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Situated, Yet Silent: Data Relations in Smart Street Furniture

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ABSTRACT

This article provides new evidence of the ways that smart cities materialize within specific sites and contexts through smart street furniture (SSF). Drawing on empirical data generated through mixed-method field research, the article examines the situated data relations that emerge in the context of the adoption of InLinkUK smart kiosks in Glasgow and Strawberry Energy smart benches in London. The concept of “silences” is proposed to analyze insufficiently articulated data relations resulting from gaps or absences in the use, design, and governance of this new type of urban furniture. The argument made is that data silences lead to failures to account for decisions and the deferral of responsibilities regarding the data aspects of these objects. It is suggested that an approach that focuses on “listening” to and “speaking” about data relations can enable dialogical forms of accountability, and realize the potential of SSF for citizens in local contexts.



KEYWORDS

data; smart street furniture (SSF); smart city; governance; Glasgow; London

Introduction

Smart cities have been imagined and planned for decades but have only recently started to materialize in urban environments (Hollands, 2008; Shelton et al., 2015; Karvonen et al., 2018; Joss et al., 2019). These instantiations combine services and technologies to create new types of infrastructures, and are being encountered by publics at street-level in new ways. One of these is through new types of digitally enhanced street furniture or “smart street furniture” (SSF). Equipped or retrofitted with sensors, wireless modules, and microcontrollers, SSF provides services ranging from Wi-Fi and charging points to data on air quality, noise level, or traffic conditions, and are anticipated to play a key role in smart cities (Nassar et al., 2019). SSF offers a window into how the smart city “lands” within specific sites and how it is actualized within existing urban planning and governance contexts.

This article examines the situated data relations that emerge in the rollout of SSF in Glasgow and London, and identifies a number of “silences.” Silences are defined as absences or gaps located in the data relations embedded in these new types of furniture in terms of their use, design and governance. This includes how different publics and

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end-users interact (or not) with SSF's data services and capabilities, the design and privacy policies of the furniture as well as their underlying governance structures and processes.

This article draws on two SSFs: InLinkUK's smart kiosks (known as "Links") deployed in Glasgow from June 2018 (Jackson, 2018); and Strawberry Energy's smart benches, first launched in London's Canary Wharf in October 2015 (Strawberry Energy, 2016). As a material technology, Links host a range of inbuilt sensors and three cameras (which were not activated at the time of installation), as well as two USB charging ports, and an emergency button, powered by mains electricity cemented in place (InLinkUK, 2019a). The Links offer users free access to Wi-Fi and telephone calls and various mapping and directory services via a touchscreen digital tablet, with the potential to offer more services at a later time. Each Link has two 135.7cm HD digital screens which support commercial advertisements (to pay for the free services) alongside other community and local content (InLinkUK, 2019b). By contrast, Strawberry Energy's solar-powered smart benches are fixed in place by only eight bolts, and can be moved if needed. Their inbuilt sensors collect real-time data on air quality, noise level, and temperature, which users can access via a downloadable mobile application (Strawberry Energy, n.d.a). The benches also offer free Wi-Fi and mobile device charging, and provide space to rest and socialize on the street even if smart features are not available.

In organizational terms, InLinkUK was a joint venture between Intersection (with investment from Alphabet Inc. owned by Sidewalk Labs) and the UK advertising agency Primesight, and in partnership with British Telecom (BT). In December 2019, the joint venture dissolved and the network of installed Links became fully owned by BT (Jackson, 2019). In July 2019, InLinkUK set out to replace over 1,000 payphones across the UK with Links, with 485 rolled out across 23 UK cities up to March 2020.¹ InLinkUK sought to integrate Links into the fabric of the city as permanent fixed-in-place features of an emerging smart infrastructure. The approach taken by Strawberry Energy differed, having adopted a more fluid and dynamic process to locating their technologies in urban space. A start-up company created in 2011, they have rolled out smart benches in cities across 23 countries,² but have done so with local authorities, through individual negotiations with planners (discussed below).

In their efforts to attract interest and support from local authorities, both companies emphasize the cost effectiveness of their products, whereby borough and city councils obtain public services and infrastructure while maintenance and upkeep are subsidized by commercial advertising revenue. This can be attractive to local authorities who, financially affected by a decade of austerity (Gray and Barford, 2018) and the recent coronavirus pandemic, often face an "infrastructural gap" (Dalakoglou, 2016). In the design and marketing of their products, InLinkUK and Strawberry Energy associate their products with smart cities: both represent their potential end-users as young, urban, and professional smartphone users in need of charging points or fast Internet access while on the go (Humphry et al., 2022). However, this conceptualization contrasts with the multiple ways in which a range of other groups use these devices (Halegoua, and Lingel, 2018).

The article proceeds by providing a review of relevant literature on the data aspects of smart cities, and an outline of our "silences" conceptual framework. It then lays out the

methodology of the research carried out and the data collected. This is followed by the findings section which examines the different silences that emerge from the smart kiosks and benches' data relations. The final sections provide an overarching discussion and conclusion with focus on policy and practice implications as well as recommendations for future research.

