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Overcoming Embedded Logics in Data

Requisite Imagination and Authorship in the Process of Mapping

Anthony Vanky

Introduction

"The variables are many, but they are not helter-skelter; they are interrelated into an organic whole," remarked urbanist Jane Jacobs about Hudson Street in 1960s Manhattan (Jacobs, 1969). Today, this observation holds true for any street in any city. But unlike Jacobs' era, when such insights were built through long hours of embodied observation, we now possess powerful digital tools to sense, record, and analyse these "interrelated variables" at unprecedented scale (Kitchin, 2014). The proliferation of locative technologies, environmental sensors, and open urban data has ushered in a new paradigm—one in which the everyday rhythms of the city are not just experienced, but rendered into data. Yet even as this datafication promises deeper insight into urban life, it also raises critical questions about who authors that data, through what ontological frameworks, and to what end.

This chapter investigates the evolving power of digital mapping as a method of urbanist inquiry—one that goes beyond visualisation to engage directly with questions of epistemology, representation, and justice. As landscape architect James Corner has written, mapping "unfolds potential; it re-makes territory over and over again, each time with new and diverse consequences" (Corner, 1999, p. 214). This generative potential is amplified in the digital context, where mapping can incorporate not only layered datasets but also new forms of participation, agency, and narrative. When embedded in practices that foreground data authorship—where residents are not merely observed, but contribute to how data is produced, framed, and interpreted—mapping becomes a powerful mode of re-seeing the city. It allows urbanists to challenge inherited ontologies and reframe what is knowable about space: not just where infrastructure lies, but how it is lived through, negotiated, and contested.

Integrating digital mapping and data authorship into urbanist practice opens new methodological and political terrain. Rather than accepting the ontological constraints of legacy datasets, urban researchers and planners can engage in practices of intentional sensing, participatory enumeration, and narrative spatialisation— producing maps that reflect the granular, embodied realities of urban life (Corburn, 2003). These methods challenge the false objectivity of generalised data and open up room for partial perspectives (Haraway, 1988), experiential heuristics, and localised knowledges to enter the domain of formal urban analysis (So, 2024). In doing so, digital mapping is reframed not as a neutral act of representation but as a co-constructed epistemic practice—one that holds the potential

to surface inequities, question normative assumptions, and imagine more just urban futures. This chapter explores how such mappings are made, what they reveal, and how they might reorient urbanism towards a more inclusive politics of space.

Data, Data Everywhere

Urban researchers now find themselves swimming in data—GPS traces, transit logs, Wi-Fi pings, pollution sensors, social media posts, building management logs, and countless more digital residues of everyday life. This abundance promises clarity: to map the pulse of the city in real time, to identify hidden patterns, to model and forecast urban systems with unprecedented precision. Yet with every new dataset, we are reminded that data alone does not confer understanding. Much like water in Coleridge's mariner's tale, the sheer volume of digital traces belies their analytical dryness. Data is not neutral; it is shaped by the systems that produce it, the assumptions that govern its collection, and the architectures that constrain its use (Kitchin, 2014). This raises the core dilemma of the digital urbanist moment: not whether we have enough data, but whether we are asking the right questions of it, and whether our tools and epistemologies are up to the task (Vanky, 2016).

Mapping offers one such tool—a means not just to depict spatial data, but to interrogate and remake the categories through which urban knowledge is produced. As Nabian et al. note, the challenge is not simply access, but *translation: to move from availability to legibility, from signal to meaning* (Nabian et al., 2013). Visualisation, in this sense, is not the endpoint of analysis but a method of inquiry in itself—a way to make data question-driven rather than answer-oriented (Vanky, 2016). When layered across different temporalities, scales, and sources, mapping becomes a site of interpretive richness, where unexpected patterns can emerge and new hypotheses can form. Yet the practice of digital mapping remains tethered to the nature of its inputs—structured either by the opportunism of residual system data or by more deliberate acts of intentional sensing. The sections that follow explore these two orientations: one that works within the limits of inherited traces, and one that reclaims authorship over what is sensed, how it is framed, and for whom it is made visible.

