Citizens, Surveillance and Sensing Responsibly:

a Consultory Digital Ethics Approach to the Simple Sensors Concept

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1. Introduction

ities are busy, ever-expanding places with increasing numbers of inhabitants. Such population increases highlight the need for crowd management, as having many people in one place comes with challenges for public safety. The solution for many municipalities is the use of surveillance technology or the placement of cameras and sensors in the public space. These technologies, though useful, come with ethical concerns regarding privacy and the collection and use of obtained data, are they used responsibly?

Enter the Responsible Sensing Lab (RSL), an organization concerned with developing responsible sensing technology for municipalities. RSL is founded as part of the Amsterdam Institute for Advanced Metropolitan Solutions (AMS) and works together with the municipality of Amsterdam. At RSL, sensing technologies are (re)designed in a way that aims to incorporate the values citizens hold with regard to privacy, control, and freedom and those outlined in the Tada manifesto for responsible digital cities.¹ RSL translates these values into design choices for sensing technologies through multiple projects. One such project is Simple Sensors (see Figure $1)^2$, where the design for crowd management and environmental sensing technology is adapted to be more privacy friendly and transparent. In this report we examine the Simple Sensors project from a data ethical perspective. The purpose is to uncover potential points for improvement regarding ethical data practices through a consult. The consult is informed by the Data Ethics Decision Aid (DEDA)³ and a conceptual framework further outlined below. Simple Sensors is an interesting prospect for such a consultation since the project stands for being a

more ethical and responsible approach to sensing. Going over their approach from an outsider's perspective can be valuable to the project and organization.

The case of Simple Sensors is interesting from a national perspective, too. Movements for standardization and a better grip on the processes surrounding sensors and the technology itself are rising municipalities related among and governmental organizations. One such initiative is 'SensRNet': an online register for sensors.⁴ SensRNet includes an information model for classifying and registering sensors, as well as a model of the data collection and publishing processes. Apart from privacy by design, the ethics of sensor surveillance does not play a very large role in this national initiative. As a project largely concerned with ethical surveillance, Simple Sensors could provide an example for municipalities across the Netherlands hoping to improve their surveillance practices.

In what follows, we first introduce the Simple Sensors and the technology they employ in (Section 2). Subsequently, in (Section 3) we provide a theoretical framework for the interview conducted with RSL by discussing the opposition between surveillance and sousveillance and data feminism. In (Section 4), we give an overview of our interview and its relation to our theoretical framework. This overview provides the basis for (Section 5), in which we expound and critically discuss points of advice, namely (a) citizen participation, (b) inclusive research and development, (c) accessibility of the data flow and (d) the limits of sousveillance.

¹ Tada, "Tada Manifest," accessed on

^{28/03/2022,} https://tada.city/.

² Responsible Sensing Lab, "Simple Sensors," accessed on 29/03/2022.

https://responsiblesensinglab.org/projects/simple-sensors.

³ Utrecht Data School, "Data Ethics Decision Aid (DEDA)," accessed on 29/03/2022, https://dataschool.nl/en/deda/.

⁴ Kadaster, "Home of the SensRNet," accessed on

^{28/03/2022,} https://kadaster-labs.github.io/sensrnet-home/.

2. Technology: What are the Simple Sensors?

R SL is a pioneering organization when it comes to ethical sensing technology and educating governmental actors with their Responsible Sensing Toolkit.⁵ Our point of departure will therefore not be to *criticize* RSL, rather we aim at *contributing* to their valuable work by discussing data ethical topics. The points we raise in what follows are aspects that, in our opinion, require attention and could guide directions for future work on the crowd management sensing technologies of RSL (such as the modular Simple Sensor and the Shuttercam) and their deployment. In what follows we will refer to these technologies simply as `sensing technologies.'

Simple Sensors is a technological concept developed by RSL as a privacy friendly and transparent alternative to ordinary public sensors, such as Closed Circuit Television (CCTV) or other cameras that are ubiquitous in Amsterdam's public space and cities more generally. Simple Sensors is the conceptual term that encompasses four types of sensors that are currently developed: (i) crowd management sensor (mmWave); (ii) environmental noise sensor; (iii) air quality sensor; (iv) water quality sensor. The Simple Sensor poles are systems of different modules. For a visualization of the different models see Figure 3 in the Appendix. For an analysis of the role of these modules in citizen participation as related to the advice of section V, see Table 2 in the Appendix.

