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In search of the Smart Citizen: Republican and cybernetic citizenship in the smart city

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Abstract

The smart city has been both celebrated for opening up decision-making processes through responsive digital infrastructures, and criticised for turning citizens into mere nodes of socio-technical networks under corporate or government control. In line with these depictions, smart city politics is often analysed as a struggle between aspirations for bottom-up participatory democracy and authoritarian control. Drawing on ethnographic research on an Amsterdam project which encourages citizens to collect and share air quality data, we problematise this vertical reading of smart city politics. The project mobilises both republican citizenship and cybernetic citizenship, each assuming different logics regarding the ways in which citizens negotiate urban life by means of data and sensing technologies. While republican citizenship emphasises citizens' sovereignty, cybernetic citizenship emphasises their immersion into informational environments. We demonstrate how, depending on specific situated interests and forms of engagement, both kinds of citizenship feed into appealing visions of urban life for different actors.

Keywords

air quality sensing, citizen participation, citizen sensing, cybernetic politics, digital urbanism, smart city

摘要

智慧城市因通过响应性数字基础设施开放决策过程而广受欢迎，也因将公民变成公司或政府控制下的社会技术网络节点而饱受批评。与这些描述相对应的是，智慧城市政治通常被分析为自下而上的参与式民主和威权控制这两种渴求之间的斗争。基于对阿姆斯特丹市的一个鼓励市民收集和分享空气质量数据的项目的人种学研究，我们质疑这种对智慧城市政治的垂直解读。该项目调动了共和公民身份和控制论公民身份，关于公民通过数据和传感技术协商城市生活的方式，这两种公民身份各有不同的逻辑。共和公民强调公民的主权，控制论公民强调他们融入信息环境。我们说明，取决于特定的情境兴趣和参与形式，这两种公民身份是如何为不同的行为者注入关于城市生活的、富有吸引力的愿景的。

关键词

空气质量感知、公民参与、公民感知、控制论政治、数字城市化、智慧城市

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Alex and Rolinda live in a houseboat in Amsterdam city centre. They love it because they can experience the bustling city while enjoying a sense of tranquillity and spaciousness. However, the rising number of leisure boats that pass by the couple's windows has made them wonder about the health effects of boat fuel emissions. Rolinda: 'I don't even know if I should be concerned. Perhaps nothing is wrong, perhaps there is. There is no way to tell.' The couple's interest was piqued when they read about an air quality monitoring project in *Het Parool*, Amsterdam's local newspaper. In the article, Waag Society, a 'bureau for creative technology and social innovation', together with the public-private Amsterdam Smart City network, announced they would lend 75 measuring kits to Amsterdam residents to be used for do-it-yourself monitoring. These so-called Smart Citizen Kits¹ (or Kits) consist of a small computer with sensors that measure substances in the air that are, in high concentrations, toxic to humans, such as carbon monoxide (CO) and nitrogen dioxide (NO₂). In addition, the Kit measures temperature and sound. An online platform collects and visualises the measurements, showing the individual devices as data points on a world map.

The recurring term used to refer to the proactive and technology-savvy type of involvement fostered by the project was *smart citizenship*. Smart citizens, according to project leader Frank Kresin of Waag Society, are 'smart, engaged, and illuminated through mastering the technologies that help them express themselves, connect to others, share their resources and thoughts so they

can decide the best course of action' (cited in Henriquez, 2015: 17; see also Hill, 2013). However, in the course of the project it became clear that the Kit could not be used to effectively monitor air quality. At one of the project meetings, Dave de Jonge, an air quality expert working for Amsterdam's municipal health service GGD, told the assembled citizen-volunteers that the sensors of the Kit were too insensitive to gauge standard levels of NO₂ in the air. 'At the very least I would like to see a correlation between the Kit's data and air pollution', he told the audience, 'but that correlation can't be found.' By the end of the project, Alex and Rolinda had not managed to get the accurate measurements they had been after and still did not know whether to be worried about the emissions entering their home.

Since the Kit had failed in what appeared to be its most essential task, it is unsurprising that the vast majority of participants had reservations about the project: of the 35 participants who filled out an evaluation survey, only one agreed the project had fully met their expectations (Waag Society Amsterdam, 2014: 20). And yet, the project was not just viewed as a failure. Considering that the technology did not do what it was supposed to do, it is striking that a majority of the surveyed participants (28, or 80 per cent) said that the project had 'partially' fulfilled their expectations (Waag Society Amsterdam, 2014: 20). Despite de Jonge's reservations about the validity of the data, the ambiance at the closing event was cheerful. A number of participants expressed excitement about the technology and their role as pioneers; project initiators and

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participants encouraged each other to continue experimenting with DIY measuring kits; and when the project initiators invited people to participate in a follow-up project during the summer of 2016, several participants who had joined the Smart Citizen Kit project agreed to take part in this second iteration.

