



Assemblage thinking as a methodology for studying urban AI phenomena

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Abstract

This paper seeks to bypass assumptions that researchers in critical algorithmic studies and urban studies find it difficult to study algorithmic systems due to their black-boxed nature. In addition, it seeks to work against the assumption that advocating for transparency in algorithms is, therefore, the key for achieving an enhanced understanding of the role of algorithmic technologies on modern life. Drawing on applied assemblage thinking via the concept of the urban assemblage, I demonstrate how the notion of urban assemblage can work as an alternative way to explore the distributed and potential dimensions of what has been termed as Urban AI phenomena. Rather than seeing Urban AI phenomena as black-boxed, unknown and opaque, the notion of urban assemblage locates such entities within the wider contexts of the city: urban places, communities and politics, where human-algorithmic relationships gather and disperse. In addition, this approach focuses on the potentialities of Urban AI phenomena—how algorithmic systems can operate differently through different aspects of the city—which can be seen to manifest new forms of resistance, collective actions and democracy. I use a case study of an algorithmic system designed to facilitate digital democracy—vTaiwan—to exemplify how assemblage methodology foregrounds the role of cities as spaces and places for exploring the democratic possibilities of algorithmic systems. This paper concludes with discussion of how the assemblage methodology contributes to serve as a bridge between critical algorithm studies and recent studies of platform urbanism.

Keywords Assemblage · Urban assemblage · Black-boxed algorithms · Algorithmic decision · Platform urbanism · Digital democracy · Smart urbanism

1 Introduction

The term Urban AI loosely describes various emergent phenomena where algorithmic technologies affect urban infrastructures, places and everyday life (Luusua and Ylipulli 2020). Various AI technologies (such as biometrics, social media platforms, smart sensors) are algorithmic systems which are capable of performing and adapting their outputs in response to changes in surrounding environments (Amoore 2013; Kitchin 2017). Such phenomena are an important field of inquiry for urban scholars and geographers: from automatic face recognition to algorithmic recommendation systems, urban scholars claim that algorithmic systems have already changed various ways in which urban

everyday life, policy-making and infrastructures operate and are (re)organised (Coletta and Kitchin 2017; Kitchin 2017; Luque-Ayala and Marvin 2020; Luusua and Ylipulli 2020). Within the notion of algorithmic governance, Coletta and Kitchin (2017, p. 4) consider algorithmic regimes as a new mode of governance in which algorithms actively “search, collate, sort, categorise, group, match, analyse, profile, model, simulate, visualise and regulate people, processes and places” (also see Kitchin 2017, p. 18).

The study of the encroachment of algorithmic technologies—particularly those involving machine learning—on urban life poses huge methodological challenges for scholars of algorithmic studies and urban studies, due to the invisible, inaccessible, contingent and heterogeneous nature of their embedded algorithms (Graham 2005; Kitchin 2017). This is not just because a large proportion of algorithms are proprietary by nature but also because of the technologically complicated and contingent calculations they embody (Graham 2005; Kitchin 2017). In his book, Frank Pasquale

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(2015) problematises the algorithmic society as “the black box society” in which algorithms make decisions about our political and economic lives in secret, opaque and unknown ways.

The mainstream approach to studying algorithmic technologies advocates for more *transparency* and *human accountability* in the deployment of algorithmic systems—for example, in terms of opening-up algorithmic source codes and operative logics—which is alleged to be the best way to enable enhanced scrutiny of algorithmic decision-making (Pasquale 2015). Graham (2005, p. 575) and others (Crang and Graham 2007) suggest that urban scholars should try to “open up” the black box of algorithmic technologies: to render them accountable, knowable and visible. As a result, transparency has become the dominant paradigmatic approach to unpacking algorithmic decision-making. Recently, however, some scholars in critical algorithmic studies and urban studies have argued that researchers should not fixate on “black box” issues of algorithms (nor dwell on transparency-based remedies); rather, they should study algorithmic systems in terms of their embedded power relationships, placing the focus on the wider social contexts in which they operate (Ananny and Crawford 2018; Bucher 2018; Crawford 2021; Fields et al. 2020). As Crawford (2021, p. 12) states, “there is no singular black box to open, no secret to expose, but a multitude of interlaced systems of power. Complete transparency, then, is an impossible goal”.

Ananny and Crawford (2018) contend that the overemphasis on the black-boxed nature of algorithmic decision-making imposes significant technical and epistemological limitations on our understanding of algorithmic decisions. In particular it privileges the role of human agency (i.e. “accountability”) in ensuring more transparent and ethical practices of algorithms (Amoore 2020, pp. 5–6). For Amoore (2020), this framing results in a simplified human-centric account of algorithmic transparency which does not consider the agency of algorithms in foregrounding possibilities for ethical and democratic practices. Framing algorithms as black-boxed forecloses chances for researchers to study them from multiple perspectives by engaging with their embodied human-nonhuman relationships of materials, infrastructures, histories, contextual environments (Crawford 2021, p. 8; Kitchin 2017; Kitchin and Dodge 2011) and cultures (Seaver 2017).

This paper draws on assemblage thinking (principally one particular application of this, the urban assemblage) to propose a useful methodological approach which goes beyond the fixation on the black box to focus on the political possibilities of algorithms in terms of their relationship to wider forms of resistance, collective action and democracy. It aims to answer the question: how can we come to know algorithmic systems from diverse urban perspectives? Building upon works of assemblage thinking (Deleuze and Guattari 1986)

and urban assemblages (McFarlane 2011a, b, c), assemblage methodology reorients our attention to two important “urban” directions in the study of algorithms: (1) the *distributed* and (2) the *potential* dimensions of a given algorithmic system. The notion of the urban assemblage (McFarlane 2011a, b, c), assists us in understanding algorithmic systems as distributed and therefore part of the multiple aspects of the “city”; it addresses the role of urban places, communities and infrastructures in *imagineering*¹ and reconfiguring algorithmic systems. Secondly, the assemblage methodology brings a novel insight to studying the potentials of Urban AI phenomena by focusing on how the function of algorithmic systems can be redirected by elements within urban life, for purposes such as democratic practice, resistance and wider aspects of everyday life practices.

This paper is organised as follows. I begin with an introduction of how assemblage thinking has been developed and used by urban scholars to open up new research inquiries and directions in urban studies. Next, I explain how assemblage thinking works as a useful methodology for understanding Urban AI phenomena: rather than focusing on the need to gain access to black-boxed algorithmic processes, it looks at how algorithmic systems can be located as part of wider urban assemblages constituted by heterogeneous actors and objects in continuous states of coming-together and falling-apart. I then demonstrate an application of this methodological approach with a case study of how an algorithmic system for democratic participation—vTaiwan—has been used by various urban actors embedded in the wider social context of the city of Taipei. I then conclude with a summary of the key contributions that the assemblage methodology can make to both critical algorithm studies and urban studies of platform urbanism.