These Simple Sensors should solve two problems when it comes to sensing and monitoring, and simplicity is the key aspect in their solution. On the one hand, simplicity refers to the *software*, meaning that each sensor solely collects what it is intended for. Moreover, the collection model is integrated into the design of the hardware. As a consequence, changing the software data collection model is not possible without having to completely redesign the sensor. Each sensor thus serves one specific purpose and collects as little data as possible while still collecting sufficient data for the municipality to make improvements in a specific domain. Secondly, simplicity is also a key factor when it comes to the hardware. RSL aims to make monitoring and surveillance visible to citizens. The simple design of the hardware functions as the translator that communicates how the sensor works, to make monitoring and surveillance understandable and approachable. The hardware displays the following information: the number of people in a certain area; the transmission interval and to what party the data is sent (e.g., the municipality of Amsterdam); and if the threshold is passed (if applicable).

In this consultation, we focus on the sensor that is built for crowd management ends. The crowd management sensor uses mmWave technology which registers the shape of objects by emitting and receiving radio waves and is hence capable of calculating the population of the crowd in its demarcated area—note that the mmWave technology is currently only capable of recognizing the shape of humans. The sensor distinguishes itself from ordinary crowd management technologies who typically collect excessive amounts of data of which the operator merely interprets a small portion to extract the crowdedness from that data. Compared to a camera that registers faces for example, the mmWave can distinguish humans from other kinds of objects but cannot identify these individuals. During the interview, we learned that the Simple Sensors are currently merely a prototype and not set to practice yet.

⁵ResponsibleSensingLab,"ResponsibleSensingToolkit,"accessedon26/03/2022.https://responsiblesensinglab.org/responsible-sensing-toolkit.

3. Theoretical framework and

method

n this section, two theoretical frameworks are set-up and applied to the Simple Sensors. The first is the transition from surveillance to sousveillance and the second is the data feminist approach to data practices. Using the notion of problematization and a previous study by the Rathenau Institute on citizens' perception of sensors, we connect both frameworks to function as a foundation for our method.

3.1 Theoretical framework A: From Surveillance to Sousveillance

The first facet of our conceptual framework pertains to the transition from surveillance to sousveillance.

Traditionally, crowd monitoring technologies are understood as practices of surveillance, or observing from above.⁶ A crucial characteristic of surveillance is the impenetrability of surveillance practices. Whilst citizens are rendered highly visible by observation technologies, observers remain largely invisible. This prevents citizens from 'looking back' at the observer.⁷ Monitoring techniques are often hidden from citizens' view (though their possible presence is always emphasized) and it is unclear when they are being operated and by whom.8 This results in a heightened sense of insecurity and visibility for individuals, moving them to self-regulate according to behavioral norms.9 visibility More practically, and information

asymmetries may prevent citizens from holding observers accountable, objecting to observation practices, and questioning the decisions made on the basis of the obtained data. Surveillance thus rests on and perpetuates striking power asymmetries between the observers and the observed.

Aiming to overcome these power asymmetries, Steve Mann coined the term sousveillance, implying observation from below.¹⁰ Ever since, authors have applied the term to a variety of technologies and practices which are united in their aim to empower citizens and involve them in crowd monitoring practices.¹¹ Sousveillance rests primarily on rendering monitoring techniques transparent. Those in power can do so themselves, for example by making internal documents publicly available and showing - as the municipality of Amsterdam has done¹² – where CCTVs are located. Individuals may also do so by monitoring observers with cameras and sharing abuses of power on social media platforms.¹³ Sousveillance thus mitigates the power asymmetries inherent to surveillance by giving everyone the power to observe.