In this article, we suggest that the contradictory evaluations of the Smart Citizen Kit project stem from two different articulations of citizenship enabled by the project. On the one hand, the project invited citizens to negotiate with institutions and the government by means of self-acquired and collected data on problems that matter to them. The 'smart citizens' participating in the project were thus addressed as *republican citizens*, who use sensor data to be informed about their environment and to gain leverage to engage in meaningful political debates. On the other hand, the project called for what we refer to as *cybernetic citizenship*. This term derives from the field of cybernetics, paradigmatically set out by Norbert Wiener (1961 [1948]) and elaborated in different directions by successive generations of cyberneticians (e.g. Kline, 2015; Rid, 2016). Cybernetics theorises the world in terms of informational feedback loops, locating decision-making and control in the ad hoc, decentralised and real-time forms of engagement between different parts of a system. As we observed, the participants of the Smart Citizen Kit project imagined their participation as contributing to an immersive, even 'sentient' digital environment. This cybernetic imaginary allowed for affective and playful engagements with data, which, we suggest, helps to explain the participants' enthusiasm for the project regardless of its failure to generate scientifically valid data.

By studying the ways in which the Smart Citizen Kit project sustained both republican and cybernetic articulations of smart citizenship, producing contrasting and occasionally

conflicting imaginations of civic power in the context of data ubiquity, this article explores the relation between (urban) digitisation and new, emergent articulations of citizenship. In critical scholarship and public debates on the smart city, there is a tendency to address the role of citizens in smart cities through a dichotomous framework: a distinction is made between smart cities that control citizens, and those that empower them; and between 'bottom-up' and 'top-down' technological appropriations. By looking at the unfolding of one particular smart city project, we demonstrate the need for new and more complex notions of urban citizenship. Citizenship in the context of digital ubiquity is a 'composite of multiple subjectivities' (Ruppert and Isin, 2015: 4) that emerges as part of the interplay between differently situated actors and agents of urban digitisation (see also Gabrys, 2014: 42; Luque-Ayala and Marvin, 2015: 2113). In particular, we show how shifting valuations of data and digital infrastructures translate into different articulations of citizenship and into multiple, sometimes conflicting, political perspectives and attitudes (see also Fiore-Gartland and Neff, 2015; Horst and Miller, 2013; Mackenzie, 2010; Sharon and Zandbergen, 2017).

To grasp the complex politics of smart citizenship, this research builds upon longstanding ethnographic research running from December 2011 until January 2018. The research followed the development of the so-called Air Quality Egg – a device that measures air quality and processes data through a digital platform (Kickstarter, 2012; Zandbergen, 2017) – and that of its successor, the Smart Citizen Kit, in part within the context of a documentary production on smart citizenship (Zandbergen and Blom, 2015). The ethnographic research consisted of participant observation and interviews with citizen-participants, the initiators of the air quality sensing projects and representatives of

institutions and corporations involved in the Amsterdam Smart City initiative more broadly. After the completion of the Smart Citizen Kit project, we conducted eight follow-up interviews with experts in air quality working for municipal, state, academic, corporate and activist research and development organisations. Unless stated otherwise, the quotes in this article are sourced from recorded observations and interviews in the context of the Smart Citizen Kit project. In the following, we first situate the Smart Citizen Kit project in the context of smart city making. We then describe how the project negotiates different understandings and expectations regarding the relationship between citizens, the digital and the social.

Variable articulations of smart citizenship

Preceded by other imaginaries of urban digitisation – such as that of the ‘informational city’ (Castells, 1989), ‘the city of bits’ (Mitchell, 1995) or the ‘computable city’ (Batty, 1997)² – the *smart city* has in recent years captured the interest of global elites as a vision of urban management by means of distributed computational intelligence (e.g. Gabrys, 2014; Greenfield, 2013; Kitchin, 2016; Rossi, 2016; Townsend, 2013). Being indebted to a multitude of legacies, including the Smart Urbanism movements of the 1990s (Dierwechter, 2013; Hajer and Dassen, 2014; Herrschel, 2013), the smart city has now become ‘a paradigmatic example of cross-national policy mobility, in light of its fast circulation at the global scale’ (Rossi, 2016: 339). As a ‘flexibly interpreted ... cluster of guiding visions’ about future urban life (Borup et al., 2006), the smart city is characterised mostly by its flexibility and cross-sectorality, associated with a range of goals such as environmental sustainability, economic prosperity and security (e.g. Gabrys, 2014; Hollands, 2008; Kitchin and Lauriault,

2014; Luque-Ayala and Marvin, 2015; Verebes, 2013).

