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Controversing the datafied smart city: Conceptualising a 'making-controversial' approach to civic engagement

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Abstract

In this paper, we propose the concept of controversing as an approach for engaging citizens in debates around the datafied city and in shaping responsible smart cities that incorporate diverse public values. Controversing addresses the engagement of citizens in discussions about the datafication of urban life by productively deploying controversies around data. Attempts to engage citizens in the smart city frequently involve 'neutral' data visualisations aimed at making abstract sociotechnical issues more tangible. In addition, citizens are meant to gather around issues already defined externally by others. Instead, we focus on how people might become engaged and develop the capacity to shape alternative urban futures. We suggest that making controversial apparently less contentious issues in the smart city allows people to identify their own issues, come together temporarily as a public, imagine alternative possibilities and thus develop capacities for action. In this context, controversies can act as agents of change and open up new spaces for participation and action. We develop the notion of controversing as a deliberate strategy of making datafication controversial, and operationalise the term along the dimensions of recontextualisation, meaning-making and agency. We then look at two cases from the mid-sized city of Amersfoort in the Netherlands, first to test the conceptual potential of controversing to expose how frictions shape citizen engagement, and second to analyse how controversing may frame design-oriented methods aimed at involving diverse participants in discussing datafication and defining public values in the datafied smart city.

Keywords

Controversies, datafication, smart cities, civic engagement, public values, research-by-design methods

Introduction: A making controversial approach to citizen engagement in the datafied city

The datafication of urban life plays out largely beneath the surface of everyday experience, and behind the screens of institutional and corporate interests and decision-making. To increase citizens' awareness and engagement with the elusive phenomenon of 'datafication' (Schäfer and Van Es, 2017), various strategies have been proposed. Often, endeavours to increase citizen engagement initiated by municipalities or through their collaborations with corporate actors tend to focus on data visualisation. These strategies frequently include creating meaningful interfaces to visualise the often-invisible presence of data in specific (urban) settings and ways to interact with those data. All too frequently in these initiatives, the implicit assumption is that visualising data will ameliorate citizen engagement. At the same time, a small but growing body of critical scholarship and artistic research attempts to move beyond this approach, and look for alternative strategies (for instance, Colangelo, 2020; Powell, 2018; Valkanova et al., 2015). Such initiatives involve creating data-driven narratives about urban infrastructures, trajectories, objects or living beings (from tracking trash to giving voice to more-than-human creatures; Foth and Caldwell, 2018), or creating ways for citizens to collect and produce data about their (urban) environment (Gabrys et al., 2016; Haklay, 2017; Houston et al., 2019; Kuchinskaya, 2019). We acknowledge, in

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particular, the value of strategies aimed at generating a variety of hands-on data practices and narratives that involve citizens in the creation and interpretation of data beyond merely visualising it.

This contribution moves away from the almost instinctive reflex to foster civic engagement through data visualisations. Instead, we propose a *controversing* approach – that is, a deliberate strategy of making datafication controversial – to address the question of how people can become engaged in issues and debates around public values in the datafied smart city. We feel that data visualisation strategies for citizen engagement are problematic because they gloss over some thorny questions raised through datafication. First, they frequently rest on a mode of reasoning in which participation and engagement are *a priori* implied. Showing the data, telling the story, or involving citizens in data collection is unproblematically equalled with increasing participation, often without much scrutiny or operationalisation of how people might actually become engaged, what exactly they engage with, and what frictions and contestations this may engender. In this contribution, we explore how citizen engagement in the datafied city actually takes place and what it is composed of.

Second, carefully designed and aesthetically pleasing data visualisations may appeal to (new) audiences and even help establish temporary publics of some sort. But they also risk hiding from sight the decisions and selections that underpin the making of these visualisations, and the fact that what is made visible (or left out) can significantly influence perceptions and discourse. More specifically, and central to our argument, data visualisations may highlight or expose certain frictions or dangers associated with datafication itself (like for instance state or corporate surveillance, biased city development patterns, social exclusion). Yet, all too often these contestations are defined and framed externally by others and not by the people interacting with the data (Rettberg, 2020). Citizens are mobilised around *predefined* controversies as objects of debate (e.g., high pollution levels on specific streets), instead of being afforded the conditions that would allow them to identify their own issues of concern. Thus, we want to inquire who gets to define and articulate controversial issues in the datafied city.

Third, data visualisations tend to be representational, depicting data *as is*, without critically reflecting on its own mediation, implicit values and its performativity. This stands in stark contrast to the datafication of urban life as we see it, which is rife with controversies that are at the heart about value clashes. Different groups have conflicting viewpoints on the issues involved and the values they attach to them. Controversies often stem from a clash between private interests versus public interests. One of the pressing challenges for cities today is how to protect and include 'public values' in their design and governance (see for example Van Dijck et al. 2018 about the platformisation of urban life). To mention a few public values, the Dutch Rathenau Institute in relation to digital developments lists the following: privacy, equality, autonomy and human dignity (Kool et al., 2017). However, what exactly is understood by these terms is subject to constant contestation and reformulation. With this contribution, we investigate how the datafied city itself spurs a continual renegotiation and redefinition of public values by multiple and diverse publics.

With the aim to address these drawbacks of data visualisation strategies, in this paper we explore how citizen engagement may occur through processes of *controversing*. Well-known examples of smart city controversies include Toronto's Waterfront development that caused uproar, facial recognition technologies and social credit systems in China as forms of totalitarian state surveillance, or the rise of individual tracking apps in the name of public health (like the 'Corona apps' in the Netherlands). However, our interest is not in discussing such pre-existing controversies, let alone solving them. With controversing, we wish to propose a more nuanced and complex understanding of how citizen engagement occurs, by focusing on creating situations for intensifying engagement around specific issues, even if they appear to be non-contentious, through which diverse urban actors come together however temporarily as a public.