Opportunistic Uses of Data

The opportunistic use of data refers to the appropriation of digital traces that were generated for purposes unrelated to research, what Nabian et al. (2013) describe as "data created as a service to ease use of the site" (p. 66), now recontextualised for new forms of analysis and meaning-making. In urban research, this often means working with data that arises as a by-product of digitally mediated systems: the residual trails from apps, devices, and platforms that structure daily life. Location histories from mobile phones, sensor logs from connected devices, and user interactions on mapping or mobility platforms all offer glimpses into the rhythms of urban activity. They can be illuminating,

pointing to collective behaviours that unfold at a scale or frequency beyond the reach of traditional methods. But they also carry forward the values, assumptions, and ontological framings of the systems that produced them.

These inherited framings rarely align with the questions urbanism is trying to ask. The data is often structured around operational priorities—efficiency, optimisation, monetisation, functionality—not around lived experience or spatial justice. What gets recorded, and how, is shaped by logics that often go unexamined. Metrics are pre-defined, categories are pre-baked, and populations are pre-filtered, leaving behind a form of evidence that demands significant interpretation before it can speak to urbanist concerns. In mapping, this is particularly fraught. The layering of opportunistic datasets can give the illusion of completeness, but in practice, these maps may reify the limitations of the underlying data. They risk naturalising absences and amplifying what is already over-represented. And unless we are deliberate, the mapping process can become complicit in reproducing the very blind spots we aim to contest.

Working with opportunistic data, then, requires a kind of epistemic modesty—and a methodological imagination. We need to remain critical of the biases, heuristics, and ontologies baked into the datasets we use, even as we recognise their utility. But more than that, we must be willing to creatively reframe these traces. Rather than treating them as raw material to be cleaned and normalised, we can ask: *what was this data originally for? What does it miss? What might it be capable of showing if layered differently, or placed in conversation with other forms of knowledge?* This is where mapping becomes more than representation—it becomes an act of translation, of redescription. It becomes a site of methodological intervention, where we push against inherited logics and begin to articulate the categories, relations, and spatial questions that matter for urbanism today (Gabrys, 2014).

In this way, opportunistic data is not inherently flawed, but it is incomplete. And if we want our maps to reflect the kinds of urban futures we imagine—more just, more inclusive, more attuned to the complexities of everyday life—we need to take seriously the work of reshaping the tools we inherit. This means designing with intention, attending to gaps, and making space for new forms of data authorship. It also means mapping not just what the data shows, but what it leaves out—and finding ways to tell that story too (D'Ignazio and Klein, 2020).

Shifting the Gaze: Revealing Patterns of Walking

The nexus of urban design and planning has increasingly depended upon advanced mapping methodologies and sophisticated analytical tools to interrogate pedestrian behaviour and infrastructural configurations. These instruments enable planners and policymakers to discern spatial patterns and correlations, revealing the complex interactions between walkability and urban form. By

methodically mapping pedestrian routes, amenities, and environmental characteristics, stakeholders can garner a nuanced understanding of the spatial determinants that influence walking activity. Consequently, such insights are instrumental in guiding strategic transformations of urban environments, promoting active transportation and enhancing public health through targeted improvements in infrastructure, pedestrian facilities, and connectivity (Ewing and Cervero, 2010).

Incorporating mobile data affords a comprehensive, high-resolution dataset that captures individual mobility patterns in various urban milieus, thereby allowing an in-depth examination of human–environment interactions. This data serves as a cornerstone for developing aggregate models to scrutinise the relationship between built environment characteristics and pedestrian behaviour, providing unprecedented opportunities for analysing walkability in urban contexts. Yet its power must be understood with care: mobility traces reflect not only movement, but also the systems through which movement is rendered legible, often embedding operational logics rather than experiential ones. The very conditions of availability—what can be known through this data—are shaped by platform constraints, detection thresholds, and the implicit spatial heuristics that define when a trip begins, ends, or matters.