Although the smart city potentially serves many different goals, one key concern has been civic empowerment. Whether in response to criticism of how smart cities extend neoliberalisation and facilitate state surveillance (e.g. Gabrys, 2014; Hollands, 2008; Kitchin and Lauriault, 2014; Luque-Ayala and Marvin, 2015), or as part of ‘bottom-up’ initiatives to produce alternative smart city discourses and practices (Amin, 2015; Cuff et al., 2008; De Lange and De Waal, 2013), civic empowerment has played a dominant role in the justification and naturalisation of the smart city as the dominant paradigm for urban development (Cardullo and Kitchin, 2018). For instance, in their efforts to propagate their smart city initiatives as ‘citizen-centric’, Anglo-American and European policy makers often juxtapose their version of the ideal smart city against allegedly ‘blank-slate’ corporate and state-controlled smart city projects, such as New Songdo in South Korea or Masdar City in the United Arab Emirates (Datta, 2015; Greenfield, 2013: 76; Halpern et al., 2013). By contrast, western policy makers foreground their version of smart city making as ‘co-creative’, ‘inclusive’ and ‘participatory’ (Manville et al., 2014; see also European Commission, 2015).

Such labels gesture towards the active role of citizens in the shaping of smart cities. Yet the transformation of citizenship that is called for in the context of urban digitisation is variable (Rossi, 2016). The manifestations of ‘smart citizenship’ depend, for instance, on the particular ways in which global incentives are negotiated with social, economic and political local traditions. Moreover, as Joss et al. (2017) argue in their study of the discursive formation of the smart city as promulgated in the British Standards Institution (BSI), the smart city discourse of

citizenship is itself a composite of multiple political traditions. The authors distinguish the 'individual-liberal' and the 'civic-republican' traditions of citizenship as reference points for contextualising the mixture of responsibilities, rights and governing practices espoused in the smart city standard. On the one hand, the standard calls for active civic participation, community-formation, public deliberation and contestation (typical for the civic-republican tradition) and, on the other, it emphasises the importance of the free market, individual self-governance and limited state intervention (typical for the individual-liberal tradition). The smart citizenship regime, they conclude, consists of a mixture of civic-republican and individual-liberal traditions.

This mixture, the authors observe, is moreover fashioned by 'the central concepts of system complexity and digital knowledge infrastructure' (Joss et al., 2017: 31). Yet, the ways in which the digital fashions particular articulations of civic power is also contingent on the particular 'fields of action' opened up by the digital (Neff et al., 2012). Wise (2011: 159) points out how digital infrastructures situate agency in multiple, sometimes contrasting ways. On the one hand, he writes, the digital world is increasingly perceived as 'responsive and information-filled'. Agency in this respect seems to reside 'in individual will, channeled through the devices which have become the remote controls of our everyday lives'. When perceived as 'remote controls', tools of knowledge or vehicles of expression and deliberation, the digital is closely tied to the republican ideal of citizenship. At the same time, accounting for the 'technical agency' (Neff et al., 2012) that is distributed across the 'devices, networks, and spaces themselves' (Wise, 2011: 159), the digital is also formative of what we term 'cybernetic citizenship'. We derive this term from the field of cybernetics.

Cybernetics was popularised by the American mathematician Norbert Wiener in 1948. As a discipline that took *information* as the key to the governing of the natural, social and mechanical world alike, cybernetics has developed into an amorphous field of interdisciplinary exchange. It inspired multiple, often oppositional political practices (Hayles, 1999; Kline, 2015; Pickering, 2010). Cybernetics has fed into fantasies of governmental control and dominance (Luque-Ayala and Marvin, 2015; Medina, 2011); but has also been embraced by countercultural activists, artists, designers and political thinkers to experiment with spontaneous self-organisation and distributed coordination as opposed to blueprint planning and top-down control (Brand, 1974; Kline, 2015; Pickering, 2010). What nevertheless united these different perspectives was an understanding of governance and control as taking place through affective, decentralised and distributed mechanisms of feedback.

Prefigured by the interactive and adaptive architectural designs envisioned by the cybernetician Gordon Pask (1969) and realised by collectives like the British Archigram group (Pickering, 2010: 364), cybernetics has also become relevant to contemporary imaginaries of the smart city. As the architect Tom Verebes (2013: 13) puts it, '[t]he hyperconnected, mobile, adaptive, and responsive condition of today's urbanity, facilitated by information networks', owes much to the 'cybernetic theories of the 1940s and 1950s', particularly for the ways in which they assume networks to be 'self-generating, self-organising, self-sustaining systems'.