Moreover, it has been argued that sousveillance allows citizens to control observation techniques and those parties employing them.¹⁴ As a movement, sousveillance aims to make information about crowd monitoring publicly available and wishes to ignite conversations about monitoring practices.¹⁵ Consequently, it equips citizens with the knowledge to understand and question how and when they are observed. It has

⁶ Hille Koskela, "Cam-Era – The Contemporary Urban Panopticon," Surveillance and Society 1, no. 3 (2003): 293-294; Jean-Gabriel Ganascia, "The Generalized Sousveillance Society," Social Science Information 49, no 3 (2010).

⁷ Michel Foucault, Discipline and Punish: The Birth of the Prison, transl. by Alan Sheridan (Harmondsworth: Penguin Books, 1979), 201-202; Koskela, "Cam-Era," 298.

⁸ Koskela, "Cam-Era," 298-299; Steve Mann, Jason Nolan, and Barry Wellman, "Sousveillance: Inventing and Using Wearable Computing Devices for Data Collection in Surveillance Environments," Surveillance and Society 1, no 3 (2003): 333.

⁹ Foucault, Discipline and Punish, 201-203.

¹⁰ Steve Mann, "Sousveillance': Inverse Surveillance in Multimedia Imaging," In Proceedings of the 12th annual

ACM international conference on Multimedia, (New York: International Multimedia Conference, 2004): 620.

¹¹ Mary Ryan, "Sousveillance as a Tool in US Civic Polity, in Spaces of Surveillance: States and Selves, ed. Susan Flynn and Antonia Mackay, (Cham: Palgrave Macmillan, 2017): 211.

 ¹² "Sensoren Crowd Monitoring Systeem Amsterdam [Sensors Crowd Monitoring System Amsterdam]," Municipality of Amsterdam, https://maps.amsterdam.nl/cmsa/?LANG=nl
 ¹³ Ganascia, "The Generalised Sousveillance Society,"
 492-494

¹⁴ Mann, Nolan and Wellman, "Sousveillance," 337.

¹⁵ Mann, Nolan and Wellman, "Sousveillance," 345.

been argued that consequently, powerful observing parties will act more responsibly, for example by using less invasive technologies or centring citizens in decision-making.¹⁶ A failure to do so can be recorded and shared and may lead to social or political repercussions. Sousveillance thus equips citizens with a heightened sense of empowerment and powerful actors with a heightened sense of responsibility. In their effort to make monitoring explainable to citizens, Simple Sensors and RSL seem to align with this aim.

While many see sousveillance as a promising forward, others step are more cautious. Sousveillance may render visible monitoring technologies of which individuals had previously not been aware. This results in a heightened sense of visibility and increased self-regulation, thus perpetuating rather than undermining the mechanisms of surveillance.¹⁷ This concern may pertain to Simple Sensors as well, as their aim is to make citizens aware of crowd monitoring practices. Parallel to its empowering effects, this visibility also emphasizes the possibility of being watched, possibly making citizens feel more watched than in traditional CCTV set-ups, which are often hidden from the public's eye. Others have argued that, without proper feedback and accountability mechanisms in place, sousveillance gives citizens the illusion of control whilst power asymmetries remain.¹⁸ In other words, whilst sousveillance may allow citizens to understand and object to monitoring techniques, this does not result in empowerment if political actors fail to respond to these objections.

We use this conceptual transition to understand how Simple Sensors may facilitate citizen empowerment by contributing to a sousveillance system. Questions informed by

¹⁶ Ryan, "Sousveillance as a Tool," 219.

sousveillance concern mostly the expected effects of Simple Sensors on citizen behavior and how Simple Sensors enable citizen involvement. This concerns passive involvement i.e. citizens' access to information about monitoring technologies as well as active involvement i.e. possibilities to provide feedback.