The data used in this research primarily derives from a commercially available activity-oriented mobile application, which, with the users' explicit permission, shows the individual their physical walks in the city akin to a phone-based fitness tracker, which availed the opportunity to overcome the limitations of traditional survey-based methods for examining the relationship between the built environment and pedestrian behaviour. By utilising the device's motion co-processor and geolocation services, the application automatically records the timing and movements of the mobile device throughout the day. About half a million daytime walking trips from roughly 15,000 users were collected over the duration of a year in metropolitan Boston and San Francisco, USA. These cities were purposefully chosen due to the mix of land uses—from traditionally defined walkable centre cities to mid-density and suburban communities within the study area.

This passive data collection process enabled the documentation of everyday mobility in real-world contexts, offering a rare view into utilitarian walking behaviour across diverse geographies. Privacy was ensured throughout, with no biographical data collected; each user was assigned a unique anonymised ID, and 0–100 metres were subtracted from both trip start and end points to protect identifiable locations. The final dataset, composed of timestamped geolocated points and step counts, allowed for the derivation of velocity, trip chaining, and path regularity.

While this dataset inherits many of the same epistemological concerns as other forms of opportunistic or system-generated data, it also offers a site for reorientation. Rather than taking the data at face value, this project approaches it as a starting point—an index that must be recontextualised through urbanist sensibilities and human-scale questions. Mapping, here, becomes

not just an act of rendering movement visible, but of reframing what that movement means. The pivot lies in asking not only *where* people go, but *why*—and how those movements reflect, resist, or reshape the built environments around them.

This interpretive lens draws from an urban design tradition that understands space as both socially produced and behaviourally consequential. By situating the data within design- and planning-relevant frameworks, the analysis foregrounds patterns of use that are meaningful to questions of access, proximity, and spatial equity. Rather than simply describing behaviour, the mappings illuminate urban conditions—sidewalk continuity, land use diversity, street permeability—that either invite or discourage walking. The aim is not to model a predictive universal, but to uncover situated logics: where walking happens despite the odds, and where spatial affordances fail to activate pedestrian potential. In doing so, this work reclaims the dataset from its algorithmic origins and retools it towards more humanistic and place-based urban inquiry.



Figure 17.1. A day's worth of recorded walking trips in the city of Boston.
Image credit: MIT Senseable City Lab

Empirical findings from the study showed a significant relationship between built environment characteristics and their impact on walking and walkability. The results indicate that spatial and infrastructural elements profoundly influence pedestrian activity—but in often surprising and context-contingent ways. Infrastructure supportive of walking, like transportation accessibility and the availability of destinations such as shops, civic institutions, or commercial centres, correlated

positively with higher pedestrian volumes. Yet, at the micro-scale, architectural details and certain amenities—like benches or plantings—had less consistent associations with walking propensity. These findings point to the remarkable adaptability of pedestrians in navigating imperfect environments, but also suggest that walkability is not reducible to a checklist of interventions. It is relational, collective, and embedded within larger urban systems of connectivity and use.

This disconnect between what traditional urban design theory assumes and what the mapping reveals mirrors an oft-cited distinction between walkability as an abstract construct and walking as a practice rooted in choice, context, and constraint. As travel writer Bill Bryson once observed of Hanover, New Hampshire: "Nearly everyone in town is within a level 5-minute walk of the shops, and yet as far as I can tell virtually no one walks" (Bryson, 1999). Such anecdotes, when backed by data, underline the importance of not simply designing for proximity but understanding how people interpret, value, and act within urban form. The mappings, therefore, do more than quantify steps—they invite reflection on the ways urban design either aligns with or departs from the lived experiences of movement in the city.