Implemented in smart city infrastructures, from smart traffic management systems to smart energy grids, and from dynamic pricing systems to crowd monitoring (e.g. Kitchin and Lauriault, 2014; Luque-Ayala and Marvin, 2015), the

cybernetic politics of the smart city has been variably assessed (Crang and Graham, 2007). Some scholars warn about the extent to which pervasive or ubiquitous computing environments support a neoliberal logic or are depoliticising in their effects (e.g. Gibbs et al., 2013; Vanolo, 2013). In these environments, citizenship based on 'individuals exercising rights and responsibilities', Jennifer Gabrys (2014: 42) writes, is being replaced by a politics based on 'operationalizing the cybernetic functions of the smart city'. Looking at proposals and implementations for New Songdo, a South Korean marketed 'smart city' built from scratch on land claimed from the ocean, Halpern et al. (2013: 273) observe a move away from a politics based on 'enlightened reason and empirical experimentation' towards implicit governance through 'manipulation of the synapses' (Halpern et al., 2013: 280).

Others, by contrast, have celebrated the affective, decentralised affordances of cybernetic urban infrastructures as facilitating new forms of civic agency, associating these with bottom-up resistance and new forms of swarm- and crowd-based tactical organisation (e.g. Amin and Thrift, 2013; Couldry and Powell, 2014; De Lange and De Waal, 2013; Thrift, 2014). Such commentary tends to juxtapose the control-based 'one-size fits all', top-down smart city infrastructures against the more serendipitous, engaging and affective networking technologies created by artists and activists 'from the bottom up'.

In the context of this debate on smart city politics, the field of citizen sensing has emerged as a self-conscious effort to counteract government and corporate digital control by 're-appropriating' civic control over urban life by digital means. The Smart Citizen Kit project needs to be discursively situated within this domain. Drawing simultaneously from the republican and liberal political traditions, the articulations of

citizenship emerging in the context of this project emphasised the possibility of civic power in the context of digital ubiquity.

Citizen sensing

When Waag Society and Amsterdam Smart City initiated their Smart Citizen Kit project, they did so as a follow-up to an earlier project that took place in 2011 and 2012. From November 2011 onwards, Waag Society co-hosted, along with 'fab labs' and neighbourhood centres in Barcelona, London, New York and elsewhere, a series of gatherings focused on the realisation of the 'Air Quality Egg', a low-cost civic air quality monitoring device (Zandbergen, 2017). Through its support for the Air Quality Egg project, amongst others,³ Waag Society established itself as one of the international nodes in the burgeoning field of *citizen sensing*.

Citizen sensing, as defined by Helen Pritchard and Jennifer Gabrys, is the 'practice of monitoring environments through low-cost and do-it-yourself (DIY) digital technologies' (Pritchard and Gabrys, 2016: 354). Citizen sensing has been celebrated as a way of 'raising awareness, building capacity and strengthening communities' (Craglia and Granell, 2014: 1) and as providing 'a democratic corrective or challenge to the standard processes for monitoring environments, gathering data, and acting on those data' (Pritchard and Gabrys, 2016: 355).⁴ This focus on civic power was also a dominant discourse of the Air Quality Egg, which aimed, in the words of project organisers, to 'give people a way to participate in the conversation about air quality' (Zandbergen, 2017: 544).

In addition to contributing to the field of citizen sensing, the Air Quality Egg project also gave substance to Waag Society's ideal of proactive, involved and empowered citizenship in the context of a digital society.

This ideal was further fine-tuned through the notion of smart citizenship, in the organisation's 2013 publication of the aforementioned *A Manifesto for Smart Citizens*. In this manifesto, Frank Kresin, by means of Waag Society, sketches an image of self-organising, empowered, well-networked and digitally inventive citizens, capable of bending digital technologies to their own ends (Kresin, 2013).

Citizen sensing projects are typically pursued by consortia of multiple organisations and institutions. The precursor to the Smart Citizen Kit project, the Air Quality Egg, was perceived as a form of Research and Development by corporations, as participatory science (or citizen science) by research institutes, as participatory governance by government authorities and as a kind of do-it-yourself tinkering by hobbyist-citizens (Zandbergen, 2017). A similar combination of start-up, scientific, municipal and civic organisations and interests sustained the Smart Citizen Kit project. In contrast to the Air Quality Egg project, the Smart Citizen Kit project was more explicitly related to the local Smart City aspirations of the Amsterdam government. The Amsterdam Smart City consortium – a public–private network focused on foregrounding the city of Amsterdam as a successful Smart City – initiated the project in collaboration with a start-up in Barcelona, several Dutch research and environmental health institutes and Waag Society.