“Actually Existing” Smart Kiosks and Benches

In the past decade, numerous smart cities initiatives have flourished in the United Kingdom (Caprotti et al., 2016; Cowley et al., 2018). For Shelton et al., (2015: 15) these initiatives are not universally incorporated into existing cities, but are “assembled piecemeal, integrated awkwardly into existing configurations of urban governance and the built environment.” This often involves a reconfiguration of public–private partnerships (PPP) to develop, retrofit, implement, and regulate smart cities and data-driven initiatives at a local level. Addressing this, researchers have started to move away from placeless and homogeneous smart cities discourses to more situated and place sensitive accounts of “actually existing” smart cities and how they materialize in local settings (Shelton et al., 2015; Karvonen et al., 2018; Madsen, 2018).

SSF typically promotes a new, efficient, transparent and data-driven form of urban governance and management of cities (Kitchin, 2014a), and are put forward by private corporations such as Alphabet, Cisco, and IBM (Sadowski and Bendor, 2019). Smart cities and data-driven initiatives are inscribed in technocratic forms of governance and technological solutionism, and often feed into policy models that “see science and technology as panaceas for economic malaise” (Shelton et al., 2015: 16). They also provoke concerns about intensified surveillance and privacy infringements. Data in this context are extracted, aggregated, and analyzed using analytics and sold to third party companies, generating a new market invested in predictive analysis. In this way, users of smart technologies in urban environments become “data points,” providing a vast amount of fine-grained data in real time about their movements (through locative media apps or MAC address tracker fitted in SSF) or their browsing habits (through public Wi-Fi) (Cardullo and Kitchin, 2019). So far, it is the data harvesting dimension of smart kiosks that has received the most attention by academic and social commentary (see, for example, Muller, 2018).

More recently, smart cities' discourses have put citizens and communities at the center of their development and making (Joss et al., 2017; Cowley et al., 2018; Cardullo and Kitchin, 2019). However, this vision has largely remained unrealized with only limited citizen participation in existing smart cities' developments (Cardullo and Kitchin, 2019; Shelton and Lodato, 2019). This shifting rhetoric remains rooted in a conceptualization of citizens as primarily consumers and data points (see above) or entrepreneurs in market-led forms of participation, limiting civic and collective engagement (Joss et al., 2017; Cardullo and Kitchin, 2019). As citizens have become more central to the discourse of smart cities, the rationale for smart urban initiatives has focused on solving long-standing issues of unequal access to communication services. For city councils, the idea of a privately funded rollout of city-wide connectivity services is an attractive selling point, and compatible with their goals of digital and social inclusion (Baykurt, 2020; Wiig, 2016). At the same time, questions of the efficacy of these “technological

fixes” and whether private investors are well placed to address these needs, are raised alongside debates about the data processes underlying the connectivity they offer.

Glasgow has adopted an ambitious digital strategy (Digital Glasgow, 2018) and was awarded £24 million in 2013 as part of the United Kingdom’s Future Cities Demonstrator Program to make the city smarter, safer, and more sustainable.³ Glasgow is part of a Scottish cities’ network dedicated to accelerating and transforming the delivery of city services.⁴ This includes the continuation of “Future City Glasgow”⁵ initiatives including Open Data Glasgow or the rollout of a city dashboard. London has a long history of innovation and investing in infrastructures and smart cities technologies (Bibri, and Krogstie, 2020). Recently, the Mayor of London set out a roadmap to make London “the smartest city in the world”⁶ with each London Borough developing its own digital strategy (Lorimer, 2018). Southwark has undertaken work to identify priority areas for improved digital infrastructure in order to eliminate “not spots” and areas of low broadband speeds. To do so, the council aims to develop commercial partnerships to widen Wi-Fi provision and support the use of smart street assets such as smart benches and billboards (Southwark Council, 2016: 12–13).

Situating Data and Emerging Silences

Data is always situated, creating what Kitchin (2014b: 24) described as “data assemblages,” composed of different “apparatuses and elements that are thoroughly entwined, and develop and mutate over time and space.” Different data assemblages or relations also characterize SSF, for example in their designs and the infrastructures in which they are embedded, in users’ and the publics’ interactions with them, and in their governance. However, these data relations are often invisible to citizens. This invisibility is generated by processes of “blackboxing” (e.g., algorithms), concealment (e.g., sensors embedded in infrastructures), and also by habitual use (Varnelis, 2008; Parks and Starosielski, 2015; Pasquale, 2015). Data processes, similarly to infrastructures, often only become visible when they fail or break down (Star, 1999; Parks and Starosielski, 2015).

The concept of visibility has been extensively mobilized by media, and urban and STS scholars (see Bucher, 2012; Parks and Starosielski, 2015; Hatuka and Toch, 2017; Halegoua and Lingel, 2018), providing crucial insights into the politics and power relations underlying digital infrastructures and platforms. This includes how infrastructures and data processes are made visible, what elements are blackboxed or obscured, and how this shapes users’ engagement. Visibility is also often connected to ideals of transparency (Teurlings and Stauff, 2014). However, visibility and transparency as conceptual tools have limitations in relation to blackboxing, data, and algorithms particularly with regard to goals of improving accountability and responsibility (Ananny and Crawford, 2018). From this perspective, transparency risks privileging “seeing over understanding” while putting responsibility onto individuals and minimizing regulation (Ananny and Crawford, 2018: 979–981).