Justice and Authorship

Urban data collection has long been defined by opportunism—repurposing data generated for system operations, billing, or logistics as proxies for understanding urban life. Yet, as this chapter demonstrates, the ontological frames embedded in such data limit their relevance for the core concerns of urbanism: lived experience, environmental risk, and human well-being. The innovation of *data authorship* lies in shifting from the retrospective use of inherited data to the prospective creation of data aligned with the granular questions urban planners must answer. Participatory sensing, as explored in this study, enables the crafting of datasets that foreground the spatial and physiological specificities of everyday life. In doing so, it refuses the abstraction of urban experience into averaged models and instead insists on fidelity to individual and community contexts—where a sidewalk, a bus stop, or a detour becomes materially consequential.

This redirection towards intentional, situated data production is not merely methodological—it is ethical. Justice in urban data practices requires addressing the long-standing exclusions and erasures that have rendered some communities legible only through deficit frames, if at all (Corburn, 2003). As environmental justice literature and the Justice40 initiative articulate, exposure to harm, such as poor air quality, is unevenly distributed along racial, spatial, and economic lines (Morello-Frosch et al., 2002). But these injustices are often invisibilised in conventional datasets that aggregate away variance or rely on static sensors far removed from human activity. By placing sensors on bodies and allowing participants to direct the questions being asked, this work asserts data not just as a

diagnostic tool but as a mode of political participation. Justice, then, emerges not only in the findings but in the act of authorship—who gets to define the problem, gather the evidence, and shape the narrative (D'Ignazio and Klein, 2020).

In this light, data authorship becomes a creative act that reclaims epistemic agency. The concept of the *data anecdote*, as advanced here, offers a methodological alternative that sits between the epistemological poles of big and small data. It allows for thick description at a personal scale while building a collective portrait that reflects not statistical abstraction but experiential truth. Rather than accepting the epistemic constraints of existing data infrastructures, this approach reconfigures what counts as knowledge and who counts as a knower (Haraway, 1988). By designing data around the real conditions and curiosities of city residents—not around the limitations of legacy systems—urban research becomes more attuned to the uneven geographies of the city and more capable of informing interventions that matter. To explore this reorientation, the study moved from working within the constraints of opportunistic data to designing a data practice rooted in intentionality, embodiment, and spatial specificity.

This shift was not merely technical—it was conceptual. Rather than allowing the architectures of pre-existing systems—be they logistical infrastructures, proprietary algorithms, or static environmental monitors—to dictate the terms of analysis, this work foregrounded the urbanist imperative: to understand space as lived, relational, and power-laden (Lefebvre, 1991). Mapping, in this view, is not simply an act of aggregation or representation; it is a proposition about what matters in the city. By centring how residents move through, experience, and contest urban environments, the project reframed sensing as a method of urban inquiry—one capable of revealing otherwise invisible dynamics of exposure, inequality, and adaptation.

This pivot required not just new tools but a new stance towards the data itself. The aim was not to reject opportunistic sources outright, but to move beyond their ontological limits by bringing them into conversation with human-scale narratives and design-relevant questions. In doing so, the project embraced a more generative and justice-oriented epistemology—one that treats the city not as a fixed geometry to be monitored, but as a contingent field of interactions to be interpreted. By embedding sensing within bodies, rhythms, and routines, and allowing research questions to be shaped by those experiencing the city most directly, mapping becomes a way of crafting knowledge that is both empirically grounded and socially situated (Haraway, 1988). The result is a form of spatial reasoning that not only diagnoses conditions but also points towards new urban possibilities.

Intentional sensing was framed not simply as data collection, but as a form of urban inquiry—one that deliberately sought to remap the city through the lens of embodied exposure (Gabrys, 2014). Unlike conventional environmental monitoring, which relies on sparsely located, stationary sensors that abstract urban space into aggregated zones, this approach followed participants as they moved

through their neighbourhoods, producing high-resolution traces of physiological and environmental data. The resulting maps were not passive outputs but authored artefacts—co-produced by residents and researchers to capture how space, time, and bodily activity intersect to shape environmental experience. These mappings visualised how air pollution exposure varied not just between neighbourhoods, but between individuals on the same street at different times, underscoring the insufficiency of conventional representations of environmental data.