The public mission for the Smart Citizen Kit was, as formulated by programme manager Saskia Müller of Amsterdam Smart City, to illustrate to Amsterdam residents 'what a Smart City can mean to them' (personal interview). At the opening meeting of the project, the Amsterdam residents who had registered for the project received low-cost air quality monitoring devices, an explanation about software that needed to be installed and a time-line for the project. Yet,

these tools and the acquired data translated into varied and variable understandings regarding the form and substance of the type of empowerment they could bring. On the one hand, the discourses surrounding the project painted a picture of assertive citizens using self-measurement instruments and digital data to engage in political debates about the urban environment. On the other hand, the project was also framed by the cybernetic discourse of informational ubiquity. This discourse posits the urban environment as a 'sentient' environment (Thrift, 2014), a kind of decentrally structured organism made of sensors which embed 'intelligence and agency' across the skin of the city (Amin, 2015: 255). In the following, we discuss in more detail both these articulations of citizenship and the ways in which they are rooted into particular valuations of the digital.

Republican smart citizenship: Data as the power of speech

At the introductory evening of the Smart Citizen Kit project, Saskia Müller, representing Amsterdam Smart City, told the audience that 'by perceiving that which is around you, you will get a better grip on your environment'. Many of the Amsterdam residents who signed up for the project had clear expectations of what such a 'grip' would entail. For Alex and Rolinda, it would mean gathering data to prove the polluting effects of tour boats so that stricter regulations could be imposed. Perhaps the boats could run on electricity instead of petrol, Rolinda suggested. As such, the Smart Citizen Kit featured as a tool that could foster republican citizenship. This promise was informed by a specific assumption regarding the way in which the data generated by the Kit would translate into power. The Kit was expected to generate data that would have the political leverage to induce policy transformations.

This, in turn, was tied to the assumption that this data would function as a crucial counterpoint to existing official measurements.

This understanding made sense to some of the volunteer-citizens who had learned in earlier projects not to take official environmental measurements at face value. Alex and Rolinda had been involved in a neighbourhood protest against the planned construction of a landing dock for tour boats on the Amsterdam Noordermarkt (Northern market). Along with other residents neighbouring the square, they were concerned that the dock would increase the levels of noise and air pollution in a location already heavily affected by tourist traffic. As they recalled, project initiators had used sound statistics to prove the relative low levels of sound. Yet, this did not appease the residents, as they suspected that this data had been sampled from quiet, rainy days only. From this experience, the couple had learned the importance of citizen involvement in environmental monitoring.

The conviction that the Kit would increase residents' political leverage was coupled to the idea that it would produce 'better facts', which could compensate for the allegedly incomplete and unreliable data produced by government institutions. As project initiators wrote in an article, the 'expensive monitoring equipment' of official authorities has a 'low spatial and temporal resolution', and is 'too sparse to meet the information demands from the public and organisations' (Jiang et al., 2016: 1). Participant Diana hoped that the more accurate data produced by the Kit would help her in her quest for an environmental zone. Together with the neighbourhood committee 'Volledig Uitstoot Vrij' ('Zero Emissions'), and in collaboration with environmental organisations such as the Dutch branch of Friends of the Earth, she had long lobbied for the environmental zone but without success. To Diana, the Smart Citizen Kit

project put new options on the table that could help reignite this political process. 'I think the moment you are able to present hard facts about air pollution, nobody can deny the problem anymore', Diana asserted. Participant Jaap imagined that citizens could form their own 'measuring brigades'. He said: 'If someone reports a nuisance – say misplaced trash or noise – this brigade can be mobilised, and start collective measuring activities. In this way, citizens can become data authorities in their own right.'

The republican ideal espoused by the Smart Citizen Kit project thus imagined the participants in terms of a collective, organising around a public issue and asserting themselves through the process of deliberation and political contestation. From the perspective of this ideal, the citizen-gathered data would acquire authority by being scientifically sound. The data, in other words, afforded the sensing citizens the power of speech, mediating between these citizens and the larger community by virtue of their representational and argumentative quality.

Yet, it was exactly this representational, argumentative quality of the data that was challenged early on in the project in a number of ways. First, expert partners from environmental health organisations argued that the Kit did not significantly add to existing data sources. As the aforementioned Dave de Jonge, working for the municipal health service GGD, told the audience at one of the gatherings, the multiple official measuring networks already in place provided 'a pretty good and detailed picture' of the city's air quality. These official measurements, made available to the public through the website of *Luchtmeetnet* (network for air quality measurement, <https://www.luchtmeetnet.nl/>), already make it possible to estimate the effect of local conditions (including canal boats or car traffic) on pollution. Second, according to the experts from GGD and the Royal Meteorological Institute, the cheap sensors

were designed to measure industry-level toxicity and were not suitable to gauge the comparatively low volumes and modest fluctuations in everyday urban environments. Third, the procedural set-up of the experiment introduced far too many uncertainties: all the Kits were hung at different heights and they were exposed in different degrees to sunlight, rain, electricity outages and Wi-Fi availability.