2 Assemblage thinking and its application in urban studies

On a very general level, an assemblage is a fundamentally relational concept which sees a given phenomenon as composed of heterogeneous entities which can be seen as human and non-human, organic and inorganic, technical and natural (Anderson and McFarlane 2011, p. 126; Bennett 2006); these heterogeneous entities exist in states of coming-together and going-away. An assemblage can claim territory through holding together heterogeneous parts/actors: these can be described as movements of territorialization; at the same time, an assemblage is constantly subject to movements of

¹ Imagineering here refers to coming up with creative ideas and strategies into practices via using analytical tools and technologies (see Amoore 2013, p.10).

deterritorialization, as any formed relationships might be reformed as new actors appear (Anderson and McFarlane 2011). In their book “A Thousand Plateaus”, Deleuze and Guattari (1986, p. 8) denote: “an assemblage is precisely this increase in the dimensions of a multiplicity that necessarily changes in nature as it expands its connections”. For example, “what just a minute ago was a constituted function in the territorial assemblage has become the constituting element of another assemblage, the element of passage to another assemblage” (Deleuze and Guattari 1986, p. 324).

Assemblage thinking has been put to diverse use in urban geography: here, I will illustrate how assemblage thinking can work in tandem as a research object, a concept and a methodological approach to opening up current understanding of the city, producing the idea of the “urban assemblage” and the approach of “assemblage urbanism”. I will particularly focus on the salience of two aspects of an urban assemblage: (1) its distributed agency across the human-nonhuman; and (2) its latent potentialities. This is in line with the use of assemblage theory by Actor-Network Theory (ANT) influenced urban scholars (Blok and Farías 2016; Farías and Bender 2010) and Deleuzian-inspired human geographers (Anderson and McFarlane 2011; McFarlane 2011a, b). Scholars of the urban environment have previously urged a focus on how different urban assemblages can shape political, social and cultural life (Anderson and McFarlane 2011; Bennett 2006; McFarlane 2011a, c).

2.1 The city as a distributed collection of agencies

Assemblage thinking, influenced both by Deleuzian assemblage thinking and ANT, commonly emphasises the *distributed agencies* of heterogeneous parts of an assemblage. It considers both human and nonhuman as actors which have “the ability to make a difference, to produce effects, or even to initiate action distributed across an ontologically diverse range of actors” (Bennett 2006, p. 446). As such, assemblage thinking bypasses the restrictive dichotomy between human/nonhuman (Bennett 2006). From here, assemblage thinking is used to stress how “the city” is composed by a process of (re)arranging heterogeneous entities or social-materialities (McFarlane 2011a, p. 221). Assemblage thinking has influenced how urban scholars understand “the city” by seeing its agency as *unevenly* distributed across social-material entities.

Firstly, McCann and Ward (2011) deploy the idea of “urban assemblage” to specifically describe their research object, urban policy mobility (also see Cochrane and Ward 2012; McCann and Ward 2012). Here, assemblage thinking functions as both a research object and a methodological approach. In this context, an urban assemblage not only refers to a specific case of urban policy but also offers a relational perspective of urban policies by going beyond

the dichotomies of “fixity/mobility”, “global/local”. An assemblage of urban policies is always in a process of formation, not just fixated in a locality but also made mobile and spreadable at the global scale (McCann and Ward 2011, p. 3).

Secondly, assemblage thinking, as a methodological approach, provokes scholars to rethink the city as constitutive of not just of humans but of multiple human and nonhuman relations and different arrangements of socio-materialities (McFarlane 2011a, c, p. 660). For Brenner et al. (2011, pp. 231–232), assemblage thinking works most effectively as a methodological approach which extends and reorients some main research focuses and concerns in studies of urban political economy. The most well-known instance is the field of urban political ecology, which examines and includes neglected dimensions of urbanisation—in particular its focus on “water” (Gandy 2004), “infrastructures” (S. Graham 2010) and “natures” (Kaika 2005)—in its analysis of the city. For instance, Graham’s (2010) work illustrated that how urban infrastructures (electricity, water, transportation) are disrupted, used and operated becomes a matter of survival for citizens’ urban everyday lives.

Thirdly, assemblage thinking is also helpful to illuminate the agency of overlooked materials in terms of unacknowledged impacts on urban housing, inequality and poverty (Dovey 2012; McFarlane 2011a, b). In his book “Learning the City”, McFarlane (2011b, pp. 33–36) describes how unwanted pieces and bits of plastic and old kitchen utensils were reassembled and cemented into the walls and roof of a house in Sao Paulo’s favela and how plastic and metal sheets were rearranged into informal housing by residents in poor communities in India. Due to its attention to distributed agencies across the human and the material, McFarlane (2011a, p. 221) uses assemblage thinking to ask urban scholars: “how materialities might make a difference to the ways in which poverty and inequality are?” Assemblage thinking offers a new methodological approach to urban studies by turning the attention of researchers to the role of mundane materials in constituting different urban lives, offering an alternative account of urban poverty and inequality. To an extent, assemblage thinking at times serves as an ontological claim on the city: the city is not reduced to a political-economic structure but is seen in terms of diverse “technologies, materials and various life-forms...read here as concrete and irreducible agents involved in urban life” (Blok and Farías 2016, p. 1).

2.2 The potentialities of a city

Urban assemblage thinking places great emphasis on latent potential dimensions of the city: in particular it focuses on times when in “the intensity and excessiveness of the moment”, new actors, encountering both peoples and

objects, can generate new actions, connections and ways of constituting urban life, such as new social movements and forms of solidarity/resistance (McFarlane 2011a, p. 209). This aspect, though somewhat similar to the idea of the “mediator” (Latour 2005, pp. 39, 106–107), is distinctly inspired by Deleuzian assemblage thinking. As McFarlane (2011a, p. 215) points out, Deleuzian assemblage thinking differs from ANT in two ways. Firstly, Deleuzian assemblage thinking gives more attention than ANT to the salience of outside influences: external human and nonhuman parts can (either individually or collectively) act on an assemblage in a way which influences and reconfigures it. ANT does not consider individual actors (either within or outside of an assemblage) can act upon assemblage in this way (Müller 2015, pp. 31–32). Secondly, unlike ANT, assemblage thinking places greater emphasis on fluidity and incoherence over rigidity in any assemblage of human-nonhuman entities (McFarlane 2011a, p. 215). Deleuze and Guattari (1986, p. 222) stress that an assemblage “swings” between states of coming-together and falling-apart; ‘Relations may change, new elements may enter, alliances may be broken, new conjunctions may be fostered. Assemblages are constantly opening up to new lines of flight, new becomings’ (Anderson and McFarlane 2011, p. 126).