The controversial nature of datafied smart cities is repeatedly pointed out (Bunders and Varró, 2019; Cardullo et al., 2019; Engelbert et al., 2019; Hollands, 2015; Meijer, 2017). Controversies can be ontological, epistemological and political-ethical in nature (de Lange, 2018: 241). How for instance are data shaping urban mobility, living environments or urban governance? What for example are the assumptions and biases in producing datafied insights, and how do data interfaces shape our knowledge of and outlook onto the world? What are the ethical implications of collecting these data, and who benefit from the insights and any resulting policies, that is: who has the right to the smart city (Cardullo et al., 2019)? These and other controversies surrounding datafied smart cities, we argue, are not merely undesirable bumps or glitches that need to be ironed out on the path to citizen engagement with the smart city. Instead, they can serve as much-needed opportunities for opening up democratic discussions about, and reconfiguring, our urban futures. Hence, instead of attempting to overcome controversies surrounding the datafied city, we propose exploring them for their productive capacity, where opposing values can coexist without necessarily

aiming for consensus. In this perspective, citizens are not only engaged in the formulation of controversial issues while coagulating into publics, they may also build action upon these controversies – that is, produce engagement. The verb controvers*ing* reflects this active role for controversies.

The paper is structured as follows: it starts with an outline of the key theoretical aspects informing our proposal, introducing implications for civic engagement that emerge through the datafication of our cities and the notion of socio-technological controversies, including their potential for addressing some of these implications. Based on this literature, we develop and introduce our conceptual framework of controversing with three dimensions: re-contextualisation, meaning-making and civic agency. This allows us to explore in more depth how civic engagement can be conceptualised as a resultant from processes of friction-driven engagement with data. In the third section, we test out the productivity of controversing in two ways. First, we use it as an analytical framework for controversing datafication, or making controversial aspects that may not initially appear to be contentious, as a form of critically engaging people with datafication in-the-making. We do this by discussing the case of Snuffelfiets ('Sniffer Bike') a citizen-sensing project initiated by the Province of Utrecht in the Netherlands in collaboration with a number of institutional and private parties. Second, we explore the potential of the concept to frame design-oriented methods aimed at involving diverse participants in discussing datafication and defining public values in the datafied city. We do this by presenting a 'controversing walk-shop' method that engages diverse urban stakeholders in debating the datafication of the city and imagining potential actions to address the issues they observe. This method is being developed as part of an ongoing project (2018–2022) in which both authors are involved and that represents the departure point for formulating our conceptual proposal. The project, entitled 'Designing for Controversies in Responsible Smart Cities',[1] is developed through collaboration involving two Dutch universities and a consortium of public and private partners, and is aimed at developing a collaboration platform for envisioning and developing responsible smart cities, including ethical reflection on issues connected to urban datafication. The project addresses the smart city ambitions of Amersfoort (a mid-sized city in the centre of the Netherlands) as its main case. Finally, reflecting on the conversing concept through the use of examples from these two cases, we re-assess the productivity of the notion of controversing and provide recommendations for future research around this approach.

Theory: Civic engagement and controversies in the datafied smart city

In this section, we discuss some of the theories positioning datafication in relation to civic engagement, and existing theories about controversies, in order to build our framework for controversing the datafied city.

Before we do so, we consider it useful to begin by broadly positioning our approach within classical political theories of citizen participation. Institutional takes on engaging with the datafied smart city in public-private partnerships typically position themselves in what is termed a minimalist and consensus-oriented mode of democratic participation (Carpentier, 2011; see Figure 1). They seek very little active involvement of people with processes of datafication, except perhaps as data producers, and when this leads to friction, the aim is to quickly resolve any ensuing issues. Instead, the controversing approach we discuss here fits in the maximalist and conflict-oriented quadrant of this model. The maximalist end of the spectrum focuses more on an everyday politics of participation instead of institutionalised politics of representation. It entails micro-scale involvement situated at the level of specific socio-spatial domains instead of the macro-level of polis and nation. In addition, it is sensitive to the heterogeneity of actors involved in decision-making processes instead of looking at a homogeneous popular will (Carpentier, 2011: 17–21). The controversing approach is meant as a heuristics that allows us to observe and theorise citizen engagement with the datafied smart city as resulting from the unstable entanglements between publics, technological objects and discursive issues. It is a multivocal, situated and frictional take on 'doing things with data'.

Civic engagement in the datafied smart city

The increasing availability of urban data is claimed to revolutionise the ways in which cities are developed, managed and governed (Goldsmith and Crawford, 2014; UN-Habitat, 2016). Data generated from people's ubiquitous use of technological devices and services spur significant shifts in policy-making, from being data-informed to being data-driven (Kitchin, 2016). In such scenarios, participation in the data-driven city happens in a 'frictionless' manner through the use of smart technologies that collect and process large quantities of data (Tenney and Sieber, 2016). This generates a rather passive form of civic engagement, which places urban inhabitants in the role of 'customers' or 'consumers' rather than citizens with the agency to shape the future of their cities. Moreover, institutional attempts to move focus from smart cities to 'smart citizens', for

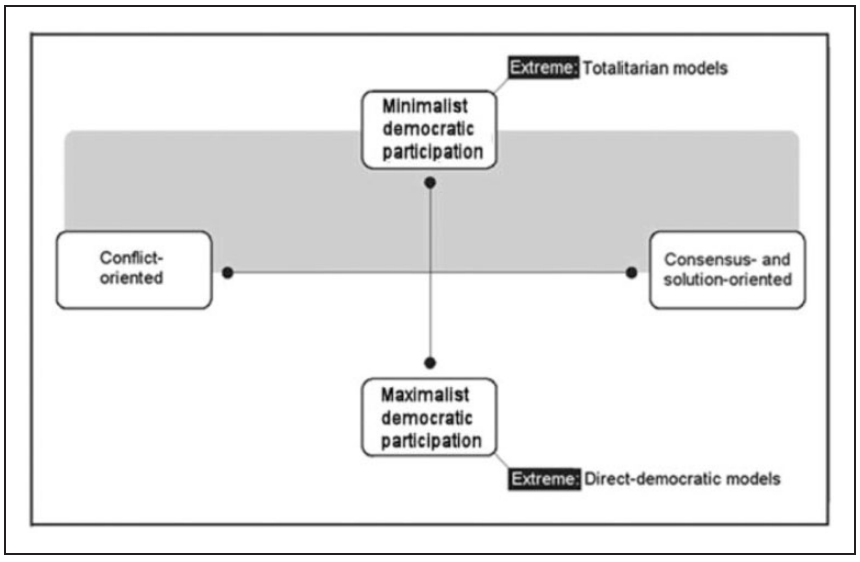

Figure 1. Participation in democratic theory (source: Carpentier, 2011: 22).

instance by involving citizens in monitoring their environments, have been criticised for continuing to reflect top-down, neoliberal and repressive visions of the smart city (Shelton and Lodato, 2019).