The first pilot study, conducted during the New York City Marathon, served as both an extreme and instructive case. Two runners, outfitted with biometric wearables and portable air quality sensors, traversed the same 42-kilometre course across all five boroughs. This case was chosen as an extreme case; this day had the fewest cars and crossed the breadth of the city. Yet, their bodily exertions, physiological rhythms, and temporal position on the route yielded distinct exposure signatures—differences not attributable to location alone, but to how the city is lived and varied. Despite running the same route, the divergence in particulate exposure and respiratory strain revealed the need for a mapping practice that centres bodily mediation, rather than abstract geospatial overlay.



Figure 17.2. A study participant with a bodily-worn air quality sensor before the marathon.

The air quality varied block to block, reflecting the measurable spikes as runners crossed intersections and exposed themselves to the congestion blocks away, or transitioned into neighbourhoods with documented histories of environmental injustice. The marathon case, despite being an extreme case, revealed that mapping is not a neutral act of documentation, but a generative process of situating data in time, space, and body. As the runners moved, their sensors captured fluctuations in pollution that mirrored infrastructural and behavioural rhythms—crossing the Verrazzano Bridge into high-exposure zones, passing through the South Bronx's "Asthma Alley," or briefly catching reprieve in Central Park. These trajectories made visible the tension between movement and risk, exercise and harm, space and strain. The marathon's unique choreography—temporarily free of most vehicular traffic—ironically accentuated the presence of lingering pollutants and the unevenness of urban air. Conventional environmental sensors, by contrast, offered none of this resolution, missing both the peaks of inhaled exposure and the bodies experiencing them.

Yet what the marathon mapped in idealised motion, subsequent studies in everyday contexts expanded in depth and granularity. Participants in a second case study, drawn from neighbourhoods like Harlem and Washington Heights, carried sensors through daily life—commutes, errands, and moments of rest. Their data, co-constructed through wearables, self-reporting, and interviews, presented a textured picture of air quality shaped by infrastructure, architecture, and routine. Critically, participants were not just subjects but authors of the inquiry: their questions, discomforts, and intuitions guided what was measured and why. This co-constructed form of mapping reframed sensing as a civic act, one where community members reclaim interpretive power and assert the legitimacy of experiential knowledge in shaping urban narratives.



Figure 17.3. The New York City Marathon route runs through the five boroughs of the city and many neighbourhoods that were considered "Justice40 disadvantaged community" due to environmental justice concerns. New York air quality monitoring stations are also marked.