3.2 Theoretical framework B: Data Feminism

To map possible power assymetries, we complement the concept of sousveillance with a data feminist perspective. Data feminism is a strand of feminist theory that mainly analyzes and combats the enforcement of structures of oppression through inequal distribution of power in data practices such as data collection, processing and interpretation. Important applications are AI-practices like machine learning or automated decision making.¹⁹ Central to intersectional analyses of data feminism as D'Ignazio and Klein describe it, is 'the matrix of domination'; a fourfold framework for interpreting society's power distribution. Without deeply immersing ourselves in elaborate explanations of the concept, we can claim that two of the domains are relevant for municipal crowd management technologies: (i) the disciplinary domain - the enforcement of inequalities and inequities with respect to laws and policies, and (ii) the interpersonal domain - the experiential aspects of oppressions in individual's daily lives.²⁰ Connected to opposition between surveillance the and sousveillance, municipal surveillance by means of Simple Sensors can be seen as an instance of the disciplinary domain, possibly reproducing policies' inequalities in the data practices surrounding

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 ¹⁷ Chloe Anna Milligan, "Participating in '1984': The Surveillance of Sousveillance from White Noise to Right Now," in Spaces of Surveillance: States and Selves, ed. Susan Flynn and Antonia Mackay, (Cham: Palgrave Macmillan, 2017): 149.
 ¹⁸ Frank Möller, "Celebration and Concern: Digitization, Camera Phones and the Citizen-Photographer," in Images in Mobile Communication: New Content, New Uses, New

Perspectives, ed. Corinne Martin and Thilo von Pape,

⁽Wiesbaden: VS Verlag für Sozialwissenschaften, 2012): 74-75; Ryan, "Sousveillance as a Tool," 222.

¹⁹ Catherine D'Ignazio and Lauren F. Klein, "The Power Chapter," in Data Feminism, (Cambridge: The MIT Press, 2020), 4.

D'Ignazio & Klein, "The Power Chapter," 6; 7-9

sensors. Aspects of citizen sousveillance (be it citizen-government sensing or citizen-citizen sensing) can be paired with the interpersonal domain by virtue of the forms of oppression experienced by citizens or the forms of resistance enacted by them in interaction with sensor technology.

The power relations embedded in data practices are highlighted by the way states of affairs are questioned. One can identify the means, ends, and marginalized groups involved in data practices by asking who-questions about them, i.e. who reaps their benefits and who bears the costs.²¹ Consider, for example, the data feminist maxim D'Ignazio and Klein recount for us: 'what gets counted counts.'²² Applied to sensors, what is measured and how (how data is collected, how data points are weighted), who is monitored and why (the possible influence of (implicit) discrimination) and which collected data points matter most are power-sensitive data feminist questions. Using sensor technology is hence a sociotechnical practice in the web of power.

Beyond the identificatory aspects of data feminism, it also proposes a revaluation of concepts that secure power into concepts that challenge power. Concepts like ethics, fairness and understanding algorithms can be appropriated for oppressive purposes - consider, corresponding in the same order, ethics bluewashing²³, fairness as reproduction of the status quo, and a myopic focus on algorithms abstracted away from the social. In contrast, they propose concepts that enable the oppressed to combat their negation in data practices: justice instead of ethics, equity rather than fairness, and placing understanding history, culture, context understanding and above algorithms.24

3.3 Theoretical framework C: Synthesis

The work done by Bunders and Varro on the problematisation of data driven urban practices bridges the frameworks of sousveillance and data feminism by connecting who-questions about the social logic of policies to smart urban technologies like sensors. They present a Foucauldian concept of problematization and use this to explain the challenges surrounding smart cities and the (implicit) political choices present in municipalities' actions and policies in this field. Through expertinterviews, Bunders and Varro survey technological, legal, organizational, informative and participative strategies employed in municipalities to come to terms with problematizations of data-driven urban practices. They conclude that employees of municipalities do not uncritically engage in datapractices and AI-technologies. The authors call for a broader (in terms of the number of participants and larger group diversity) problematization of datadriven urban practices that require further contextualisation to reveal the social logics (i.e. power relations) present.²⁵

Regarding the citizens' experience of the consequences of that social logic, a study conducted by the Rathenau Institute on citizens' experience of sensor technology can serve as a basis. The Rathenau Institute surveyed citizens so as to better understand the public's conception of, attitude towards and sentiments regarding sensor technologies. The most important conclusions of their research were that privacy should be part of the sensor by design, transparent information should be supplied, individual's sense of freedom be

²⁴ D'Ignazio & Klein, "Collect, Analyze, Imagine, Teach," in Data Feminism, 12-13.