These reflections were discouraging to both participants and project initiators as they had to adjust their expectations of the project's political potential. As Alex put it during a project meeting: 'If we want to try to use this data to convince the ministry to take steps they don't want to take, they'll wipe it off the table immediately.'⁵ Yet for many participants this did not immediately disqualify the project. The empowerment afforded by the project was not merely and only imagined through the republican tropes of public debate, objective data and collective action. It was also rooted in local and ad hoc forms of negotiation based on individualised and affective forms of sense-making. This implied an appreciation of the sensing tools and the produced data, not for their scientific accuracy and representational value but for the ways in which they constituted cybernetic environments.

Cybernetic citizenship: Data as decentralised sentience

The final evening of the Smart Citizen Kit project was cheerful. The presentations and discussions were permeated with an excited anticipation of an emergent newness, a *something* that the project participants had helped to build the first stages of. Amsterdam Smart City representative Saskia Müller told the audience that they were only standing at the beginning of 'an enormous development'. This development, she indicated, had something to do with 'large amounts of data

being gathered on almost everything'. Marita Voogt, from the research organisation TNO, added that it also had to do with 'new ways of measuring', and for Waag Society project leader Frank Kresin the project was about finding 'new ways of making sense of one's environment'.

The key message of these concluding presentations was that the volunteers were pioneers in the exploration of uncharted territory. Joris Lam, a start-up entrepreneur who participated in the successor project of the Smart Citizen Kit, used a science fiction narrative to try and convey his sense of what this uncharted territory looked like. Lam sketched the urban environment as a sphere of distributed intelligence, forming an affective, animate, informational environment in which one could be sensorially immersed. Anticipating the full realisation of this informational environment in the future, Lam envisioned a 'seamless connection of humans with sensors, data and artificial intelligence'. In this future, Lam predicts, 'humans will be in direct contact with a field of intelligence'.

Joost Wesseling, a scientist at the Dutch government environmental monitoring agency (RIVM), came up with a more concrete vision of the future data-infused city. In this vision, bicyclists navigate the city based on their personal preferences and medical conditions. Tapping into databases with real-time urban environmental data – for instance on air pollution, solar radiation and noise – and combining this data with their preferences for that day, a navigation app would route them automatically through the city. If time-constrained, the app can simply pick the fastest route. If prompted to prioritise health concerns, it would route through back-alleys shielded from car traffic.

Although the RIVM's vision was not as futuristic as those of Lam and Wesseling, their engagement with the Smart Citizen Kit stimulated other participants to also imagine themselves as part of an urban environment

consisting of information flows to which they could attune their senses. Jaap, for instance, mused about expanding the Kit into something 'you can wear as a jacket' that feeds information to your senses about the levels of 'CO₂, moisture and radiation you are exposed to in a day, and how this impacts your health'. For Rolinda, the Kit played a role in augmenting her sensitivity to her environment in a more indirect way. She discovered that, from observing the graphs produced by the Kit, the levels of sound that were registered correlated with fluctuations in the weather. After a while, she was interested to learn that, even without having to look at the graphs, the sheer presence of the Kit made her more acutely aware of weather fluctuations. The sensors of the Smart Citizen Kit, in other words, prompted the sensitivity of her physical senses.

What stands out in these cybernetic visions is the individualised approach to sense-making. Even though relying on collectively gathered data, this data does not comprise a common language through which social concerns are addressed. Instead, the data comprises an affective environment to which each individual can relate in different ways, depending on momentary, constantly shifting preferences and types of concern.

Project participant Diana, for instance, embraces the Smart Citizen Kit not only for its potential political influence, but also because she hopes that it can tell her, in real time, when to open or close windows at which side of the house, all depending on the level and location of air pollution at different times of the day. Participant Douwe draws meaning from the different types of data-streams generated by the Kit in his own, personalised ways. For him it is like a fun and interesting game to search for correlations between, say, the time of day and the level of sound. To keep this kind of exploration interesting, it is important for Douwe

that the Kit is extendable, with more and different types of sensors. Sensing, and thinking of interesting types of uses based on the data, is in and of itself a satisfying activity for him. In this way, Douwe is the prototypical customer that another project participant, the aforementioned Joris Lam, has in mind for his services. For Lam, individualised forms of sense-making are central to his business model. Lam defines his business as being 'an insight provider through data'. He said: 'What these data are, and what this insight consists of, should be up to the people themselves and might also change as people develop their interests.' To realise this vision, Lam develops a modular Lego-like system of a microcontroller on top of which different kinds of sensors can be added. In this way, 'people can assemble their own mix of data, about gases, for instance, or air quality, or whatever'.