The datafication of the city entails complex forms of processing that retract data even further from the grasp of ordinary citizens, cognitively and socially (Michael and Lupton, 2016), while often reinforcing already existing structures, power imbalances and biases (Costanza-Chock, 2018). 'Data' then becomes an abstract notion removed from people's everyday realities, as they do not have the access to, or the means to create, ways to make sense of it. Furthermore, formal strategies centred on processing and visualising large amounts of 'big' data to inform data-driven policies take data out of their spatio-temporal context, thus providing only a partial and decontextualised view of social urban realities (Boyd and Crawford, 2012).

Yet, data is a product of society, of (local) culture and specific moments in time (Dourish and Gómez Cruz, 2018). The 'digital traces' we leave behind reflect place-based, experiential aspects of everyday life; for instance of how we move through, interact with the city and others (Thatcher, 2014). These experiential and situated dimensions of datafication underpin calls for relocalising (big) data (Dalton and Thatcher, 2014; McFarlane and Söderström, 2017), for example in their urban contexts when focusing on data in smart cities. Doing so could open up opportunities for democratising externally developed smart city models by making them relevant to the urban contexts for which they are developed, and the people living in them (Vanolo, 2014). Moreover, relocalising 'big' data by situating them in their urban context can make data 'thick', revealing the social context where it was produced and uncovering the meaning behind data visualisations (Bornakke and Due, 2018; Loukissas, 2019; Wang, 2013). This can thus enable meaning-making and also expose the underlying complexities, frictions and contestations in producing data in the first place.

In order to engage with the datafied smart city, citizens need ways of 'interfacing' with abstract dimensions of datafication in meaningful ways and 'translating' them into collective issues of concern (de Lange, 2019). In terms of democratic engagement in urban politics, this raises the need for mechanisms through which people can engage in formulating the issues that (may) affect them, making 'things' public and formulating them as 'matters of concern' (Latour, 2005a, 2005b). We suggest that socio-technical controversies can have a productive role to play as part of such democratic mechanisms. Specifically, this can unfold through processes of 'making-controversial' issues of concern, which do not see participation as involving one generic public – 'citizens', whether 'smart' or not – but rather as a dynamic process that unfolds through changing relationships with institutional actors.

Controversies as vehicles for civic engagement

Science and Technology Studies (STS) offer a fruitful entry-point for reconceptualising civic engagement in the datafied smart city through the concept of controversies. According to Noortje Marres (2007: 761–765), opening up avenues for participation in issue formation is a key aspect in processes of democratisation. This is because the politicisation of technology (or the ways in

which people formulate an issue) typically revolves around aspects that directly affect people at a specific moment in time, are often mediated and mediatised, and may not be solved through established institutional procedures (Callon, 2004; Marres, 2007: 770; Nold, 2018).

Socio-technical controversies are seen as sites of 'shared uncertainty' and 'situations where actors disagree (or better, agree on their disagreement)' (Venturini, 2010: 4). They tend to arise from shared struggles around things and ideas, which up to that point are taken for granted, thereby transforming unquestioned matters of fact into matters of concern or issues, which in turn produce 'publics' (Latour, 2005b). These characteristics of socio-technical controversies illustrate the public value tensions and contestations around datafication and smart cities already mentioned. We use Marres's work to distil a number of productive insights for understanding how controversies are intertwined with public values and how they drive civic engagement.

Controversies have spatio-temporal dimensions. Do they exist now, in the past, or in the future? Do they exist on a hyper-local scale, or globally, or – in line with one of the axioms from Actor-Network Theory – do they straddle macro-meso-micro levels? Moreover, controversies 'live' through various stages, from being born in issue articulation and opening up debates, to 'de-publicising' and closure (Marres, 2007: 772). For example, in the context of our own research project in Amersfoort, there has been some controversy within the municipality itself about the legalities and desirability of using the commercial services of data company Locatus to trace people's mobility patterns in the city centre through WiFi tracking.[2] An initial pilot suggested benefits for crowd control and spatial planning. Plans to scale up were met with opposition from within the municipality, with the argument that it clashes with the basic task of governments to protect the rights of its citizens. The project was eventually discontinued by Locatus itself due to general data protection regulation (GDPR) violation, effectively bringing the controversy to closure.

Controversies tend to be not just cognitive or rational but also affective. They flare up around issues towards which people have strong shared feelings and/or close personal attachment. In the case, for instance, of predictive policing, the public values we wish to uphold as a society and to which at least some people may feel deeply committed (e.g., safeguarding democratic principles and rights like equality) may clash with deep-seated personal preoccupations (e.g., safety and crackdown on criminality).

Frequently, controversies involve conflicts between professional expert knowledge and the 'folk knowledge' of the general public. In ethnography, this is known as the sometimes tension-wrought relationship between etic and emic knowledge, recently also discussed in relation to data and algorithms (Siles et al., 2020). In the context of datafied smart cities, we can see this strenuous relationship in many citizen-sensing initiatives, which often implicitly or explicitly contest the legitimacy of professional expert knowledge and its production. Inversely, citizen-generated data in itself is frequently not fully acknowledged by professionals or institutions. Controversies are often central to create new interpretative insights and counter-narratives, and for political leverage. Examples include the project Geluidsnet, which measured and visualised noise pollution in the vicinity of Schiphol Airport as a reaction to the official models and measurements that were distrusted (de Lange, 2019); and the Smart Citizen Kit used for measuring air quality (Zandbergen and Uitermark, 2019).

Furthermore, Marres (2007: 764) proposes to shift our understanding of controversial issues as purely discursive to becoming object-oriented 'things' ('matters of concern' in Latourian terms). For instance, in discussions about the future of smart cities, public concerns often revolve around particular objects, spatially situated in specific urban contexts – from the small, like the data-gathering 'smart' lamppost (Zandbergen, 2020) to the extra-large, like the now retracted Toronto Waterfront plan.