“Excess”, “flux”, and “transformation” (McFarlane 2011c, p. 654; Anderson and McFarlane 2011; Müller 2015) are terms used by geographers to denote the shifting nature of the assemblage. They are similar to what Deleuze and Guattari (1986) refer to as “deterritorialisation”, which highlights the potentialities inherent within existing human-nonhuman relationships; new potentials can be initiated due to the appearance of a new actor or the removal of an existing actor (Deleuze and Guattari 1986, pp. 9–11). The emphasis on new ways of reordering human-nonhuman entities means that deterritorialization is thought of as “a perfectly positive power”, which is able to create new connections, positions and possibilities (Deleuze and Guattari 1986, pp. 54–56). Such an understanding of deterritorialization has been utilised by urban geographers and scholars as a way to generate alternative perspectives on rethinking what possibilities can the city offer in reconstituting urban everyday life (McFarlane 2011c), informalities (Dovey 2012) and poverty (McFarlane 2011b).

Recent works have deployed assemblage thinking primarily as a concept to discern “the potential of urban histories and everyday life to be imagined and put to work differently” (McFarlane 2011c, p. 654). Alternative possibilities, seen as resistance, solidarity and resilience (McFarlane 2011a; Dovey 2012), can be found in the rearrangement of everyday materials, in moments when new connections and encounters with new actors are formed. For instance, Dovey (2012) utilises assemblage thinking as a conceptual framework to discuss the dynamics of and symbiotic relationships

between “formality” and “informality” in Southeast Asian cities. What matters here is that assemblage thinking is useful in rethinking the concept of urban informality *not just* as a negative urban problem that requires eradication or resolution but as part of the “productive resilience” of cities (Dovey 2012, p. 6). In other words, the concept of urban assemblage highlights various forms of possibility that the city—by continuously reordering and rearranging its social-materialities—can generate.

2.3 Learning from critiques of urban assemblage

Rethinking the city as urban assemblage has been subject to critique, principally from scholars of urban political economy (Brenner et al. 2011; Tonkiss 2011): they focus on what they see as ambiguous, all-purpose and template-like usages of assemblage thinking. For Brenner et al. (2011, p. 232), assemblage thinking is more productive as a methodological orientation to bring new insights on neglected dimensions in current urban enquiries and concepts than as “a radical ontological alternative to political economy” as some have claimed (e.g. Blok and Farías 2016; Farías and Bender 2010). In addition, the other problem with the idea of urban assemblage lies in how “an approach such as this [assemblage] might over-write the empirical contexts it seeks to describe” (Tonkiss 2011, p. 588). Such a critique does not mean assemblage thinking is problematic per se, but points to the need to remain cautious to the ways in which researchers apply such thinking in urban studies to stay true with what Deleuzian assemblage thinking is concerned with: the empirical illustration of a given phenomenon.

Learning from these critiques to urban assemblage, it is clear that assemblage thinking, with its concern towards heterogeneous relations and latent potentialities, works at best as a methodological approach to bring these concerns into a dialogue with research inquiries and concepts that are developed for understanding specific urban issues. As Tonkiss (2011, p. 588) points out: “the real value of assemblage to critical urbanism is in its capacity to generate critical descriptions that trace out the workings of a given empirical context”. What this means is that to make assemblage thinking useful, assemblage thinking has to be situated within the particular context of research inquiries about Urban AI phenomena.

3 Assemblage thinking as a methodological approach to studying urban AI phenomena

Urban AIs are beginning to catch the attention of urban scholars and scholars from critical algorithmic studies; however major methodological challenges for studying them

remain. Of particular relevance to this paper is the emphasis researchers have placed on the black-boxed nature of algorithmic processes within the different forms of urban AI, as discussed in the introduction. This has produced a research focus on an area of algorithmic systems which raises particularly difficult methodological obstacles. Researchers have assumed they must fully comprehend how algorithms operate, which has led to a fixation on “calls for transparency” as the key method to render algorithmic technologies knowable. In addition, the critical study of algorithms has tended to downplay or ignore the role of the city—whether considered in terms of urban space, specific places or politics—in shaping the design, development and latent possibilities of an algorithmic system.

By situating assemblage thinking within this particular context, I show that it can be helpful as a methodology to help urban scholars make sense of Urban AI phenomenon in two ways: (1) by rethinking algorithmic systems as distributed assemblages constituted of elements reaching far beyond the black-boxed nature of a given Urban AI application; and (2) by focusing on the latent potentialities of algorithmic systems.

3.1 Beyond the black-box: rethinking urban algorithmic systems as distributed

Assemblage thinking, with its emphasis on the distributed agencies within the various human-nonhuman relationships constitutive of an assemblage, is useful to open up current understanding of algorithmic systems as “black-boxed”. By focusing on the distributed nature of a given phenomenon, assemblage thinking understands algorithmic systems as gatherings and fallings-out of distributed relationships of users, programmers, machine learning algorithms, big data, digital infrastructures, governmental institutions, policy and cultural practices (Kitchin and Dodge 2011; Kitchin 2017; Crawford 2021); or, as Amoore (2020, p. 9) succinctly puts it, “composite ... human-algorithm relations”. Using a different metaphor, Bratton (2020) describes algorithmic systems as sharing the quality of “landscapes”: “physically embedded, sensory, decentralized, distributed, and heterogeneous”. Understanding algorithmic systems as distributed is an important methodological stance, as it does not see these phenomena as determined by the black-boxed algorithmic technology per se (which thus needs to be unveiled). Rather, assemblage thinking understands the nature of Urban AI systems can be explored empirically without reference to the black-box itself: how can algorithmic systems be seen in terms of wider digital infrastructures, interested policymakers, programmers and system designers, protocols, residents of localities and modes of urban governance? How do these distributed parts gather and disperse in situ at specific times? To put this differently, assemblage methodology orients

researchers to extend their attention to diverse urban places, infrastructures or communities to develop an understanding of how algorithmic systems are made, used and given meanings with multiple effects and implications.

This assemblage turn echoes recent reflections on researching the notion of smart cities in urban studies, where scholars and geographers have sought to go beyond the rhetorical and techno-solutionist understanding of “smart cities”. They have urged greater scrutiny of both the environments in which operative logics of algorithm-driven technologies are developed and on the actual impacts of smart city technologies in specific cities (Greenfield 2013; Luque-Ayala and Marvin 2015; Shelton et al. 2015). In their critical review of smart cities studies, Luque-Ayala and Marvin (2015) note the need to conceptualise how specific smart technologies (data analytics, smart meters/home/sensors, biometrics) operate in relation to specific urban surroundings, and how they (re)configure citizens’ everyday practices in relation to urban spaces and infrastructures (Shepard 2011). In their recent book “Urban Operating Systems”, Luque-Ayala and Marvin (2020, p. 4) argue that digital technologies and systems are not only operating/seen as urban infrastructure but are also transforming the forms and the capacities of urban infrastructure into new technologies of governance and control.