O’Donnell et al. (2009) provide a useful alternative and argue that the concept of listening can help to reframe “media theory and practice in relation to questions of difference and inequality” (2009: 423). It offers a complementary approach to the politics of representation with a stronger emphasis on interaction and dialogue. Listening is interwoven with the politics of voice (Couldry, 2009; Lawy, 2017). As Couldry pointed out “it

is through the process of listening that the value of voice is mutually registered between us” (2009: 580). In other words, the power relationships between who speaks and who listens affect the ability for voices to be heard and acted upon. Such approach, which sheds light on power and interactions, allows deeper insights where “silence and silencing take on new meanings; [and] misinterpretation and dissonance move to the forefront of our concerns” (O’Donnell et al., 2009: 423).

Following on from this literature, we argue that the concept of “silences” and its correlates “listening” and “speaking” shed new light on SSF’s data relations and help foreground interactions and power structures shaping these relations. We define silences as absences or gaps located in the different types of data relations embedded in SSF. We contend that the concept of “silence” provides an understanding of the processes of obscuring and blackboxing as well as the risks associated with modular designs in urban contexts. Importantly, it adds to existing frameworks that rely on metaphors of “seeing” and “representing” by pointing to the need for more explicit articulation and discussion of data and its governance. Silences can be intentional, through for example taking minimal responsibility for data protection but can also result from omissions and absences such as a lack of public data literacy, inaccurate or unreliable data, confusion about where accountability for data lies, and data risks that arise with new features or services added to original designs. Thus, we understand SSF’s data relations as dialogic processes of “listening” and “speaking” (or lack thereof) between different stakeholders (e.g., providers, local authorities, urban planners, and citizens) and within which, crucially, silences can emerge.

In the case of the SSF examined here, we posit that silences in data relations manifest themselves across three domains: (1) users and publics; (2) design; and (3) governance, as summarized in Table 1. Silences in our research were first found in the degrees to which different publics were engaging (or not) with SSF (domain 1). Indeed, the data services offered by SSF did not fully speak to users and publics who, when presented with the devices, did not necessarily recognize their smart functions, nor the ways in which data were collected through the furniture. This created silences surrounding SSF’s data services and collection. They were compounded by a lack of data knowledge required to use and actively engage with this new type of furniture. Secondly, data-related silences were found to be built into the furniture’s design and in their privacy policies (domain 2). This included omissions or a lack of clarity on behalf of the SSF companies, in particular in the case of InLinkUK, to explain how data are captured, aggregated, shared and used. Silences also arose concerning the veracity and accuracy of the environmental sensors in the benches, as well as a lack of articulation regarding the furniture’s future data capabilities embedded in their modular designs. Finally, we observed silences in the data governance arrangement underlying SSF (domain 3). This relates to the ownership and

Table 1. Analytical framework of data-related silences across three domains of interaction with smart kiosks and benches

Data Silence 1 <i>Users & Publics</i>	Data Silence 2 <i>Furniture</i>	Data Silence 3 <i>Governance</i>
Data Services & Offering	Data Capture, Aggregation, Sharing & Use	Data Ownership & Regulation
Data Collection	Data Veracity & Reliability	Data Stewardship
Data Knowledge & Literacy	Future Data Capabilities	Data Use

regulation of data in the planning process, as well as the stewardship and use of the data generated once the kiosks and benches were rolled-out in specific urban and governance contexts. We argue that these different silences point to missed opportunities for both “listening” and “speaking” and, thus, reveal unattended reciprocal interactions and power asymmetries in the situated data relations of SSF.

Methodology

This article draws on qualitative data collected as part of a research project⁷ which examined and compared InLinkUK kiosks in Glasgow and Strawberry Energy benches in London *in situ* at the street level and within local governance contexts (Wessels et al., 2020). We conducted 75 street vox pop interviews, also known as “person-on-the-street interviews” (Beckers, 2019) with passers-by and users. This involved short 5–10-minute interactions to gather insights on their initial impressions and lived use rather than in-depth reflections (Mason and Davies, 2011). We paired vox pops with *in situ* observations of three kiosks and three smart benches (See Table 2), as well as six semi-structured interviews with local stakeholders including representatives from local authorities in London and representatives of InLinkUK and Strawberry Energy. We also conducted a documentary analysis of material made publicly available by both companies including privacy policy, terms of use, device specifications, press kits, blog posts, and material amassed on their websites.