Finally, a point we made before and partly derive from Marres' work is that controversies need not be framed as problems to be overcome but can be potentially productive means for fostering participation in the datafied smart city, without necessarily even needing resolve.

In light of the above, we conclude that controversies are central to civic engagement. A controversy-based understanding of civic engagement will consider issues of delineation in time and space as part of any public issue, gives central stage to affects that may flare up and shape the debate, is sensitive to contestation of expertise and knowledge between professionals and lay people, and explores the relationships between publics, discourses and objects. In doing so, controversies can act as resources for agency, mediating and shaping how 'publics' may think, speak and act in relation to the datafied city by opening up spaces for engagement.

These insights allow us to focus on the question of *how* citizens may engage with the datafied smart city using a controversy-mediated approach. In response to our previous discussion on the kinds of civic engagement deficits brought about by datafication, we suggested that the qualities of controversies might help to address these needs. First, looking at spatio-temporal contestations can address the need for

recontextualising urban data, for instance, by situating discussions around datafication around the 'objects' raising frictions. Second, paying attention to affect in understanding an issue and knowledge contestation can address the need to reconsider how meaning-making occurs. Third, and potentially the most important, acknowledging the constellation of publics, discourses and objects, and – again – the sometimes-uneasy relationship between professionals and non-experts, emphasises the fundamental relationality in socio-technical controversies. We suggest that from this relationality agency can emerge: controversies generate a relational space for various elements to rub against one another, for humans and non-humans to move and be moved by others. In the next subsection, we bring these three lines of thought (recontextualisation, meaning-making, and agency) together into a controversing framework.

Conceptualising a controversy-mediated approach to value-focused civic engagement

Against this background we propose the notion of *controversing* as a situated and iterative process to engage citizens in the making of smart cities that address (multiple and diverse) public values. Spanning domains like Critical Data Studies, STS and Urban Studies we further operationalise controversing as comprising three interlinked dimensions.

1. ***Recontextualisation:*** *Controversing 're-urbanises' (big) data by situating contestations around datafication in specific spatio-temporal settings.*

We posit that the re-contextualisation of typically abstracted, generic and globalising smart city data is a necessary precursor to civic engagement. Reflecting wider criticism about the direct adoption of imported urban development models, this can enable more relevant smart city applications to their urban contexts and the people inhabiting them (Vanolo, 2014). Moreover, linking data back to people's everyday environments and lived concerns is a precondition for making it 'thick' with meaning, enabling people to reconnect data to local issues that they find important (Loukissas, 2019). This offers opportunities for creating 'public spaces' around shared matters of concerns, issues and worries in ways that are more directly relevant to how people engage in 'real politics' (Latour, 2005a), when things affect them in specific contexts and at particular moments in time (Marres, 2007).

2. ***Meaning-making:*** *Controversing acknowledges an epistemological need for ways of 'interfacing' with abstract dimensions of datafication in meaningful ways and 'translating' them into collective issues of concern.*

As it was pointed out, making data 'thick' and actively producing data, for example as part of citizen-sensing initiatives, can offer people ways to make sense of it, by uncovering the meaning behind data visualisations or generating new interpretative insights and counter-narratives. At the same time, controversies often flare up around issues for which people care and feel strongly attached to (Marres, 2007). In our view, considering affects and imaginations around datafication and smart cities complements the tendency to address socio-technical controversies cognitively and view civic engagement as rational stakeholdership (de Lange, 2013; Michael and Lupton, 2016). For instance, as part of our project, we are exploring a research-by-design methodology aimed at involving diverse audiences and stimulating different forms of sense-making around smart city issues through participatory design (Matos-Castaño et al., 2020). One example of method that we use to illustrate controversing in practise (outlined here in A 'Controversing walk-shop' method: Illustrating controversing in practice section) combines experiential, awareness-raising methods (e.g., walking) with co-design methods, as a hands-on approach to studying datafication. With our methods, we highlight the importance of moving from mere engagement with datafication to supporting people in formulating shared feelings, attachments, ideas and strategies that could be taken to protect public values, or those aspects of the city and urban life they consider important.

3. ***Agency:*** *Controversies are seen as key actors in processes of democratising datafied smart cities, shifting the onus of participation from individuals to the conditions and strategies enabling and sustaining participation in the shaping of city futures.*

Critical data scholars have raised important questions around the production, access, interpretation and ownership of data. Such questions are particularly pertinent to urban contexts, as they highlight important urban democracy gaps in the governance of cities due to a lack of civic engagement. At the same time, being able to make sense of abstractions like 'datafication' is a prerequisite for people to identify potential frictions and controversies and develop the political capacity to act on them, and thus produce engagement. We suggest that, given their intrinsic relationality, socio-technical controversies can act as a 'glue' for generating spaces for engagement and potential for collective action, which can arise, for instance, through bringing together people, data, sensors, and (urban)

environments. Materialising this potential for collective action requires us to move our attention beyond individual agency to a dynamic and relational form of agency – and therefore, to the conditions and strategies fostering civic participation.

Case(s): Controversing civic engagement in the datafied smart city

In this section, we develop the controversing approach outlined above, by looking at two cases through the analytical lens of *re-contextualisation*, *meaning-making*, and *agency*. Both cases are rooted in the Dutch city of Amersfoort, since this is the prime locus of our research project, 'Designing for Controversies in Responsible Smart Cities', which has led to the articulation of the notion of controversing. The first case is Snuffelfiets, a citizen-sensing project initiated by Utrecht Province of which the city of Amersfoort is part. The Snuffelfiets case serves as a try-out of the conceptual framework for analysing how citizen engagement can be understood as emerging from processes of controversing instead of being a priori assumed, and for teasing out much-needed discussions around public values in the smart city. The second case involves a method developed as part of our research project. This case serves to develop the applicability of the concept in practice, as we place controversies at the centre of participatory practices to proactively engage citizens in shaping smart cities based on public values.