McFarlane and Söderström (2017, p. 2) propose an alternative mode of smart urbanism which prioritises local knowledge of everyday life struggles and needs in urban communities over detailed knowledge of technological systems. In their words, “technological solutions should, when needed, be shaped by *place-relevant* forms of knowledge” (emphasis my own)—in particular those who are disadvantaged and excluded from techno-solutionist discourses of smart urbanism (McFarlane and Söderström 2017, p. 2). In a similar vein, Bratton (2020, no page) also points out that a major limit of techno-solutionist discourses of “smart cities” is that they privilege computational, augmented and automated practices and imaginaries of urban architectures and planning over other ways of making cities smart. By looking at algorithmic systems as “material processes” shaping urban place and life, urban scholars can overcome this issue of lack of imagination and establish novel perspectives on knowing AI urbanism. For Bratton (2020, no page), urban scholars should start with the beneficial impacts of existing digital systems on urban society and see what algorithmic systems can add. These urban scholars are critical about the discourse of smart urbanism, pointing to the need to understand algorithmic systems as distributed and embroiled in urban infrastructures, places and communities. In particular, focusing on local knowledge of what is needed for a specific urban place or a community has the potential to reshape the development and effect of algorithmic systems.

What is added to these critical perspectives is a focus on a particular city where a given phenomenon of Urban AI emerges in a way that does not assume the effects of an algorithmic system are harmful or beneficial. By focusing on diverse urban places and communities, assemblage methodology allows researchers to study such phenomenon from the empirical account of how algorithmic systems are animated, developed and used by particular arrangements of programmers, citizens, policymakers, activists, regardless of the location of technologies under different “marketing” names such as smart city, intelligent city, automatic city or platform urbanism. This focus goes beyond a rhetorical and techno-optimistic understanding of smart cities to speak to the wider material turn in unpacking digital impacts on cities (Ash et al. 2018; Dalton 2020; Kinsley 2014; Luque-Ayala and Marvin 2015). For assemblage methodology, the question of what Urban AI is can only be answered by examining *how* such phenomenon is distributed through various relationships of data, algorithms, local residents, policymakers, governmental structure, digital infrastructures in and beyond cities.

3.2 Latent potentialities in urban AI assemblages

Assemblage methodology orients researchers towards the manifold possibilities the richness and vibrancy of urban life (McFarlane 2011b; Simone 2011) can offer to reconstitute algorithmic systems towards the good by rearranging relationships between citizens, infrastructures and digital technologies. Assemblage thinking, with its focus on rearranging overlooked materialities, can shed new light on how the unpredictability and messiness of the city can offer citizens or algorithms chances to produce new political possibilities. Such possibilities are primarily seen (but are not limited to) as forms of resistance, negotiation, solidarity (McFarlane 2011a, p. 217, 219, 200) and resilience (Dovey 2012). As such, assemblage methodology can draw our attention on understanding what can be made possible through algorithmic technologies and their embeddedness in wider networks of human/nonhuman actors. Whilst we might not fully comprehend how AI technologies such as facial recognition and biometric systems operate, assemblage methodology helps us to uncover those latent potentialities produced by the ways in actors can reorder, break and destabilise the existing relationships that make up a given instance of Urban AI. Such possibilities could open up in the “disjunction between design and use” of algorithmic technologies (Ash et al. 2018, p. 36); in particular they point focus on moments of “collapse”, when algorithmic technologies work “with new data, scenarios, bugs, viruses, communication and hardware platforms and configurations, and users intent on pushing it to its limit” (Kitchin and Dodge 2011, p. 38).

Assemblage thinking echoes recent works on platform urbanism which have cast the city as a dynamic and contingent environment in which encounters between users and algorithm-driven platforms do not submit to predetermined logics of algorithmic control (Bissell 2020; Dalton 2020). Based on each user’s local knowledge, tactics or collective actions, users can *shift* their existing relationship with algorithmic systems and can therefore create alternative possibilities as manifested in forms of resistance or negotiation with algorithmic decisions embedded within digital platforms such as Uber or food delivery platforms (Bissell 2020; Dalton 2020; Gregory and Maldonado 2020; Leszczynski 2019).

Dalton (2020) deploys assemblage thinking to illustrate how a new mode of resistance was made possible when urban activists repurposed and de-territorialized housing data from the US census and Airbnb website into a counter-mapping system aimed at fighting gentrification. By putting housing data to another use—mapping out potential locations for practices of gentrification—urban activists destabilised the Airbnb data assemblage and established “creative possibilities” for marginal groups to think and act about data-driven smart cities (Dalton 2020, p. 1094, 1103). In this sense, Dalton (2020, p. 1096) makes it clear that assemblage thinking does not see urban data assemblages as “apparatuses of establishing ordered data and knowledge” (as in the discourses of algorithmic governance); they “involve a tension between centralizing data order and dissolution to multiple data resistances, counter-narratives and possibilities for new, alternative formations”. Making a difference by unleashing the potentials of Urban AI depended on how a community of urban activists were able to calculate and visualise data via algorithmic systems in a specific place and time, in the context of specific alignments of human/nonhuman entities.

By focusing on everyday life practices in algorithm-driven urbanism, Leszczynski (2019) uncovers various cases where citizens, either individually or collectively, utilised various tactics to work with the unpredictability of digital urban everyday life. Citizens as collectives in Toronto raised unanticipated concerns over data privacy and jurisdiction in relation to a new sensor-driven data lab. Individual citizens, such as the urban scholar Leszczynski herself, managed to come up with a “re-routing” strategy to deal with the disappointing situation when she found out that the Uber platform did not operate in the city. She used her smart phone to find other possible modes of transportation to get to the destination. In the context of food delivery couriers, Gregory and Maldonado (2020) reveal that Edinburgh-based couriers for the Deliveroo platform creatively and collectively use their local knowledge to push back and resist algorithmically-suggested cycling routes. Based on personal and local knowledge of urban geography, couriers can find out the

most efficient routes to deliver food are often different to what the algorithms suggest (Gregory and Maldonado 2020, pp. 1195–1198). Gregory and Maldonado (2020, p. 1190) argue that new forms of collectivity can emerge when couriers navigate through and work with “the unpredictable, the serendipitous, and the creative aspects of ‘messy’ urban situations”.