When asked how these practices of civic data gathering would impact the urban environment, Lam sketched an image of an urban environment in constant flux, governed by a decentralised process of constant local adjustments. Lam thinks that the current process of air quality governance, based on long-term, European processes of decision-making, is too slow to keep up with actual urban developments. He believes more in the effects of real-time locally responsive smart urban objects. For instance, when local values of air quality are bad, such an environment could immediately respond with changed traffic light settings and a reduction of the maximum speed.

Another example of real-time personalised responsiveness comes from the humorous reflections of participant Alex. As mentioned earlier, his participation in the Smart Citizen Kit was motivated by his desire to reduce the air pollution caused by leisure boats in the canal. This translates into his hope that the registered air pollution data would result in more and better

regulation. But he also fantasised about more personalised, real-time and immediate forms of solving the issue. ‘What if’, he imagined:

I would connect the Kit to a water hose pointing at the canal. Every time a boat passes by that produces high levels of emission, upon registering this, the Kit could instantly turn on the hose, spraying the passengers in the polluting boat as a form of punishment.

The flexible ideal of smart citizenship

The type of ‘smart citizenship’ called forth by the Smart Citizen Kit project is rooted in a composite, paradoxical form of subjectivity. On the one hand, the participants embraced the sensor kits in order to gain more political power, hoping the data could be used as statements regarding public concerns. On the other hand, participants also enjoyed the ways in which the Kits invited playful engagements with a cybernetic environment in which data translates into action in ad hoc, real-time and individualised ways.

As we observed, project organisers and participants drew from both these different perspectives and forms of envisioned civic power. At the final event, *both* articulations played a role in imagining future iterations of the project. Participants and initiators looked forward to more collaboration with air quality professionals and engineers to fine-tune sensor calibration techniques and to translate sensor data into more realistic understandings of health-related effects of air quality. In the final project report, Waag Society called for better procedures and standards for maintenance and repair of the sensing kits in subsequent projects (Waag Society Amsterdam, 2014: 7, 11). In this way, new projects would empower citizens with well-calibrated sensors and accurate data in their quest for cleaner cities.

Simultaneously, future iterations of the project continued to rely on an explicit anti-

authoritarian and anti-establishment narrative, suggesting that the success of civic sensing does not stand or fall with accurate, formally sanctioned data. As a video on the Making Sense EU website suggests, central to the motivation of people to participate in citizen sensing projects is an active attitude towards one’s environment (Making Sense EU, 2017). As was also narrated in the context of the precursor to the Smart Citizen Kit, the Air Quality Egg, this active involvement does not require the authorisation of expert organisations or the legislative power of politicians (Zandbergen, 2017). Smart citizenship, from this perspective, is about motivating citizens to actively contribute to urban data and engage with their urban environments through this data, in whatever way makes sense to them. As formulated by project leader Saskia Müller, the Smart Citizen Kit project would be a success if it were to ‘incentivise people in wanting to gather more and different data’.

Smart citizenship, as shaped in the context of the Smart Citizen Kit, thus calls forth an urban sphere that is bound to social rules and agreements but that is also flexibly responsive to individual preferences. More specifically, it is a form of citizenship that finds opportunities for civic power in relation to different digital ‘fields of action’ (Neff et al., 2012). Civic power can be imagined and experienced in relation to digital tools producing scientific data as well as to data infrastructures that produce environments of affect and real-time decentralised action; and citizens can thus enact their power in assertive relations with scientific and political authorities as well as with complex, ‘out of control’ digital environments.

The project’s flexible and open-ended ambitions fit with the anticipations and forms of engagement of certain types of participants. These included ‘tinkerers’ like Douwe who perceived of data infrastructures in creative ways and who envisioned

innovative types of use for them. These also included entrepreneurs like Lam and Smart City propagators like Saskia Müller, as well as others invested with an information-dense future. By contrast, the flexible ideal of smart citizenship did not fully match the interests of those participants who had joined for the singular reason of acquiring better data on air quality. These included the air quality experts to whom scientific validity of data is key to the success of civic collaborative sensing projects. Dave de Jonge, for instance, applauds civic participation in environmental monitoring but is also wary of the kind of anxiety and trepidation that inaccurate measurements and interpretations of data can cause. Another disenfranchised project participant was Michael, a technical assistant at a secondary school in North Amsterdam. Michael had joined for the sole purpose of using the Kits to once and for all settle an issue that his school was facing. Parents of his pupils had voiced concern about the environmental conditions around the school. Michael hoped that the Kit would show them that the school was, in fact, located in an area where the air was much cleaner compared with schools in the inner city. When asked how he would respond if the data testified to air pollution, he responded: 'At least we then have the data to show that something needs to be done.' The project's finalisation without acquiring this objective data left Michael, at the end, empty-handed.