InLinkUK rolled out its kiosks in Glasgow City Center which has a population of approximately 20,000 people.⁸ While having a relatively moderate population density, the city center is highly urbanized and the biggest shopping destination in the UK outside London.⁹ The first kiosk we selected (See Figure 1) is located at the low end of Buchanan Street, a busy pedestrian commercial street with an upmarket range of shops and near St Enoch’s high-end shopping mall. The site is also near the main train station and St Enoch subway station. The second kiosk is situated at the intersection of Hope Street and Bothwell Street, two one-way traffic streets close to transport connections (buses, trains, taxi rack). This area of the city is populated with offices as well as

Table 2. Observations and vox pops conducted in each site at the beginning of July 2019

Sites	Observations	Vox Pops
GLASGOW		
Kiosk 1 <i>Buchanan Street</i>	Saturday: (a) 10.30am – noon; (b) 2pm – 3.30pm	10
Kiosk 2 <i>Hope Street</i>	Tuesday: (a) 8.30am – 9.30am; (b) noon – 1pm; (c) 4.30pm – 5.30pm	11
Kiosk 3 <i>Sauchiehall Street</i>	Thursday: (a) 10am – 11.30am; (b) 1.30pm – 3.30pm	9
LONDON		
Bench 1 <i>Great Suffolk Street</i>	Wednesday: (a) 10am – 11am; (b) 12.30pm – 1.30pm; (c) 5pm – 6pm	15
	Thursday: (d) 9am – 10am	
	Saturday: (e) 11.30am – 1.30pm	
Bench 2 <i>Borough Road</i>	Wednesday: (a) 10am – 11am; (b) 12.30pm – 1.30pm; (c) 5pm – 6pm	16
	Thursday: (d) 5pm – 6pm	
Bench 3 <i>Elephant and Castle</i>	Wednesday: (a) 10am – 11am; (b) 12.30pm – 1.30pm; (c) 5pm – 6pm	14
	Thursday: (d) 12.30pm – 1.30pm	
	Saturday: (e) 11.30am – 1.30pm	



Figure 1. InLinkUK kiosk on Buchanan Street, Glasgow

takeaways and restaurant outlets. Kiosk 3 is located on Sauchiehall Street, a pedestrianized shopping street with a range of high street retailers and other commercial outlets.

Southwark is a diverse and densely populated borough located in South London with a population of over 314,000 people.¹⁰ The research was conducted within the borough's areas of Elephant and Castle, and Newington. Bench 1 is located along Great Suffolk Street (See [Figure 2](#)), outside a small supermarket, and sets back into the precinct of a



Figure 2. Strawberry Energy's Smart Bench (version 1) on Great Suffolk, Southwark, London

former postal sorting office at the corner of three main roads. Bench 2 is located along Borough Road, near the intersection of two main roads. The bench is within 100 meters of a Link kiosk, and situated outside an entrance to a higher educational

center, with offices nearby. Bench 3 is located on Elephant Road, at close proximity to the underground station and along a side street housing small businesses ranging from couriers to cafes and eateries.

Vox pops and observations were carried out in the vicinity of each site during the first week of July 2019 (See Table 2). Observations allowed us to capture each SSF within their contexts while gaining situated insights into the patterns of interactions and use (or lack thereof). The team systematically tested and recorded the different features of each SSF including registration, Wi-Fi access; battery charging; mapping and directory services, and access to environmental data. Vox pops provided insights into public awareness, perceptions, and use of SSF as well as of their embedded data processes. Interviews with local stakeholders focused on the vision and strategy behind the adoption of SSF, their perceived benefits and disadvantages, and the governance arrangements underlying their implementation.

All interviews were audio recorded and transcribed verbatim while observations were typed up. All research material was coded using NVivo, so as to identify emerging themes, cluster them into categories and develop a coding framework across all datasets. The coding framework was based on a review of relevant literature and an initial analysis of emerging themes conducted after the fieldwork. Individual team members then systematically coded a sample of interviews, vox pops and observations across research sites. Subsequently, the coding framework was refined by merging duplicate codes, discussing emerging nodes and codes, and ensuring there was consistency across all datasets.

The sampling of vox pops was dependent on people walking by and/or using the smart kiosks and benches at the time of the fieldwork. To achieve a good mix, locations were selected from different urban contexts and studied at a range of time periods during the week and at the weekend to widen as much as possible our sample. While many interviewees had not themselves used the kiosks or benches, we did observe the SSF in use, and spoke to some who had used them and listened to stories of use recounted by others. We noticed that the free Wi-Fi available from these services and telephone service in the Links were mostly used by people living “rough” (i.e., homeless), young people, and gig economy workers whom we saw making phone calls and recharging their mobile handsets. The Strawberry Energy benches had the added benefit of being a place to sit and rest, and were used this way by a wider range of people.

Findings

Silences at the Level of the Users and Publics: Data Perspectives, Practices, and Knowledge

From the perspectives of users and publics, we identified three kinds of silences: the first related to the data offering and services embedded in the kiosks and benches; the second to data collection; and the third to data knowledge (or lack thereof). Our observations in both Glasgow and London suggest the smart benches and kiosks were already mundane; integrated into the streetscape and largely ignored by the public:

At 8:30am the traffic is noisy, and there is heavy pedestrian traffic ... None of the passers-by seems to notice or look at the InLink, unless to avoid it as they walk past. (Observation of the Link kiosk, corner of Hope and Bothwell Sts, Glasgow)

The muted public response captured in the observations started to give way as passersby were engaged in vox pops and provided with opportunities to encounter and discover these objects *in situ*. In contrast to the wide media coverage of the Link kiosks in New York City following their rollout in 2016 that put these in the public spotlight, there had been relatively little reportage of the InLinkUK kiosks. Members of the public we interviewed often relied on our prompting about the smart functionalities of the kiosks and benches to develop an awareness of these:

Interviewer: Have you noticed these InLink kiosks before in the city?