²¹ D'Ignazio & Klein, "The Power Chapter," 26.

²² D'Ignazio & Klein, ""What Gets Counted Counts"," in Data Feminism, 1.

²³ Luciano Floridi, "Translating Principles into Practices of Digital Ethics: Five Risks of Being Unethical," Philosophy & Technology (May 2019) 32: 187.

²⁵ Damion J. Bunders, Krisztina Varró, "Problematizing data-driven urban practices: Insights from five Dutch 'smart cities'," Cities 93 (October 2019): 146; 148-150.

respected and that the use of sensors should not lead to discrimination. $^{\rm 26}$

To sum up, the data feminist perspective and the concept of sousveillance inform our consultation of the Simple Sensor project through (i) the questions posed about the project and in conversation with RSL and (ii) the concepts used to structure our advice on future directions taken by the initiative.

3.4 Method

The empirical component of this consultation consisted in an interview with a representative of RSL.²⁷ The theoretical frameworks discussed in the previous section guided our conversation with RSL and our reflection on their technologies. Each question was informed by the application of a framework to sensing technology in general and the Simple Sensors and RSL's development strategy in particular. For the questions, see table 1 in the Appendix of this document. For each question, the framework it is inspired by is listed - if the question is informed by sousveillance, data feminism or the DEDA -, as well as a short motivation for the question itself.

The questions sparked further conversation with RSL's representative. We documented, structured, summarized and reflected upon this conversation, an overview of which is available in section IV. Based upon this picture of RSL's views on our data feminist- and sousveillance-informed questions, section V provides points of advice regarding room for development within RSL's programme and technologies. Each point of advice is accompanied by a critical discussion so as to contextualize them and avoid the consultatory pitfall of presenting advice as 'quick fix' solutions.

4. Responsible Sensing Lab about data feminism and sousveillance

4.1 Practical understanding

efore diving into theoretical questions about data feminism and sousveillance, we wished to gain a better understanding of the practical aspects of the technology and data flows. Starting with these questions concerning data, we wondered what data were collected, for what kind of research the data were used, and how the Simple Sensors are protected against risks. As just mentioned, responsible monitoring is at heart of what RSL does. The answers on these questions form RSL's definition of responsible sensing. The data that Simple Sensors collect are minimized. As explained, the mmWave sensors can serve as a replacement for cameras. This ensures that only the data is collected that is necessary for certain monitoring or analyses - for example, you would like to know how many people are on a square or place, not necessarily who those people are. Concerning risks, it is not completely thought through how information could anonymous possibly he (re)identified. We will elaborate on this in our advice on accessibility of the data flow.

4.2 Data feminism

Besides a practical understanding of the technology and collected data, the data feminist framework allows us to examine the tool's broader implications. Our questions from this framework were twofold. We wanted to know more about the *communication and evaluation* of the technology towards the audience, the citizens of Amsterdam, and wanted to know

²⁶ Dhoya Snijders, Marijn Biesiot, Geert Munnichs, and Rinie van Est, Citizens and sensors – Eight rules for using sensors to promote security and quality of life, (The Hague: Rathenau Institute, 2020), 101-103.

²⁷ Authors' note: We leave the organizational function of the representative unnamed for purposes of privacy.

about whose perspectives were considered in the *design* of the Simple Sensors.

It was during the interview that we learned that the Simple Sensor is currently a prototype and therefore not communicated and evaluated with citizens in а real scenario. Concerning communication, RSL explains that the Simple Sensors will come with an explanation card that also contains contact details of RSL. When it comes to the citizen's attitude towards the final design, this has thus not been tested yet. However, one can draw lessons about both communication and evaluation from other sensors, such as the Shuttercam.²⁸ When the Shuttercam was tested, passengers were asked 'what they thought about it.' Unfortunately, most people did not seem to care about the camera enough or they simply never thought about surveillance before. RSL acknowledged that this is not the best way to communicate about surveillance technologies, nor is it the way to do a proper evaluation. The lack of knowledge or interest is a problem that RSL encounters frequently. Most people are not concerned, aware, or involved when it comes to surveillance technology, which is a barrier to RSL for improving the evaluation of technologies. As such, it remains challenging to facilitate the evaluation of the Simple Sensors and other monitoring technologies by a group that represents the affected parties. It can therefore not be stated what the attitude of the citizens of Amsterdam would be - even if the Simple Sensors were more than a prototype.