Conclusion

In recent years, critical scholars and public commentators have voiced their critique of how smart cities limit civic agency by eroding the basis for deliberative politics and sustaining environments of permanent, sensorial nudging and surveillance. The *smart citizen* has emerged as a figure resisting these forms of cybernetic control

through self-conscious appropriation of tools of meaning making. One of the fields that sustain this ideal of smart citizenship is *citizen sensing*. By providing citizens with digital measurement tools for the creation of data on issues that matter to them, they are enabled to assert themselves as smart citizens vis-a-vis legislators and policy makers. As foregrounded in the *Manifesto for Smart Citizens* cited above, smart citizens as such create a bottom-up antidote to otherwise top-down, controlling, surveilling and nudging forms of smart city techno-politics.

Zooming in on the unfolding of the Smart Citizen Kit project, this article problematises such a dichotomous reading of smart city politics, and smart citizenship in particular. Resisting any easy qualification in terms of vertical politics, the Smart Citizen Kit project was simultaneously a form of municipal branding and citizen sensing, corporate prototyping and scientific experimentation. Moreover, our exploration of the Smart Citizen Kit project draws attention to the messy ways in which different and occasionally contradictory ideas and aspirations of digital urbanism coexist. We showed how the Smart Citizen Kit project thrived on different criteria of success, drawing from different imaginaries regarding the relationship between civic power and the digital. The vision of citizens collectively mobilising data to make claims about the urban environment in a commonly agreed-upon, authoritative language calls forth a typical *republican* ideal of smart citizenship. By contrast, the project simultaneously valued the digital in cybernetic terms, calling forth an informational environment that cannot be grasped or governed by a priori agreed-upon forms of interpretation and regulation. As *cybernetic citizens*, drawing inspiration from *liberal* politics, citizens can find their agency through ad hoc, decentralised and individual forms of engagement.

Whereas critical scholarship on smart cities tends to perceive cybernetic and republican forms of power in opposition to one another, this article shows smart citizenship as a constant negotiation between both articulations of citizenship. Moreover, whereas cybernetic power is often identified with top-down control, corporate nudging and state surveillance, this article also showed how cybernetic environments can translate into new appealing forms of relations imagined and experienced between individuals and the environment in which they are implicated. Even though standing in opposition to republican forms of power, the playful, individualised types of interaction afforded by cybernetic environments were much appreciated by project participants.

These findings and interpretations complicate an analysis of smart city politics – and urban politics more generally – in vertical terms: we cannot assume that politics corresponds to a struggle between the system and the lifeworld, between top-down imposition and bottom-up cooperation or between citizens and authorities. The lines of division are more complex. As we illustrated in this article, smart citizenship differentiates between sensing citizens, to whom digital infrastructures and data matter in different ways. On the one hand, this means that it may be more difficult than previously anticipated to foster empowerment and to question sanitised conceptions of the city. On the other hand, our analysis suggests that cybernetic experiences and practices are not inherently authoritarian and may contain seeds of alternative ways of organising urban life.

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Notes

1. The Smart Citizen Kit was originally developed by the Fab Lab Barcelona at the Institute for Advanced Architecture of Catalonia, via the Goteo and Kickstarter crowdfunding platforms (Smart Citizen, 2018).
2. Roche (2014: 703) sums up a range of other terms, such as 'WikiCity', 'City 2.0', 'ambient city', 'real-time city' and 'ubiquitous city'.
3. Waag Society has continued to develop citizen sensing activities in a variety of other settings and sites as part of EU-funded international projects. An example is the series of citizen sensing projects falling under the umbrella of the Making Sense EU programme. These pertained to a broad range of civic sensing practices, ranging from collaborative air quality and sound sensing to geographical mapping and open source collaboration (Making Sense EU, 2017).
4. Citizen sensing can be considered an expanded and diversified form of citizen science, broadly defined by Haklay (2013: 106) as 'the scientific activities in which non-professional scientists volunteer to participate in data collection, analysis and dissemination of a scientific project'. See Haklay, 2013 and Eitzel et al., 2017 for a more elaborate discussion on the definition and different ways of classifying citizen science.
5. See Pritchard and Gabrys (2016) for an elaborate discussion of the problems faced by a citizen sensing project mobilizing citizen-gathered data for political change.

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