992). Politics and space/time. *New Left Review, 196*, 65–84.

May, J., & Thrift, N. (2003). *Timespace: geographies of temporality*. Routledge.

Meyer, E. (2018). *Inner animalities: theology and the end of the human*. Fordham University Press.

Naas, M. (2018). E-phemera: of deconstruction, biodegradability, and nuclear war. In M. Fritsch, P. Lynes, & D. Wood (Eds.), *Eco-Deconstruction: Derrida and environmental philosophy* (pp. 187–205). Fordham University Press.

Peterson, M. (2018). Responsibility and the non(bio)degradable. In M. Fritsch, P. Lynes, & D. Wood (Eds.), Eco-Deconstruction: Derrida and environmental philosophy (pp. 249-260). Fordham University Press

Richards, R., Brothman, D., & Leibowitz, M. (2019). *Urban tech is the next frontier in the digital revolution*. The Star. Accessed August 13, 2019.

Rieland, R. (2018). *Artificial Intelligence is now used to predict crime. But is it biased?* Smithsonian Magazine. Accessed April 26, 2019.

Saxe, S. (2019). *I'm an engineer, and I'm not buying into 'Smart' cities*. New York Times. Accessed July 18, 2019.

Shea, S. (2019). *Smart streetlights build smart city network backbone*. IoT Agenda. Accessed August 13, 2019.

Shelton, T., Zook, M., & Wiig, A. (2015). The 'actually existing smart city'. *Cambridge Journal of Regions, Economy, and Society, 8*(1), 13–25.

Slade, K. (2018). Kierkegaard and the politics of time. In R. Sirvent & S. Morgan (Eds.), *Kierkegaard and Political Theology*. Pickwick Publications.

Townsend, A. M. (2013). *Smart cities: big data, civic hackers, and the quest for a new utopia*. WW Norton & Company.

Uprichard, E. (2012). Being stuck in (live) time: the sticky sociological imagination. *The Sociological Review, 60*(1), 124–138.

Van Zoonen, L. (2016). Privacy concerns in smart cities. *Government Informational Quarterly, 33*(3), 472–480.

Vincent, J. (2019). *Gender and racial bias found in Amazon's facial recognition technology (again)*. The Verge. Accessed April 26, 2019.

Virilio, P. (1997). *Open sky* (vol. 35). Verso.

Wajcman, J. (2008). Life in the fast lane? Towards a sociology of technology and time. *The British Journal of Sociology, 59*(1), 59–77.

Wang, G., Anesini, D., Bisht, A., & Siviero, A. (2019). *Worldwide smart cities spending guide*. IDC.com. Accessed 14 Aug 2019.

White, J. M. (2016). Anticipatory logics of the smart city's global imaginary. *Urban Geography, 37*(4), 572–589.

Williams, T. (2019). *In high-tech cities, no more potholes, but what about privacy?* New York Times. Accessed August 13, 2019.

Wood, D. (2018). The eleventh plague: thinking ecologically after Derrida. In M. Fritsch, P. Lynes, & D. Wood (Eds.), *Eco-Deconstruction: Derrida and environmental philosophy* (pp. 29–49). Fordham University Press.

Wylie, B. (2018a). *Sidewalk Toronto: time to take data governance away from Sidewalk Labs and Waterfront Toronto*. Medium. Accessed April 26, 2019.

Wylie, B. (2018b). *What is a data trust?* Centre for International Governance Innovation. Accessed April 26, 2019.