What these examples indicate is that potentialities within the city are actualised as forms of resistance by consolidating actors from distributed relationships via negotiations and tactical discussions that are external to the algorithmic systems themselves. These potentialities are realised when citizens and activists navigate through and utilise the contingent urban environment to rearrange their (existing) relationships with algorithmic systems and wider urban surroundings. It is clear that how the assemblage methodology can assist researchers to bypass the black-boxed assumption of algorithmic systems and focus on what is made possible through an empirical account of Urban AI.

Algorithmic technologies do not emerge and perform in a void; there is a need to view digital technologies through their entanglement with different aspects of the city. It is cities—specific sites where urban communities and everyday practices perform, thrive and wither—which have profound impacts on the performance and operation of algorithmic technologies in given instances (Bratton 2020). Urban places where possibilities of “escap[ing] the reach of regressive software” (Graham 2005, p. 557) can be foregrounded: the various projects of smart cities can potentially be modified, contested or resisted by citizens (Luque-Ayala and Marvin 2015, p. 2112; Datta 2015). Such urban places present sites of engagement for researchers to search for actors who are likely to “change the status quo” of an Urban AI phenomenon. As such, researchers are encouraged to orient their observation of Urban AI toward *identifying* and *differentiating* forms of possibilities which play out across and at the interface of algorithmic and urban space.

4 Illuminating the democratic potentials of Urban AI: a case study of the vTaiwan system

In this section, I use a case study of the vTaiwan system to illustrate how an assemblage approach can shed light on a complex algorithmic Urban AI system. In particular, I will show how such an approach can bypass the need for researchers to focus on black-boxed areas of algorithmic operation by focusing on the wider relationships of actors associated with these systems. By doing so researchers can

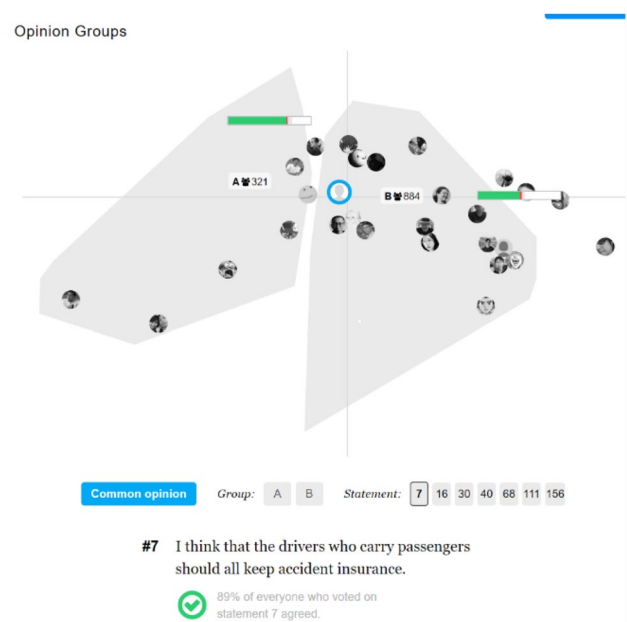


Fig. 1 Screenshot showing the visualisation of two Opinion Groups (in grey clusters) and a majority opinion during an Uber consultation on vTaiwan. Source: <http://pol.is/3phdex2kjf>, access at 06/01/2019

uncover new forms of democratic practices—collective actions which are actualised from latent potentialities within Urban AI systems.

vTaiwan is an open-source² algorithmic system. It is powered by a software called “Pol.is”, which was developed and built by civic hackers³ in Taiwan and the US with the specific intention of empowering citizens in democratic decision-making processes. Within vTaiwan, citizens can comment and vote on various political issues. More specifically the platform focuses on issues related to the digital economy and e-services: these have included the regulatory status of Uber and Airbnb, the regulation of Fintech, the provision of e-clinics providing medical services via digital platforms and other issues within the purview of the Taiwanese government. Instead of seeking a single majority opinion, citizen input is processed by machine learning algorithms in a way which identifies multiple “opinion groups” which classify users according to their responses to the issues under discussion (see Fig. 1). The machine learning algorithms, instead of only visualising “like-minded” comments for algorithmic recommendation (Pariser 2011), were designed to display various comments from *different* opinion

² Under the license of GNU Affero General Public License v3.0, programmers from vTaiwan have to publish their algorithms on the website GitHub.

³ Civic hacker is a loose term meaning software engineers who volunteer to code for various good causes in societies.

groups. By sorting opinions in this way, the theory is that policymakers engaged in revisions to policy or legislation are more likely to take account of the views of a range of different citizens, as these are sorted into algorithmically-calculated opinion groups and opinions.

Assemblage methodology guides us away from a reductive perspective which focuses only on accessing the black-boxed features of machine learning algorithms, which is difficult due to technical complexity, invisibility and secrecy which surrounds them. Whilst vTaiwan's machine learning algorithms are already transparent to an extent, due to its developers utilising open source licensing,⁴ this only displaces the problem. Making the *source codes* of algorithms accessible does not give us any sense of how algorithms make decisions in situ at a particular time. As Kitchin (2017) and Amoore (2020) remind us, the ways in which algorithms make specific decisions are *contingent* on contextually-shaped relationships with data, programmers, protocols and digital infrastructures. Understanding algorithms in this way, we can see that simply publishing or studying the source code of algorithms on GitHub does not make them fully transparent but only lead to a decontextualized understanding of algorithmic decisions (Amoore 2020, p. 97; Ananny and Crawford 2018). The source code of algorithms may provide some information on the logics of algorithmic operation but it does not tell us how algorithms make decisions in relation with data inputted by users in real-time, neither does it tell us what effects such decisions might have on democratic participation.

Assemblage methodology's response to this methodological impasse is to bypass it all together. Rather than stressing their internal processes, assemblage methodology proceeds by stressing the *location* of algorithmic systems in wider social contexts and their *interactions* with different parts of the city. To study algorithmic systems is to understand how they are animated by and become incorporated within parts of urban life such as infrastructures, communities and governments. It is also to focus upon for what purposes algorithmic systems are used and on what effects they produce on the external world. Finally, it is to discern how a city is likely to (re)shape the potentials of an algorithmic system. If we view the development of vTaiwan via the lens of assemblage, what matters is not to study the vTaiwan system by simply reading off its source codes; instead, assemblage methodology makes it possible to look at how machine learning systems can be reimagined and reconstituted as new models for democratic participation by urban communities

and politics where actors come together/go away across different professions and geolocations.