Snuffelfiets: Controversing public values

In the project *Snuffelfiets* ('Sniffer Bike'), taking place in several cities in the central Dutch province of Utrecht, citizens collect data about air quality while using their bikes. The data is collected through mobile sensors in a little box installed on the participants' bicycles, which connects to an IoT network. The project is an initiative of two public partners, Utrecht Province and the National Institute for Public Health and the Environment (RIVM), plus two private parties, the smart city platform Civity and the IoT sensor company Sodaq. While the Netherlands is known for being a bicycle-friendly country, the project claims that not much is known about bikers' preferences and behaviours. According to the project website and an online presentation, the project is an experiment to explore and possibly interconnect several challenges in Dutch cities, including traffic and mobility, air quality, public health, citizen science and civic participation, the potential of big data, and a general sense of wellbeing and people's happiness.[3] While Snuffelfiets was conceived as a fairly non-controversial participatory sensing project, we suggest that approaching it through the controversing lens serves to expose numerous thorny issues that have to do with civic engagement and public values.

When we look at Snuffelfiets through the analytical lens of *recontextualisation*, the first element of our framework, the project shows how abstract public issues like air quality and environmental health can be anchored to very common everyday life practices like riding the bike in one's own living environment. This however is not an unproblematic 'feature' of the project but in our view arises from its 'bugs', that is, its openness to controversing. The project started out in a smaller town (Zeist) and quickly expanded to the two largest cities in the province (Utrecht and Amersfoort). By now it has moved to other cities in the Netherlands and even abroad. The exact aim and scope of the project has shifted over time. It has gone through a number of stages, from an initial proof-of-concept phase to test the basic technical infrastructure, to scaling up the experiment in terms of participation by involving cycling associations, improving data quality, and assessing the usefulness of the data. Through the controversing framework, we can see how Snuffelfiets seems to touch upon a wide range of thematic issues, like air quality, urban heat islands, road surface quality, traffic and mobility challenges, the potential of citizen science and big data, while relating to wider normative debates about, for instance, public health, climate change and sustainable/resilient cities. Moreover, Snuffelfiets data is local but the issues above are complex and networked. This challenges any neat boundaries between micro and macro levels of issues and potential actions. In line with Marres's point about the difficulty of spatio-temporal delineation of controversies, the Snuffelfiets project appears hard to pinpoint and hence is open to multiple interpretations, each with its own spatial anchoring. Controversing Snuffelfiets like this serves to recontextualise abstract issues to specific urban contexts. This is a precondition to make sense of those issues.

When we look at Snuffelfiets through the second term of the framework, *meaning-making*, Snuffelfiets appears to combine a 'rational' approach to issues surrounding bicycle mobility – 'getting the facts' through measurements – with more affective dimensions. From the perspective of participants, air quality, bicycle mobility and motorised traffic are issues that solicit strong feelings because these affect people's everyday life. People may bring their kids to school every morning on their bikes in the morning traffic with palpably foul air, or may feel like they are competing for scarce space with other vehicles on the streets. The way people engage in meaning-making in our view rests on their active participation in the project, being able to

contribute to a communal effort to collect data, interpret it and perhaps change an existing situation, not from letting the 'facts speak for themselves'. We suggest that since the Snuffelfiets's aims are not very explicit or targeting a single outcome, it offers participants the opportunity for storytelling. A presentation during a webinar about the project presents the following statement: 'People like to look at the data after a specific situation where they suspect air quality was bad'.[4] People have the opportunity to recount their concrete everyday lived experiences 'after the fact', by looking back at their own data through the interface, and give abstract issues like air quality or urban mobility a place in these narratives. They may feel empowered to positively contribute to the environment in a hands-on way, while the collaboration of many participants in one project could establish a collective social dimension to these challenges, a communal sense of shared values around a clean environment and the future of city life. Meaning-making however is not the same for everyone involved. For the project founders, meaning-making primarily involves making sense of technical challenges like sensor accuracy, incomplete data and data quality (and to a lesser degree how to do responsible community-management). In presentations given during several webinars, the project initiators mention various issues with the data collection. For example, PM2.5 measurements apparently are good (according to calibrations with high-quality stationary RIVM sensors), PM10 is said to not work well. Nitrogen measurements cannot be done dependably, while sensing vibrations is very experimental and interpretation troublesome, and the data require 'cleaning' to cull out bikes taken along on car rooftops or in trains. The question of what the data represent is equally controversial. For instance, it is easy to mistake the displayed data to directly correlate to motorised vehicle exhaust. In various discussions online and offline, experts point out that there is no direct relation between the data visualisation and car traffic.[5] Humid air may be displayed on the interface as containing more fine particles and thus suggest pollution. On colder days when people turn on their heating systems, the levels of fine particles being measured will increase. An eastern wind from the European mainland also increases aerosol levels, independently of (car) traffic. Datafying air quality thus is controversial and according to the initiators requires expert knowledge to interpret and contextualise. A controversing view highlights how meaning-making is not simply increased by default in citizen-sensing projects. Instead, it is complicated, scattered into many directions, and precariously balances between expert/amateur knowledge, facts and affects, attachment/detachment, communality and idiosyncrasies.

Through the third element in the framework, *agency*, we may see how civic engagement is relational and dynamic. Snuffelfiets is an assemblage of things, people, and issues, fed by a network of distributed bicycles owned by individual participants, numerous IoT sensors crammed into a physical box small enough to be inconspicuously fitted underneath a bike wheel, a backbone of networked infrastructure, an ever-expanding archive of open data stored in a database on some computer server, an interface (app and web) based on dynamic real-time data visualisation, a number of public and private actors who have temporarily aligned their interests in a joint project, and so on. This results in a series of active and also controversial translations. The sensing device measures a range of environmental data, which are categorised into aerosol types (PM10, PM2.5 and PM1.0), temperature, humidity, air pressure, volatile organic compounds, global positioning system (GPS) location and the data/time. The device also contains an accelerometer and vibration meter, that allow for the translation of data into the detection of street bumps. The collected data is moulded into conventional open document formats like csv and xlsx, and made openly accessible on a platform that offers an application programming interface (API) based on the comprehensive knowledge archive network (CKAN) specification for access to resource data. During every step of the process inferences and translations are made. In Actor-Network Theory vocabulary, we could say that the project acts as an intermediary that aligns a wide variety of actants and actors into an unstable alliance that continually translates needs between objects, people and issues (Latour, 2005a). The provisional associations between those elements in the project generate a potential for reconfiguration and change, and hence allow for the emergence of (civic) agency as an unstable and relational force.