Respondent: No.

Interviewer: So now that you can see one, what is your first impression?

Respondent: It just looks like a signpost, like a map and it's non-offensive, doesn't stick out really. Um yeah.

Interviewer: Yeah? Do you know how to use them or do you know what they do?

Respondent: Um I'm guessing it emits a Wi-Fi signal and I have the option to er connect with my phone. (Hope Street, July 2, vox pop 8)

When prompted, many users speculated on the functions and utility of the designs:

Interviewer: It's a so-called Smart Bench, as it says on the label. So what do you think a Smart Bench does?

Respondent: Um maybe it has, you can say where you're wanting to go and it'll give you a map? I don't suppose it monitors your heartbeat does it? ... or see if you're going to have a heart attack! [laughs] (Borough Road, July 3, vox pop 6)

Members of the public had a low level of awareness of the range of information and data services offered by the SSF, particularly the InLinkUK kiosk interactive services accessible via the touchscreen tablet and the smart benches' air quality data offered via a mobile app (Chesher et al., [forthcoming](#)). The SSF observed, thus, remained mostly silent to (potential) users about their information- and data-related functionalities, especially concerning personal data that users generate when interacting with these objects as well as technical and environmental data generated through built-in sensors and connected devices.

In contrast to the general public, who tended to know little about the kiosks and benches until these were pointed out to them, a smaller subset—those with greater needs for Internet access and charging facilities such as the homeless, gig workers, and students—were likely to use and know about the features of the SSF. This was particularly the case for the free access services (Wi-Fi, charging facilities, and telephone) that allowed them to stay connected. Notably, while more savvy about these aspects of the SSF, this knowledge did not extend to their data collection aspects.

Vox pop participants generally accepted the SSF's data harvesting practices and few voiced concerns about the risks that data collection posed for them personally. Some

accepted that data collection was a tradeoff to access free Wi-Fi or thought that data collected about users was harmless:

Um any data you're putting in there's going to be fairly harmless, isn't it, it's nothing personal, nothing sensitive so yeah, it's absolutely fine. (Hope Street, 2 July, vox pop 4)

People we spoke to found it difficult to identify and articulate specific concerns, given so many platforms and points of data, making it difficult to grasp what data was collected, for what purpose and whether it was secure:

Well what is it [data] being used for? Is it being used for marketing purposes, is it being used for safety, security, what is it being used for? So these are the only concerns I have. (Sauchiehall Street, 4 July, vox pop 2)

I've got no idea about this. I have got no idea if it's secure or not, no. No idea. (Borough Road, 3 July, vox pop 3)

Rather than a lack of concern and resignation, these public responses suggest a silencing effect around the possibility of knowing in any real sense the type, source and purpose of data collected and thus assessing it in any meaningful way. Researchers were also notably hindered in their efforts to understand SSF's data relations with minimal documentation available on the specific data points and uses, as further discussed below. These data silences are significant, insofar as they point to the spaces for action and kinds of knowledge that are required to have a fuller understanding of SSF data risks and safety practices.

Another barrier to developing effective data practices is that users were not always aware of their connection to the Wi-Fi service provided by the SSF. There are three kinds of gaps responsible for this. First, there are literacies and skills needed to be able to check a Wi-Fi connection and the network they are connected to, which users may lack. Second, it can be confusing to identify the active network since this will default to the first connection made by a passing device as shown in the excerpt below:

Respondent: I might be or I might be on data, it depends because sometimes if I'm passing by and it's a Wi-Fi thing that I don't know and hasn't logged me in, I'll just have the data instead so that I can get any messages or whatever. (Sauchiehall Street, 4 July, vox pop 4)

Third, and related to this, is the automatic passing off of one Wi-Fi connection to another. Links are designed not so much as standalone units but as a wider network. In line with their key promise to provide “free, super-fast Wi-Fi” and connect local communities, the InLinkUK Wi-Fi network provides a seamless sense of connectivity as users move about the city (InLinkUK, 2019a). Users are not prompted or reminded of when and to what network they are connected. Indeed, they are encouraged to “set and forget.” This raises important questions in relation to how necessary it is to have users' awareness of when their devices connect to SSF to ensure informed consent to share their data, and what this awareness should cover.

Public perceptions and data practices of users of the smart benches/kiosks were largely driven by what remained unknown or guessed about the data services offered, as well as the status of the data belonging to users and their mobile devices. These perceptions and practices did not necessarily stem from people's passivity towards SSF's data offering or the acceptance of data collection. Rather, they were understandable responses to the

absence of information about the data and network arrangements and related limits of user-agency, alongside skills and knowledge requirements to use SSF.

Silences at the Level of Design: Data Capture, Veracity, and Future Capabilities

Data silences were also found to be embodied within the design of the furniture and their privacy policies. These were related to omissions or lack of clarity, in particular concerning InLinkUK, to explain how data is captured, aggregated, shared, and used. In addition to these more expected forms of blackboxing and obfuscation, silences also surrounded the veracity and accuracy of the data generated by environmental sensors in the benches; as well as the furniture's future data capabilities.