Because the Simple Sensors are not put to practice yet, we could not take a closer look at the representativeness of the data and the data processing. However, we did discuss who were represented in earlier phases of the design process. To make sure that other perspectives than that from professional designers were taken into account, RSL involved lay people during the design phase. This way, RSL tried to ensure that a more representative group has its say in evaluating each iteration of the Simple Sensor design.

When it comes to data feminism, it becomes clear to us that RSL is aware of the importance of clear communication and representative evaluation of their technologies but does not seem to know how to overcome the barriers that obstruct proper communication and evaluation. Including lay people into the design phase of the Simple Sensors is one way to keep affected people in mind, but as subevaluations are often not done on a large scale, it is likely that the perspectives of a selected, nonrepresentative group guide the design of the sensors. This risk can be mitigated by critically looking at whose perspectives are considered during the design process and in the processing of the data. Also, a more holistic view on how to solve these barriers, such as a general understanding or interest in surveillance and monitoring technologies, could help to understand how to clearly communicate to affected individuals and how to better evaluate a sensor in practice. In our advice in the section on inclusive research and inclusive evaluation, we'll elaborate on these statements.

4.3 From surveillance to sousveillance

Although the term sousveillance is quite philosophical, RSL recognises and engages with the concept in their designs. To achieve sousveillance, citizens need *understanding* and a possibility for *participation*. Accordingly, the final concept of the Simple Sensors emphasizes playfulness and the interaction between the sensors and the passengers. RSL explained that these features serve to make abstract topics explicable. By making concepts such

²⁸ Author's note: The Shuttercam is a camera of which the hardware shows whether it is turned on or off. It is inspired by the lid some people use to securely open or close their webcam, cf. Responsible Sensing Lab, "Shuttercam,"

accessed on

^{29/03/2022.} https://responsiblesensinglab.org/projects/shut tercam2.

as surveillance, monitoring, and artificial intelligence simpler and more approachable, RSL hopes to close the gap between sensing and understanding of the sensed passengers. Simplicity is a key term when it comes to explaining their technology. The Simple Sensors are designed so that the passenger can easily see and understand what is monitored, for example the number of people on a square. This could impact someone's behavior. We wondered for what purposes it would serve to actually steer citizens into a certain action. However, the sensors are not designed to trigger a specific change in behavior. To illustrate with an example: during the Covid-19 measurements, one may have wanted to know how many people are walking around a square. One could then decide on a course of action, but the Simple Sensors are not designed to ensure that only a maximum number of people will be on the square at a certain time.

Although simplicity is key in making the technology understandable for lay people, a possible risk is that complex concepts are presented too simplistic. The transparency paradox appears to be a genuine problem for RSL. We wondered, therefore, if the playful and interactive features of the design are not only necessary to *explain* what a sensor is doing, but also *to create more awareness* about surveillance and monitoring in general. RSL explains that explanation is the primary goal, but that overall awareness and literacy can be seen as a secondary objective. However, more digital literacy and understanding of surveillance is necessary to transition to sousveillance.

Alongside understanding, citizens should have clear possibilities for participation to achieve sousveillance. RSL cannot ensure participation on all levels, however. For example, whether a certain place is monitored is a political choice that is up to the municipality. RSL cannot impact such decisions. However, as long as monitoring practices are in place – whether this concerns crowd monitoring, air quality, excessive trash or parked cars – RSL wants to ensure that this is done justly, responsibly, and relatively transparently. We notice, however, that there is something tricky with regard to the earlier mentioned simplicity of the design. As explained, the Simple Sensors display the number of people in a certain area, the transmission interval and to what party the data is sent, and if a threshold is passed. It remains vague, however, how RSL uses simple communication to empower citizens to take certain actions. In other words, an understandable design might give the impression that citizens are now able to take actions, while the actual handles to take such actions are still lacking. In that case, it looks like the power of surveillance is shifted to the public sphere, while in reality it merely gives the impression of sousveillance rather than incentives for sousveillance.