By summarising the productivity of controversing as an analytical framework, we address the question of how Snuffelfiets actually is controversial. Is it the definition of the 'object' itself, a 'boundary object' perhaps that connects multiple communities of professionals-amateurs and that represents a variety of (public) values? Is it what the object helps produce (data and its discontents), or what happens with the data? Is it the disagreement on what the data actually represent, and the fact that it cannot be taken at face value? Could it be the mobilisation of 'free labour' veiled as civic participation that the project relies on for acquiring the data? Is it the close entanglement of public and private partners in neoliberal data-driven smart city pilots? For us, it is all the above. Indeed, using the lens of controversing as a heuristic allows us to raise these types of questions about public values in apparently

noncontroversial projects. Some of the technical controversies (e.g., about the quality of the sensors and the data) appear from an engineering point of view as imperfections that can be overcome. We however argue that the merit of the project lies less in striving for technical innovativeness and more in the potential to engage publics in discussions about datafying environmental matters. Civic data collection then is not so much a solution to a problem but quite the contrary, a means of *controversing* concerns at the intersection of (urban) environment, datafication and public participation.

A 'Controversing walk-shop' method: Illustrating controversing in practice

In this section, we discuss how controversing can offer a hands-on approach to involving diverse participants in discussing controversies around datafication and public values in the datafied city through design-oriented methods. We illustrate this with a 'controversing walk-shop' method, which we developed in the context of our research project. In the project, we explore how controversies can be activated and how urban stakeholders can engage with data and public values in smart cities. Through a series of research-by-design interventions, the project looks at how citizen engagement can move beyond merely reacting to externally formulated controversies (e.g., '5G health hazards') towards collectively formulating questions around shared matters of (civic) concern and discussing what they consider to be important public values.

The walk-shop we discuss here combines experiential and awareness-raising qualities of data walking methods (Powell, 2018; van Es and de Lange, 2020; van Zoonen et al., 2017) with co-design elements inspired by the Scandinavian ethos of participatory design (Björgvinsson et al., 2012; Hillgren et al., 2016). We did not aim to develop a data walk but more broadly to use walking as a method to interrupt 'autopilot' forms of interaction with the city. Walking heightens our consciousness of the surrounding environment and thus also of the presence of datafication in-the-making. Paired with specific tasks like observing physical elements related to the datafication of the city, this may increase individual awareness and open up opportunities for collective reflection (Baibarac, 2015). This is key to identifying issues of shared interest and imagining ways of acting on potential controversies. Co-design elements, such as mapping the shared walk experience, defining issues and imagining tactics to act on them, were used as a way of bringing together the participants as a 'public' and negotiate and define 'public values'.

As a design-oriented method, the walk-shop has a future-looking dimension, aimed at engaging participants in imagining and debating 'what if' scenarios. Thus, the method is not focused on conflict. Instead, it aims to create situations through which participants become aware of how datafication engenders or exacerbates value conflicts. This enables them to identify elements of the city that they consider important and ways through which the values these elements reflect can be preserved. Conflicts resulting from socio-technical controversies tend to be felt in 'visceral' ways at a specific moment in time, only when it actually affects individuals. We use design to explore how controversing might become part of ongoing processes of developing responsible smart cities centred on public values. From this perspective, it is important to bring to light and reflect on potential issues and controversies that might emerge when diverse values clash, identifying ways in which they could be tackled before they actually take place.

The walk-shop includes three main steps: *first-hand experiences of space* (step 1/walk), *knowledge sharing* (step 2/walk experience and value mapping) and *reflexivity* (step 3/controversy intensity graph and tactics). This method was tested as part of a meeting with the consortium partners involved in our project, which took place in the city of Amersfoort, in November 2019. The preliminary results obtained during that meeting are used to reflect upon the potential applicability of the concept of controversing in practice. We suggest this could be during the initial phases of planning citizen-centred smart city projects, as a way to sensitise diverse interest groups to values that such projects may strengthen or weaken, foster or ignore, and the potential controversies that could emerge. The results are discussed in relation to the three dimensions underpinning the notion of controversing, to illustrate the applicability of the framework in practice.

Recontextualisation. The first step, the walk, was carried out in a central area of the city, nearby the workshop location. Participants were divided into teams of about three to four people. Some of the participants, who included municipal workers, lawyers, designers and researchers, were fairly familiar with the area. Nonetheless, walking with the task of searching for signs of datafication, assigned roles (e.g., map-maker, photographer, note-taker) and the use of polaroid cameras, prompted the participants to observe their environment differently. As a group, they identified and discussed smart technologies present in the area (e.g., air quality sensors, radio-frequency identification (RFID) readers) and also possibilities for future digitalisation (e.g., personalised city information panels), including potential forms of exclusion that they might

Figure 2. Examples of datafication signs photographed by the participants (source: 'Designing for Controversies in Responsible Smart Cities' project team archive).

create. Some examples of datafication signs photographed are illustrated in Figure 2.

While the types of datafication noted by the participants often included elements visible to the eye and more obvious technologies like surveillance cameras, this step was important for eliciting group discussions about the values each participant associated with them through their own perspectives and practices. For instance, sound sensors installed in a public square reflected the value of public safety for municipal workers. Moreover, it also enabled participants to share their 'folk knowledge' about contextual aspects of the urban environment. For instance, one of the municipal participants pointed out a chiselled cross in the pavement near the central church tower that marks the cadastral centre of the Netherlands, as a physically inscribed symbol of spatial measurement and datafication. Similar to the observations made by others, our initial experiment also suggests that walking while focused on issues of datafication may play an important role in grounding data as material, situated and embedded in everyday life practices (van Es and de Lange, 2020). Consequently, this helps to recontextualise the abstract notion of datafication by bringing it closer to people's everyday urban realities.

Meaning-making. In the second step, participants were asked to create a map of their walks using their notes and the photos they took, and to consider the kinds of values and potential tensions that could be associated with each of the entries on their maps. The resulting maps ranged from geographical representations of the routes to maps based on the group's interpretation of the main tensions and controversies identified during the walk (Figure 3).