According to InLinkUK's privacy notice, the company could collect, use, store, and transfer personal data including username, first name and last name, email address, and social media identifiers. It also amassed service and technical data such as URL requests, IP addresses, MAC addresses, browser plug-in types, operating system, device type, information about date, time, and duration of Wi-Fi connection as well as the location of the Links providing that connection (InLinkUK, 2018). The company grants itself the right to share data with Intersection, their affiliates, third-party providers, and service providers on the understanding that these might be based in "countries where data protection and privacy regulations may not offer the same level of protection as in the EU" (InLinkUK, 2018: n.p.). While providing us with *some* information about the data they collect, InLinkUK's actual data sharing and use remain unclear. The Privacy Notice also varies from that of LinkNYC in New York City, which was updated in March, 2017 in response to concerns raised by the New York Civil Liberties Union (Buttar and Kalia, 2017). Strawberry Energy also collects data including email address, username, MAC address, IP address, and device model (Strawberry Energy, n.d.a.). The company has clear policies about data transfer and sharing, stating in their privacy policy that data is stored on servers located in Belgium and that personal data will not be sold or shared with any third party (Strawberry Energy, n.d.a.).

Strawberry Energy makes accessible real-time environmental data collected from each of its smart benches to users via a mobile application. This includes data on temperature, air humidity, noise level, air pollutants (CO, NO₂, O₃, SO₂, N₂S), and air pressure, humidity and temperature. During our site observations we discovered problems concerning data accuracy and reliability. For example, one of the benches recorded an ambient temperature of 8.7°C and air pollution at 0.36 ppm CO₂ which was in discrepancy with the Met Office data for the same location on that day (i.e. 25°C, 711 ppm CO₂). Across the three benches observed (different days and times), a majority of environmental data seemed inaccurate. When asked about it, the CEO of Strawberry Energy explained that the reiterations of their bench designs meant that older models may have less accurate data than new ones due to airflow over the components. He highlighted the challenges faced by the company which "cannot finance the super-high level accuracy because that's like £80,000 per unit" (Interview with CEO of Strawberry Energy, 27, September, 2019, hereafter Interview 1). As a trade-off, the company aims to provide "[data] precision that can be beneficial for the size of the coverage [with] good enough accuracy" (Interview 1). However, this compromise and how it may affect data veracity and reliability are not clearly stated to end-users as well as local authorities. Strawberry

Energy shares aggregated local data, via a dashboard, with local authorities or local owners of the land where benches are installed (Strawberry Energy, n.d.b). The related promise is to capture “air quality down to individual street level” and provide local authorities with “hyper-local” data to complement current city sensor systems (Strawberry Energy, 2017: 35). However, the lack of calibration as well as issues of data veracity and reliability may limit collaboration between the company and local authorities as highlighted below:

We have access to the dashboard, we're in discussion with Strawberry because some of the data we're not sure it matches ours, so we want to find out why. So perhaps it's a calibration thing, we're not quite sure ... once we've sorted out the calibration issues then we'll be using it to guide people around the borough, say, this area is less polluted, walk this way, that sort of thing. (Interview with Southwark's highways licensing and enforcement manager, 11 October, 2019, hereafter Interview 2)

In short, variability in component quality between bench designs, and compromises made between production cost and data accuracy, can undermine the potential of the (environmental) data generated to be fully analyzed and harnessed for local decision-making. This speaks more broadly to the tendency of smart cities to be technologically-driven and focused on Big Data extraction and production before understanding the benefits of deploying these technologies and capturing such data (Kitchin, 2014a).

Furthermore, we found the issues surrounding data veracity to be largely left unaddressed. This, in turn, risks hindering the necessary dialogue that stakeholders should have from the outset about who has, or should have, responsibility for data verification and analysis to ensure data quality, and how data can be rendered accessible and useful to local decision-makers and communities, as intended.

Finally, at the level of the design, both InLinkUK and Strawberry Energy have adopted a modular approach whereby new features and sensors can easily be added to their products. Kiosks may be enhanced “with sensors which are used to collect useful, real-time environmental information such as information relating to air and noise pollution, outdoor temperature, pedestrian volumes, and traffic conditions” (InLinkUK, 2018: n.p.). Similarly, the CEO of Strawberry Energy describes smart benches as:

[A] smart city hub in which you can plug and play different things ... if two years from now, all of a sudden a specific part will become a major pollutant in London, then you suddenly need to start tracking more precisely. We can add a sensor and start measuring that ... (Interview 1)

Here, such added features and capabilities could potentially benefit the community and/or provide more fine-tuned local insights to local authorities. However, this also raises questions about the potential risks of these new data capabilities as well as the need for due accountability and public scrutiny in assessing them. SSF's potential data capabilities remain largely unarticulated by providers, but are by default accommodated in the modular design of their product. This may generate a governance-related silencing effect if future upgrades take place without local decision-making and public scrutiny processes.