The city of Taipei is home to various subcultural communities—particularly in this instance, movements of “civic hackers”, who use advanced programming and IT skills to solve problems with an emphasis on open-source solutions—and to broader social movement organisations. In the early 2010s, many of these actors came together to become associated with the so-called “Sunflower Movement” in which civic society actors with a shared interest came to together to defend the Taiwanese democratic system (only in place since the late 1980s) from external threats to the integrity of the Taiwanese political system stemming from the People's Republic of China. In this context, an environment developed which foregrounded creative possibilities for rethinking, redeveloping and reconfiguring algorithmic systems for democratic purposes. During my ethnographic fieldwork in Taipei (Tseng et al. 2021), two leading figures involved in the Taiwanese civic hacking community for more than a decade depicted how the so-called “g0v” community developed in the 2010s as a distillation of the wider culture of open-source software advocacy existing since the early 2000s. With the outbreak of the Sunflower Movement in Taipei in 2014, the g0v community began to receive substantial attention from wider society and the Taiwanese government. The Sunflower Movement brought people from different backgrounds—programmers, journalists, activists, students and citizens—to work together against a specific policy, the Taiwan-China Cross-Strait Service Trade Agreement, which appeared to undermine Taiwanese democracy by deepening economic ties with China (Ho 2018). The Sunflower Movement became labelled as part of the wider global Occupy Movement in the early 2010s; as part of this development, Taiwanese civic hackers were able to reach out beyond the spatial territory of Taipei City to a global community of activists and civic hackers. At present, g0v has organised 40 hackathons and four international seminars with participants from the UK, Spain, USA, India, Hong Kong and South Korea.

It was in the context of the growth of the g0v community in Taipei and the specific circumstances of the Sunflower Movement—particularly the aftermath, when the Taiwanese legislature was physically occupied by activists in 2014—that Sunflower Movement activists became co-opted into the Taiwanese political system (Ho 2019). Taiwanese policymakers expressed willingness to implement some core goals of the protestors, one which was to design a digital forum to facilitate public discussion on political issues. After the occupation of the legislature, the Minister of the Taiwan government, Jaclyn Tsai, promised to g0v that she would work alongside a key g0v civic hacker, Audrey Tang, to develop a new digital platform to discuss and make decisions upon urban policy issues (O'Flaherty 2018). In this context,

⁴ Unlike other proprietary platforms, the source code of vTaiwan's algorithms has been made openly accessible on the GitHub website (<https://github.com/pol-is/>).

vTaiwan was born: specifically, the design was agreed upon during a hackathon project which brought together Taiwanese civic hackers, Taiwanese policymakers and programmers from the United States (the latter group developed the Pol.is system chosen to underpin vTaiwan's operational infrastructure). It was this specific alignment of Pol.is software with the political commitment from Taiwanese policymakers and civic hackers that opened up a creative possibility to imagine an algorithmic system for democratic empowerment.

Here I will focus on one issue covered on vTaiwan, the case of vTaiwan's facilitated discussion around the issue of the legalisation and regulation of the Uber platform in Taipei. In this instance, we see that instead of simply highlighting one view supported by the majority, machine learning algorithms made it possible for policymakers and participants to understand the issues from *multiple viewpoints*. Within the first day of public consultation, the “public opinion” on Uber was configured into four “opinion groups” which were identifiable with discrete interests of different Taiwanese “publics”: private taxi drivers, Uber drivers, government officials and service users. In each opinion group, comments about whether Uber should or should not be legalised were visualised. As the process went on, algorithms ended with the two groups—“anti” and “pro” Uber legalisation—and grouped their associated comments. This configuration should not just be read as “binary”; each opinion group (whether a majority or minority) contained multiple opinions which are important for policymakers to learn from. For example, Opinion Group A (see in Fig. 1) represented some variations within the anti-Uber perspective. Algorithms featured the comments (from Opinion Group A) which not only concerned Uber's potential risks to passengers and drivers but also urged the Taiwanese government to take action in regulating Uber as a transportation business (instead of a software company). Embedded within the policy-making process, different opinions were taken into account by policymakers in the legislation process.

What is intriguing about this story lies in how the coming-togethers and going-aways of Uber drivers, taxi drivers, algorithms, civic hackers, policymakers in Taipei City have disclosed the ability of vTaiwan system to concretise latent democratic potentialities in Taipei. Just as Taipei City gathered actors from various professionals and geographies for the democratic development of vTaiwan system via the g0v community, it continued to play a crucial role in further unpacking vTaiwan's democratic potentials by mobilising external groups (taxi drivers, Uber drivers and Taiwanese government officials). The key issue was not the output of vTaiwan per se but how this output was interpreted by Taiwanese policymakers and how the two main interest groups related to this interpretation. Thus, the output of the algorithmic system can only be grasped by looking at how it was interpreted and acted upon subsequently by a range of

external actors embedded in specific contexts. Focusing on greater transparency of the algorithmic operations themselves will tell us nothing about these subsequent processes.

After the online consultation was finished, the Taiwanese government held subsequent offline consultations on Uber legalisation and regulation. They used the data from the online consultation as a framework which was then presented to consultees for the purpose of making decisions. However, in doing this, their moderators essentially misrepresented the output of the online consultation. Specifically, they only publicly displayed the “consensus”—the opinions that were supported by the majority of vTaiwan participants—instead of representing different opinions from both majority and minority groups which had been configured by the vTaiwan algorithms. As a result, the Taiwanese government revised the relevant legislations on the basis of the single and majoritarian perspectives described from the offline consultation's mischaracterisation of the results of the online consultation. A decision was taken to mandate that Uber must follow the Taiwanese Highway Act 2017 and other public transport regulation, like any other taxi company. This meant Uber had to register as a taxi company, meaning Uber had to pay taxes to the local authorities and obtain insurance for its drivers and passengers (Ministry of Transportation and Communications 2017). This decision ended up sparking disagreement from both Uber drivers and taxi drivers. Uber drivers wanted to stall the Taiwanese government from enacting the revised legislation to negotiate a better deal; taxi drivers, however, wanted the government to immediately crack down on all illegal Uber drivers. To these ends, both Uber drivers and taxi drivers went on to organise separate protest marches in central Taipei starting from 2017.

The existence of these on-going urban protests—which developed via a chain of events stemming from the misrepresentation of the conclusions of online consultation—illuminates how algorithmic democracy is inextricably entwined with wider currents of urban politics. By giving voice to different opinion groups such as taxi and Uber drivers, it is the city of Taipei *as urban assemblage* which functions as a pivotal political place for gathering “different knowledges, voices and concerns” (McFarlane 2011b, p. 213) and in particular those who are minority or marginalised; vTaiwan and its decisions should be seen only as one part of this assemblage. It is the city of Taipei and its latent potentialities which can make those who were previously silenced and excluded by policymakers from decision-making processes—different voices and perspectives of Uber legalisation—visible. One could say that such political decisions have undermined the democratic potential of the vTaiwan system. Having said that, from the viewpoint of the urban assemblage, it can be said that the vTaiwan system, as embedded within the urban politics of Taipei, was able to

demonstrate and ensure a plural democracy by decanting dissent into urban protests.