The mapping of the walk, particularly through the use of instant photos as tangible evidence of ephemeral datafication processes, enabled group discussion about the effects of particular technologies in terms of the values they reflected and how this shapes the surrounding environment. For instance, deserted shopping streets were associated with increased online shopping. As some of the participants later noted, the mapping exercise helped the groups to discuss and debate potential tensions around datafication, by rendering them visible and explicit on the map. In this sense, we suggest that these maps have a valuable role in establishing a shared situation, a 'meeting place', and promoting a 'common language' between participants from diverse practices and with sometimes contrasting values (Baibarac, 2015). The map acts as a meaningful interface that helps to generate group discussions about emerging controversies around datafication, and makes them debatable.

Agency. The third step included brief presentations of the maps, followed by a collective discussion of the tensions and controversies identified by each group through a 'Controversy Graph' (Figure 4), and ideas about how to make these controversies more explicit. The graph was aimed at categorising frictions into 'visible' (e.g., tensions arising from the presence of

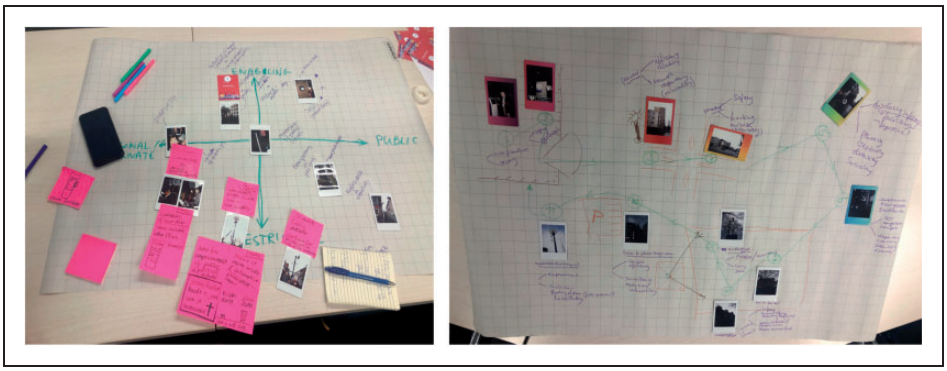

Figure 3. Examples of map representations: Maps based on tensions/controversies identified during the walk (left) and maps representing the route (right) (source: 'Designing for Controversies in Responsible Smart Cities' project team archive).

Figure 4. Illustration of the 'Controversy Graph' (source: 'Designing for Controversies in Responsible Smart Cities' project team archive).

surveillance cameras), 'less visible' (e.g., conflicting values around the same technology, like surveillance, safety, privacy, anonymity, freedom in the case of CCTV cameras) and 'invisible' (e.g., a lack of clarity regarding data ownership, e.g., whether data is collected by private companies or by municipalities).

Based on the controversy graph, the participants were invited to imagine types of strategies that could be used to engage a wider audience with the issues identified. Some of the proposed strategies focused on provoking controversies with the technologies that generate them by situating them in their specific (physical) contexts (e.g., stickers announcing the presence of a 5G antenna). Others included processes that municipalities could develop to enhance participation in smart city projects, by consulting citizens about a technology to be deployed in public space, incentivising them to use it, creating means for evaluation, and implementing changes based on these evaluations (Figure 5). While the strategies presented were speculative in nature, this step illustrates the potential for making datafication actionable by creating conditions for collective reflection on the mediating roles of technology in the city (Verbeek, 2015). By reflecting on desirable human/technology relations, people can define the kinds of values they wish to protect and to come together as a 'public' empowered to act on collective matters of concern.

Discussion and directions for future research

In this paper, we have introduced the concept of controversing as a situated and iterative approach to bolster participation in the smart city by engaging citizens in discussions about urban datafication. We have proposed a controversing framework composed of three main dimensions, *re-contextualisation*, *meaning-making* and *agency*. This framework allows us to address key challenges posed by the datafication of everyday human activities and the implications for civic engagement. We outlined the concept against its theoretical background, tested and reflected on its applicability through the case of Snuffelfiets and the Walkshop as a methodological approach aimed at involving participants in articulating controversies around urban datafication and imagining ways of acting on them. The controversing approach, to reiterate, is not necessarily focussing on existing

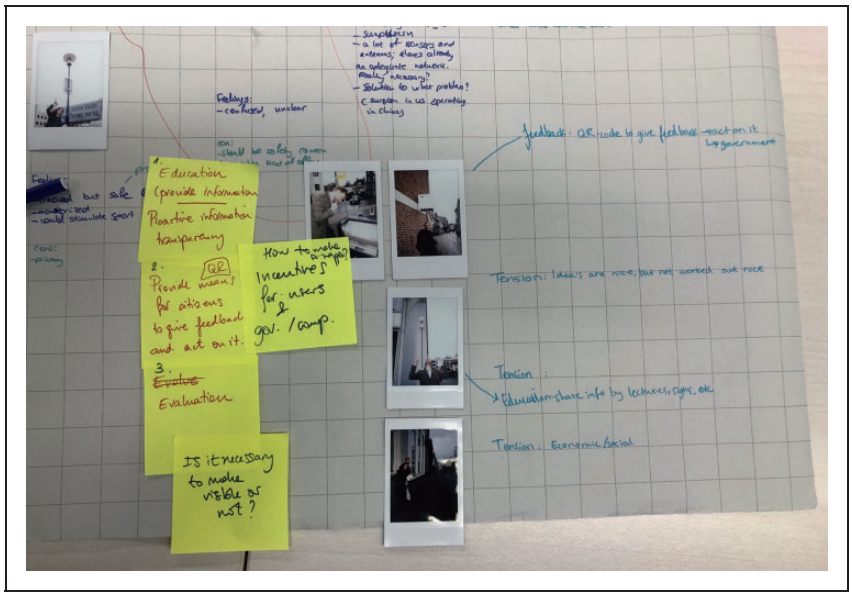

Figure 5. Examples of participants' tactics to address highlighted tensions (source: 'Designing for Controversies in Responsible Smart Cities' project team archive).

controversies in the datafied smart city but is a heuristic for teasing out frictions or creating situations through which datafication becomes debatable, and public values can be redefined and renegotiated.