Silences at the Level of Governance: Data Regulation, Stewardship, and Use

The PPP arrangements underlying smart kiosks and benches produce, often inadvertently, silences around the regulation of the different data aspects of SSF, the stewardship of data generated, and the use of data for decision-making.

In the context of austerity and the impact it has had on local government, procurement arrangements based on outsourcing to the private sector are seen as a cost-effective way to provide or upgrade local infrastructures. PPPs can also allow local authorities to support innovation and test bedding while managing the risks that come with it. This experimental ethos was observed in Southwark Council's response to Strawberry Energy:

The agreement we've made is more of a Memorandum of Understanding. There are so many points that we couldn't cover in a temporary highway license, we needed something else and, particularly from a legal point of view, liability ... So we drew up this agreement. It took around a year, I think, back and forth, making various points. So there's two parts, well there's more than two parts, but the two main parts are the license agreement and also attached to that is the highway license. (Interview 2)

This licensing agreement provided more flexibility than a planning application and only took a year to set up. This innovative approach arguably allowed the council to respond to opportunities, such as bringing charging capabilities and environmental monitoring to the borough, while giving them a chance to evaluate the benefits of SSF after five years (the duration of the contract). By using a licensing agreement, the smart benches were understood as a moveable structure (benches are only bolted to the ground on three points). This was crucial from the council's perspective, as "people knew that if it didn't work out in this location, we could easily move it somewhere else" (Interview 2).

Links kiosks are governed differently, as they are not easily removable and are approved via a planning application (rather than licensing agreement). The opportunity to review the planning applications after their approval is very limited which impedes not only the evaluation of the kiosks' benefits for a locality, but also leaves out the embedded modularity of their design (and hence their future applications).

Furthermore, the planning process tends to focus on the physical infrastructure of SSF and their materialization on the street (in particular regarding street cluttering, visual amenity, and pedestrian obstruction) whereas the data embedded in and generated by SSF come under data protection legislation (GDPR). This means that the physical and digital components of SSF are not necessarily looked at as a whole¹¹. Importantly, such disassociation risks an omission to account for SSF's data capabilities in the specific socio-urban contexts in which the furniture are implemented (e.g., continuity of data capture and analysis from a fixed location, data aggregation from networked SSF in a neighborhood). In turn, this impedes full accountability of these specific data capabilities.

The gap resulting from the dissociation of regulatory frameworks can be managed and reduced by internal coordination at the level of local government. In the case of the smart benches in Southwark, the highways licensing and enforcement manager liaised with relevant teams within the council to consider all aspects, including data:

From a personal data point of view, Strawberry approached us two years ago I think to ask if they could do a Google search function on the bench, so you could speak to the bench and ask it a question and it tells you something ... So I approached our GDPR team, who didn't like the idea of people speaking into it and giving them information without signing in ... we weren't sure that was compliant. (Interview 2)

The active consideration of data governance in the public realm would seem important if public expectations are to be met that local authorities lead on ensuring data compliance by private technology companies. This was voiced in two instances during our vox pops in Glasgow (InLinks).

In the case of the smart benches, while data protection implications were considered by the council, there was a notable silence around the stewardship of the harvested data. This includes questions around data collection, curation, and maintenance. While Strawberry Energy is the primary data collector, the company shares the benches' data with local authorities:

They [the council] have access to ... full data that's being gathered. Er basically we, you, you'll have to check with them more precisely ... So, when it comes to the sensor data we have all of the data available on two hands. The first hand is the dashboard that the local government has access to. So they can check it out in a full, like display version. (Interview 1)

However, the local councilor (elected representative) for the area covered expressed some uncertainty and concern about the harvested environmental data:

Respondent: But they [council staff] were saying that there's nothing, that there's nothing to collect pollution data ... either they don't know or it is true that they don't collect data. Or who do they give the data to?

Interviewer: Exactly. That's what we want to find out.

Respondent: How do, how do they work with the data? Because if the data is collected, where does it go? Where does it go after it's ... ? And what people doing with the data, you know what I mean? Because it can be used and misused. (Interview with Southwark Councilor, 27 September, 2019)

This points to a lack of active voicing of how data relations are governed in the particular PPP arrangement. Moreover, it indicates a relative lack of understanding and agreement concerning the use of data for local decision-making. According to the Southwark's highways licensing and enforcement manager, environmental data was a key aspect of the benches' licensing, as the council wanted "more information about air pollution" whereby the "more [they] have the better it would be" (Interview 2). This data was intended to feed into "all our [the Council] other data" (Interview 2), but this has yet to be realized.

It may be in the nature of experimental initiatives that data governance arrangements need to be figured out flexibly. This, however, risks creating poorly understood, articulated, and scrutinized processes, as illustrated by Southwark's smart benches. Subsequently, such governance arrangements can easily lead to more enduring silences with regards to data regulation, stewardship, and use for local decision-making. Furthermore, it undermines the assertion that local (environmental) data generated by SSF can contribute to public data sharing and decision-making.