To summarise, with the assemblage approach, algorithmic systems are not understood in terms of trying to penetrate their unscrutinised black-boxed nature. Rather, assemblage methodology shows an effective way to develop a knowledge of algorithmic systems as products of the city where alternative possibilities for reconstituting an algorithmic democracy: from the Sunflower Movement to the g0v community, from algorithmic configuration of multiple opinions to urban protests. In some ways, the methodology of urban assemblage, with its emphasis on rethinking the city (urbanism) being plural and possible (McFarlane 2011a, p. 220), gives a story, a context, and an alternative account of what is or can be made possible by algorithmic systems. This assemblage approach grounds the city as a methodological space for researchers to “work with the propensities and possibilities that algorithms embody, pushing the potentials of their arrangements beyond the decisive moment of the output” (Amoore 2020, p. 7).

5 Conclusion

This paper uses assemblage thinking to offer an alternative methodology for studying the phenomena of Urban AI, overcoming the methodological barriers set up by the assumption of algorithmic systems as black-boxed in critical algorithm studies. Instead, assemblage-based methodology provides two urban perspectives to study algorithmic technologies by focusing on: (1) how does the city – urban places, communities and politics – constitute algorithmic systems?; (2) how can these aspects of the city influence the potential of algorithmic systems to create different political possibilities through resistance, negotiation and democracy? Assemblage methodology addresses the important role of the city in unleashing what is or can be made possible with algorithmic systems. In doing so, this methodology hopes to create a *bridge* between critical algorithm studies and urban studies to rethink how we study algorithmic systems.

Assemblage methodology makes at least three contributions to the critical studies of algorithms. Firstly, assemblage methodology rethinks the agency of algorithmic systems as distributed across contextually-shaped human-algorithmic relationships embedded within urban infrastructures, communities and politics. That said, this methodological approach seeks to focus on how a given algorithmic system is constituted by an assemblage of shifting relationships between algorithms, data, citizen-users, policymakers, infrastructures and other actors in urban places.

Secondly, the assemblage methodology pushes current understanding of algorithmic technologies towards a focus on urban places and communities where alternative

potentials can open up new sites for democracy and resistance. Assemblage methodology draws our attention to focus on the vital role of the city (overlooked in critical algorithmic studies) where *new* or rearrangements of algorithmic-human relationships might emerge from communities via everyday practices (delivering, navigating, cycling, walking, searching) and can reconstitute what we mean by algorithmic systems. Such new arrangements of algorithmic systems can lead to new forms of resistance, negotiation and democracy. The case study of vTaiwan specifically shows how assemblage methodology works to emphasise the role of Taipei city—both as a community of civic hackers and as a place for democratic protests—in rethinking what an algorithmic system means in terms of democratic decision-making. In this sense, assemblage methodology prioritises the city as a space for enabling and discovering various potentials of Urban AI in practice. To be clear, this methodology is *not* intended to suggest specific practices to collect data about Urban AI assemblage but to flesh out a distinctive urban perspective to open up the current studies of algorithmic systems.

Thirdly, an important implication of this assemblage approach is that by not predefining the nature of an Urban AI application in advance, we can loosen the effect of disciplinary norms which predefine and specify researchers’ perspectives on algorithmic systems.⁵ Assemblage methodology, by seeing algorithmic technology as unfolding human-algorithmic relationships in urban places and beyond, avoids following a linear, simplified and human-centric approach to developing our knowledge of Urban AI phenomena. By doing so, the assemblage methodology intends to serve as a bridge allowing various researchers with different concerns to come together and explore what is or can be made possible by situating algorithmic systems via urban perspectives. It is through the city that allows us to openly follow, discern and differentiate the possible lines of flight of a given algorithmic technology.

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⁵ For example, see the division in defining what algorithms are between social science and computer science in Moats and Seaver (2019).