A key take-away from Snuffelfiets is that data-driven smart/sustainable city projects are brimming with controversies around public values. First, *recontextualisation* exposes the tensions that stem from connecting abstract and global issues like air quality or the future of urban mobility to street level everyday activities like biking. The term recontextualisation is not an argument for simplifying our understanding of datafication by myopically obsessing over the hyperlocal. Snuffelfiets, as we have seen, is local *and* networked, and any attempt at establishing neat spatio-temporal or thematic boundaries exposes entanglements and controversies. The project 're-urbanises' abstract (big) data, by making datafication itself controversial and subject to normative debates about the kind of city people want to live in. Its potential for engaging citizens, we believe, lies not so much in citizen production of data or in engaging people with the project, but in eliciting controversial issues around datafication itself as value-driven and multi-layered. Second, through *meaning-making* we can observe tensions between for instance various modes of narrativising data by participants, initiators or experts. We wish to avoid classifications based on dualistic frames like top-down/institutional versus bottom-up/civic, or rational/fact-based/objective versus affective/fictional/subjective meaning-making. If anything, the controversing approach suggests that those very tensions may increase criticality and self-awareness around datafication and engagement with it. Third, on a superficial level civic *agency* appears in the form of people actively contributing to an otherwise abstract and complex issue like air quality and urban mobility challenges by producing data. However, we have seen that Snuffelfiets does not simply increase agency but actually complicates it. The datafication of urban issues spurs a distributed form of agency across a variety of objects, actors, issues, infrastructures and institutions. The locus of agency itself is controversial. Through controversing, participants may begin to understand and work with those entanglements, learn how to do things with data and thus generate *agency* for themselves. This is in line with the notion of 'recursive civic engagement' where publics reflexively create the conditions for their own existence (Kelty, 2008; Teli et al., 2015).

One of the implications for smart cities, we propose, is that designing them with public values in mind can never simply be done procedurally at the drawing table. There are no a priori blueprints to design for public values. Instead, we suggest that public values around datafied smart cities emerge as the unstable provisional outcomes of controversing. Moreover, what is 'public' about public values is not their shared foundation or singular homogenising force but the fact that the discussions about them are held *in* public. Then, designing responsible smart cities entails creating the conditions for people to participate in (ongoing) discussions about public values.

We explored how this might be realised through our 'controversing walk-shop' method. Here, controversing serves to include people in the process of articulating, making sense of, and collectively defining strategies

around issues arising from urban datafication. This is proposed as a way of enhancing civic engagement in the datafied smart city on the ground, for example by including the method in the initial phases of citizen-centric smart city projects to sensitise diverse parties to the potential controversies that may arise from values that are included or excluded. The method was initially tested within the 'controlled environment' of a meeting with our project consortium partners, and datafication was purposely left open to the participants' interpretation. Acknowledging that the outcomes are likely to change in other settings, the method illustrates the benefits of combining individual awareness through experiential engagement with datafication, with group discussion through map-making and thinking (with) data, and a collective articulation of potential strategies. We suggest that the approach has the potential to bring to the surface elements of practice that may otherwise go unnoticed, expose and question values taken for granted, and help formulate shared goals while preserving value pluralism. Moreover, the examples of strategies developed by the participants in the last step of the walk-shop highlight the importance of creating opportunities for a public not only to formulate issues but also to imagine ways of acting on them. On the one hand, this could counterbalance the current data-driven and 'frictionless' forms of participation, reflecting instead a relational mode of agency, for example generated through connecting people with tools and learning opportunities to understand, use and transform the data they produce (Pybus et al., 2015). On the other hand, creating situations through which diverse individual values are articulated and alternative futures imagined, could challenge how data is ordinarily seen and narrated, creating new 'social imaginaries' (Bendor, 2018) through which collective action, and therefore engagement, becomes possible.

The concept of controversing is still in its infancy. More work will need to be done in order to fully explore its potential for enhancing civic engagement in the datafied smart city. We suggest that a fruitful avenue is to investigate further how controversies around data and the datafication of urban life, once articulated, may be 'stabilised' as an outcome of democratisation processes. Could this be achieved through institutionalising issues revolving, for example, around safeguarding public values? And what might be the role of urban 'mediators' (Calzada and Almirall, 2019; Durose et al., 2019)? What does it mean to have a smart city based on 'public' values? Who are the 'public' and whose values might such a city actually express and support (and the inverse)? How can value pluralism (e.g., McAuliffe and Rogers, 2019) be articulated and co-exist in practice, perhaps as a way of 'unblocking' controversies and releasing their potential as agents of change?

Controversing requires a leap in how policymakers think about and develop smart cities: a different way of seeing and doing. While making controversies visible or explicit can be seen as a crucial aspect in the democratic governance of the datafied smart city – as conditions for participation – we argue that it is equally important to create strategies for acting on them through civic engagement. Some controversies may, by their nature, recede into the background once defined, as they become part of normalised everyday practices. Other controversies, however, may need to be stabilised – or acted upon – through institutionalising, for example addressed through formal institutions, such as policy-making or education around specific topics. We would like to invite an exploration of alternative forms of 'stabilising' controversies, by looking specifically at their intrinsic relationality. This involves opening up spaces through which provisional associations can emerge. The 'gluing' of relations between humans and non-humans, technology and wider techno-social issues, such as sustainability and climate change, to name a few, would enable us to shape new social imaginaries. Freeing the imagination about *other* smart city futures may just be the key to start building them together.

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Notes

1. Project website: https://responsiblecities.nl/.
2. Source: personal communication with Amersfoort municipal data manager Janette van Dijk on 5 December 2018.

3. Source: https://snuffelfiets.nl/experiment/ and https://www.datakennishubgsl.nl. For technical details, see: https://sodaq.com/projects/sniffer-bike/ and https://civity.nl/wp-content/uploads/2020/04/brochure-Snifferbike-20200401-Civity-1.pdf.
4. Source: https://snuffelfiets.nl/wp-content/uploads/2020/05/Webinar-12-mei-2020-1.pdf, p. 10.
5. Data repository: https://dataplatform.nl/#/data/9cc4de28-6d03-4b59-8c66-085b3e8b3956 and real-time visualisations: https://snuffelfiets.nl/data/. Under the hashtag #Snuffelfiets, some debates can be found on Twitter about data quality.

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