Discussion

This article has shown that SSF have become part of the materiality of cities, yet the public is not fully aware of them, nor of the smart functions and data services they offer. Citizens, by and large, have a limited understanding of the data collected by SSF and the restricted access to the data they generate. Compounding this are issues of data veracity and reliability which further impede the use of data by local authorities, community groups and citizens. These challenges hinder the repurposing and use of locally generated data by citizens to their own ends. While SSF could be an important component of bottom-up citizenship, for example by using local environmental data to inform policies on traffic management or pollution, to allow community voices to be heard, and to hold relevant stakeholders accountable, this has not yet been realized.

The research also found discrepancies between the promise of connectivity made by InLinkUK and Strawberry Energy and the actual uses of their products by the public. Both corporations portray mobile and already connected urban users on their websites. However, these intended users were not fully aware of the data services offered by the kiosks and benches, nor did they see themselves as becoming users as they could afford substantial data packages (Wessels et al, 2020). Instead, these devices were used most by groups with significant digital barriers, many of whom were socially disadvantaged. The question of who is connecting to and accessing services via SSF is important because it highlights the real and future potential of SSF in the context of local communities. Particularly, it draws attention to vulnerable members of the community who rely on SSF the most, but whose voices may not be heard and whose exposure to data extraction may be most acute.

Cities are increasingly not only the site of urban experimentation but the subject of new technological test-bedding (Voytenko et al, 2016). SSF fit neatly into this paradigm, offering a means to experiment with new combinations of technologies, services, and public-private governance arrangements. At the same time, the partnerships responsible for governing the kiosks and benches do not sufficiently articulate or explain the data relations embedded within these new assemblages. This also applies to the variety of regulatory and planning frameworks deployed to approve SSF. Consequently, this generates a series of silences which hinder the scrutinizing of SSF's current and future data relations and capabilities and risks leading to the deferral of responsibility for decisions regarding the use, design, and governance of these objects. We argue that to overcome these obstacles, providers and local stakeholders need to *articulate* more clearly the different data aspects of SSF in relation to their uses in public spaces, their design and governance arrangements, as well as to foster *conversations* in order to better understand the diversity and inequalities in how SSF are used and experienced.

Further, while ensuring that SSF were compliant with data protection regulatory frameworks, the local authorities concerned did not fully plan for the stewardship and use of data in an aggregated form. This highlights a broader silence and lack of public discussion around the *value* of aggregated data collected by SSF and the social benefits that can be obtained by using these data as a public good, as well as the potential harm that this data can do. This silence is inscribed not only in the siloed nature of local government and regulatory frameworks but also in the enduring focus on individual personal data rather than on the aggregated and relational nature of data (Wachter, 2019). As a way

forward, it seems urgent to more actively incorporate the *relational and aggregated aspects of data* in the governance of SSF in PPP as well as at the level of publics (e.g., public accountability and consultation on these aspects which concern them). This should also include agreement on data stewardship and quality (e.g., calibration) which would allow local authorities as well as citizens to use data generated by SSF for their own ends.

We argue that applying “silences” as a conceptual lens is useful for examining issues related to the landing of smart technologies in public spaces and surfacing the elements relating to data relations in SSF. This framework complements the existing work conducted on the politics of visibility/invisibility in relation to digital infrastructures (see Bucher, 2012; Parks and Starosielski, 2015; Hatuka and Toch, 2017; Halegoua and Lingel, 2018) by broadening our understanding of urban smart technologies and infrastructures as forms of interactions and dialogue (O’Donnell et al., 2009)—or lack thereof. The different types of silences we identified in relation to smart kiosks and benches result, to a large extent, from limitations in “listening” and “speaking” (often overlooked as resignation or lack of engagement), and subsequently the failure of specific voices (of end-users but also of local authorities) to be heard in the design and governance of these objects and of their underlying data relations.

Conclusion

This article has outlined several significant silences characterizing data relations in smart kiosks in Glasgow and smart benches in London over the three domains of users and publics, design, and governance (See Table 1). These silences need to be addressed by SSF providers and local stakeholders to lay the groundwork for dialogical forms of accountability and governance, in order to realize the potentials of SSF in local contexts and for citizens. Practically, we argue that the three domains of data relations outlined in this article should be taken into account when planning and implementing SSF, and that data legacy—including how data is given back to citizens—should be established from the outset. Increasing citizens’ data literacy is important for improving personal data protection as well as building community data capability. In addition, we recommend addressing the uncertainties and silences around SSF’s data veracity and reliability by equipping local authorities and public users with the means to assess the accuracy and reliability of SSF data. As more SSF (new or retrofitted) materialize in cities and towns across the world, future research should explore in more depth the emerging public–private governance arrangements of these new types of smart infrastructures, focusing in particular on data, how it is collected, aggregated, (re)used, and shared.

Notes

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7. The project was approved by the College of Social Sciences Research Ethics Committee of the University of Glasgow in June 2019 (reference 400180241).
8. <https://www.glasgowlive.co.uk/news/glasgow-news/plan-double-population-glasgows-city-17352545> Accessed August, 11, 2020.
9. Ibid
10. <https://www.southwark.gov.uk/health-and-wellbeing/public-health/health-and-wellbeing-in-southwark-jsna/southwark-profile> Accessed August, 11, 2020.
11. This point was strongly made by a local activist opposed to the InLinkUK kiosks during a phone interview conducted on the 13th of August 2019.

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