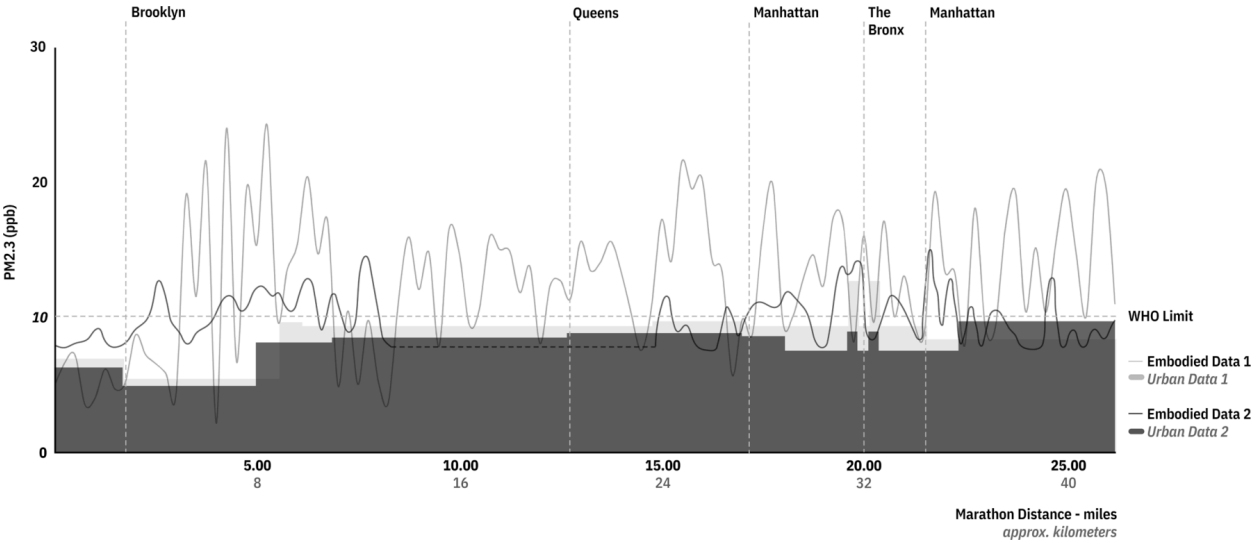


Figure 17.4. The air quality exposure of the participants along the marathon route.
Almost at no location was the runners' air exposure healthy, made worse by their heightened respiration. The values show heightened exposure at intersections, at which the government's sensing system could not read such spatial granularity.

Taken together, these cases point towards a broader redefinition of mapping— less as a tool for top-down surveillance or statistical generalisation, and more as a collaborative epistemological practice. By foregrounding partial perspective and embodied variation, intentional sensing unsettles the authority of inherited spatial categories and fixed ontologies (Haraway, 1988). It invites planners, designers, and citizens to ask not only what the map shows, but whose stories it tells, and whose remain hidden.

Conclusion

Mapping continues to hold immense power as a tool for shaping urban understanding and action—its ability to render complex conditions legible makes it indispensable for fostering more equitable dialogues around data. Yet this is both its promise and its vulnerability. The authority of mapped representations can sway public opinion, structure policy, and reframe entire urban imaginaries, often without adequately communicating the assumptions, uncertainties, or exclusions embedded in the data itself. As each new dataset or spatial layer promises a closer approximation of "reality," we must also confront the constructed nature of these representations and the ways they privilege certain ways of knowing while obscuring others. The work of mapping, in other words, is never purely technical—it is deeply epistemological and political.

Imperfect though it may be, the influence of data-driven mapping on urban decision-making is undeniable. Misguided models or reductive abstractions— such as those that shaped service provision in 1970s New York (Wallace and Wallace, 1998)—offer enduring cautionary tales about the risks of overconfidence in technical rationality. But these pitfalls should not dissuade us from engaging creatively and critically with data. Much like meteorological forecasts, which inform action despite their inherent uncertainties, urban mappings grounded in diverse epistemologies and plural authorship can become tools for navigating complex futures—not because they are flawless, but because they are situated, reflexive, and open to reinterpretation. Their value lies not in perfect prediction, but in their capacity to orient action amidst complexity and surface dynamics that demand new forms of collective attention.

Design, as Herbert Simon reminds us, is fundamentally about envisioning how the world might be (Simon, 1996). For urbanists, this imperative is not abstract— it is embedded in the decisions we make about methods, representation, and authorship. Each choice about how data is collected, structured, and visualised carries with it a latent theory of the city: who is visible, what is valued, and which futures are imaginable. The methodological turn towards participatory sensing, embodied data, and situated mapping is not simply a technical innovation—it is a political orientation towards justice (D'Ignazio and Klein, 2020). It acknowledges that the tools we use to understand the city also shape what kinds of interventions are possible. By designing data practices that foreground inclusion, narrative, and lived experience, we not only expand what we *know* about cities—we begin to design

towards the cities we *want*. In doing so, digital mapping becomes more than a representational device; it becomes a platform for collective visioning, a means of reclaiming spatial knowledge, and a step towards building more just, equitable urban futures.

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