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References

- Amoore L (2013) *The politics of possibility: risk and security beyond probability*. Duke University Press, Durham and London
- Amoore L (2020) *Cloud ethics*. Duke University Press, Durham and London
- Ananny M, Crawford K (2018) Seeing without knowing: limitations of the transparency ideal and its application to algorithmic accountability. *New Media Soc* 20(3):973–989. <https://doi.org/10.1177/1461444816676645>
- Anderson B, McFarlane C (2011) Assemblage and geography. *Area* 43(2):124–127
- Anwar M, Graham M (2020) Hidden transcripts of the gig economy: labour agency and the new art of resistance among African gig workers. *Environ Plan A* 52(7):1269–1291. <https://doi.org/10.1177/0308518X19894584>
- Ash J, Kitchin R, Leszczynski A (2018) Digital turn, digital geographies? *Prog Hum Geogr* 42(1):25–43. <https://doi.org/10.1177/0309132516664800>
- Bennett J (2006) The agency of assemblages and the North American Blackout. *Polit Theol Public Relig Post-Secular World* 17(3):602–616. <https://doi.org/10.5422/fso/9780823226443.003.0031>
- Bissell D (2020) Affective platform urbanism: changing habits of digital on-demand consumption. *Geoforum* 115:02–110. <https://doi.org/10.1016/j.geoforum.2020.06.026>
- Blok A, Farías I (2016) *Urban cosmopolitics agencements, assemblies, atmospheres*. Routledge, Abington
- Bratton B (2020) AI urbanism: a design framework for governance, program, and platform cognition. *AI Soc*. <https://doi.org/10.1007/s00146-020-01121-9>
- Brenner N, Madden DJ, Wachsmuth D (2011) Assemblage urbanism and the challenges of critical urban theory. *City* 15(2):225–240. <https://doi.org/10.1080/13604813.2011.568717>
- Bucher T (2018) *If...then: algorithmic power and politics*. Oxford University Press, New York
- Cochrane A, Ward K (2012) Researching the geographies of policy mobility: confronting the methodological challenges. *Environ Plan A* 44(1):5–12. <https://doi.org/10.1068/a44176>
- Coletta C, Kitchin R (2017) Algorithmic governance: regulating the ‘heartbeat’ of a city using the Internet of Things. *Big Data Soc* 4(2):1–16. <https://doi.org/10.1177/2053951717742418>
- Crang M, Graham S (2007) Sentient cities ambient intelligence and the politics of urban space. *Inf Commun Soc* 10(6):789–817. <https://doi.org/10.1080/13691180701750991>
- Crawford K (2021) *Atlas of AI*. Yale University Press, New Haven and London
- Dalton CM (2020) Rhizomatic data assemblages: mapping new possibilities for urban housing data. *Urban Geogr* 41(8):1090–1108. <https://doi.org/10.1080/02723638.2019.1645553>
- Datta A (2015) New urban utopias of postcolonial India: “Entrepreneurial urbanization” in Dholera smart city. *Gujarat Dial Hum Geogr* 5(1):3–22. <https://doi.org/10.1177/2043820614565748>
- Deleuze G, Guattari F (1986) *A thousand plateaus*. University of Minnesota Press, Minneapolis and London
- Dovey K (2012) Informal urbanism and complex adaptive assemblage. *Int Dev Plan Rev* 34(4):349–367. <https://doi.org/10.3828/idpr.2012.23>
- Farías I, Bender T (2010) *Urban assemblages: how actor-network theory changes urban studies*. Routledge, Abingdon
- Fields D, Bissell D, Macrorie R (2020) Platform methods: studying platform urbanism outside the black box. *Urban Geogr* 41(3):462–468. <https://doi.org/10.1080/02723638.2020.1730642>
- Gandy M (2004) Rethinking urban metabolism: water, space and the modern city. *City* 8(3):363–379. <https://doi.org/10.1080/1360481042000313509>
- Graham S (2005) Software-sorted geographies. *Progress in Humran. Geography* 29(5):562–580
- Graham S (2010) When infrastructures fail. In: Stephen G (ed) *Disrupted cities*. Routledge, New York, pp 1–26
- Greenfield A (2013) *Against the smart city*. Do projects, New York
- Gregory K, Maldonado MP (2020) Delivering Edinburgh: uncovering the digital geography of platform labour in the city Delivering Edinburgh : uncovering the digital geography of platform labour in the city. *Inf Commun Soc* 23(8):1187–1202. <https://doi.org/10.1080/1369118X.2020.1748087>
- Ho MS (2018) From mobilization to improvisation: the lessons from Taiwan’s 2014 sunflower movement. *Soc Mov Stud* 17(2):189–202. <https://doi.org/10.1080/14742837.2017.1377603>
- Ho MS (2019) Comment: why was the sunflower movement successful? *J East Asian Stud* 19: 309–311. <https://doi.org/10.1017/jea.2019.31>
- Ministry of Transportation and Communications (2017) Impose legal regulation on Uber. https://www.motc.gov.tw/ch/home.jsp?id=14&parentpath=0%2C2&mcustomize=news_view.jsp&dataserno=201702100004&aplistdn=ou=data,ou=news,ou=chinese,ou=ap_root,o=motc,c=tw&toolsflag=Y&imgfolder=img%2Fstandard. Accessed 10 Oct 2020
- Kaika M (2005) *City of flows: modernity, nature and the city*. Routledge, New York
- Kinsley S (2014) The matter of “virtual” geographies. *Prog Hum Geogr* 38(3):364–384. <https://doi.org/10.1177/0309132513506270>
- Kitchin R (2017) Thinking critically about and researching algorithms. *J Inform Commun Soc* 20(1):14–29. <https://doi.org/10.1080/1369118X.2016.1154087>
- Kitchin R, Dodge M (2011) *Code/space*. The MIT Press, London
- Leszczynski A (2019) Glitchy vignettes of platform urbanism. *Environ Plan D Soc Space* 38(2):189–208. <https://doi.org/10.1177/0263775819856626>
- Luque-Ayala A, Marvin S (2015) Developing a critical understanding of smart urbanism? *Urban Stud* 52(12):2105–2116. <https://doi.org/10.1177/0042098015577319>
- Luque-Ayala A, Marvin S (2020) *Urban operating systems*. The MIT Press, Cambridge and London
- Luusua A, Ylipulli J (2020) Artificial intelligence and risk in design. In: *Proceedings of the 2020 ACM designing interactive systems conference July 2020*, pp 1235–1244. <https://doi.org/10.1145/3357236.3395491>
- McCann E, Ward K (2011) *Mobile urbanism: cities and policymaking in the global age*. University of Minnesota Press, Minneapolis
- McCann E, Ward K (2012) Assembling urbanism: following policies and “studying through” the sites and situations of policy making. *Environ Plan A* 44(1):42–51. <https://doi.org/10.1068/a44178>
- McFarlane C (2011a) Assemblage and critical urbanism. *City* 15(2):204–224. <https://doi.org/10.1080/13604813.2011.568715>
- McFarlane C (2011b) *Learning the city: knowledge and translocal assemblage*. Wiley-Blackwell, Oxford
- McFarlane C (2011c) Encountering, describing and transforming urbanism. *City* 15(6):731–739. <https://doi.org/10.1080/13604813.2011.632901>
- McFarlane C, Söderström O (2017) On alternative smart cities: from a technology-intensive to a knowledge-intensive smart urbanism. *City* 21(3–4):312–328. <https://doi.org/10.1080/13604813.2017.1327166>

- Moats D, Seaver N (2019) “You social scientists love mind games”: experimenting in the “divide” between data science and critical algorithm studies. *Big Data Soc* 6(1):1–11. <https://doi.org/10.1177/2053951719833404>
- Müller M (2015) Assemblages and actor-networks: rethinking socio-material power, politics and space. *Geogr Compass* 9(1):27–41. <https://doi.org/10.1111/gec3.12192>
- O’Flaherty K (2018) Taiwan’s revolutionary hackers are forking the government, *Wired*. Available at: <https://www.wired.co.uk/article/taiwan-sunflower-revolution-audrey-tang-g0v>. Accessed 1 Sep 2019
- Pariser E (2011) *The filter bubble: what the internet is hiding from you*. The Penguin Books, New York and London
- Pasquale F (2015) *The black box society*. Harvard University Press, Cambridge and London
- Seaver N (2017) Algorithms as culture: some tactics for the ethnography of algorithmic systems. *Big Data Soc* 4(2):1–12. <https://doi.org/10.1177/2053951717738104>
- Shelton T, Zook M, Wiig A (2015) The ‘actually existing smart city.’ *Camb J Reg Econ Soc* 8:13–25. <https://doi.org/10.1093/cjres/rsu026>
- Shepard M (2011) *Sentient city*. The MIT Press, Hong Kong
- Simone A (2011) The surfacing of urban life. *City* 15(3–4):355–364. <https://doi.org/10.1080/13604813.2011.595108>
- Tonkiss F (2011) Template urbanism. *City* 15(5):584–588. <https://doi.org/10.1080/13604813.2011.609026>
- Tseng Y (2021) Doing ethnography with a dual positionality: experiences in Spanish and Taiwanese governmental institutions. In: Ajebon MO et al (eds) *Navigating the field*. Springer, Switzerland, pp 91–100

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