A second problem arises from the transparency paradox: whilst RSL may not communicate all relevant information to citizens, it may simultaneously be undesirable to do so. We can distinguish between the front- and the backstage of the technology. Let us suppose that the Simple Sensors clearly explain to passersby what the sensor does and how it works (i.e. the frontstage). How can one ensure that the average citizen also understands the other relevant practices such as data collection, data processing, and possible consequences or measurements based on the data (the backstage)? RSL is developing a project about visual language and iconography to make the backstage of technology more explainable and approachable. While it is important to communicate the backstagefacet to citizens, such efforts also result in an even larger amount of information, which may overwhelm citizens and make technologies more difficult to understand. RSL recognises the predicament induced by the transparency paradox and emphasizes that 'transparency' might not be the right term to use because it is almost impossible to overcome. Instead, they focus on explainability and negotiability to make the transparency paradox a more practical problem to tackle. Rather than communicating all aspects of a technology, RSL wishes to broadly explain its relevant features to enable citizens to critically engage with monitoring practices. This vision is in line with our vision of sousveillance: explainability will lead to understanding, just like negotiability will lead to participation amongst the citizens.

5. Advice and discussion

aving characterized the Simple Sensors and having reflected upon the context and consequences of the crowd management sensing technology using the data feminist way of questioning and the sousveillance vs. surveillance theoretical framework, we have now arrived in a position were some aspects worth discussing have come to the fore. To facilitate a clear discussion about the points raised, we have merged the advisory and discussible aspects into a single body of reasoning. In doing so, we hope to provide a context for our points of advice for RSL while at the same time acknowledging points of improvement are never 'solutions' abstracted away from the practice of sensing technology development, but rather always situated decisions, leading to unexpected connotations or problems of their own.

5.1 Citizen participation

The interaction between citizens and sensors is the backbone of the Simple Sensors project. The way this interaction is currently facilitated is through (playful) gimmicks that are part of the sensor. See table 2 in the appendix for a discussion of the Simple Sensors' modules and their relevance and adequacy for citizen participation.

During our conversation with RSL, we discussed further involvement of citizens for multiple purposes. In order to improve future research, (a

more diverse array of) citizens can/should be included in the design process, which is discussed in the next section. This section is concerned with citizen participation in the light of increasing the municipality's accountability with respect to sensor usage. The Simple Sensors are also intended as an interface to city management.²⁹ There is room for development concerning this goal. The situation signaled by us is that in interaction with the Simple Sensors, citizens seem to be in a more powerful position Vis-à-vis the surveillance system, but we contend this is mainly a *frontstage* affair. 'Backstage' on the other hand, by which we mean on the side of the data processing as opposed to the data collection, the matter seems to be different. There, the data is fed into business intelligence tools, the crowd management systems or other applications, but the citizen whose data is collected has no such power. It is not our intention to argue that the citizen should have full control or anything similar to that. Rather, what is missing from the frontstage/backstage opposition, is the ability on the side of the citizen to hold the municipality accountable for the data practices backstage, as would for example be the case by establishing a realtime dialogue. A possible way to improve on this 'accountability gap' is that citizens should have more say in the behavior of the sensors and a means to interact with the sensor and its processing of data.

Additionally, Simple Sensors could invest in mobile applications to increase citizen participation, which have already been successfully implemented for municipal asset management in public space. As municipal assets - due to the digital or mechanical data collection functionality - Simple Sensors may benefit from similar practices. Citizens are urged to participate in public space monitoring by using these applications that can make notice of all kinds of problems with municipal assets. Successful mobile

²⁹ The Incredible Machine, "Simple Sensors Final Concept," 20, available for download at https://responsiblesensinglab.org/projects/simple-sensors.

apps that facilitate the interaction between citizens and the municipality's asset management department are Fixi³⁰ and MeldDesk.³¹ A solution like MeldDesk uses a free application for citizens (the 'MyGemeenteApp') and envelops a management system for the reports received from citizens. One imagine how systems similar to this can report/management system can be used for (i) processing questions about sensors; (ii) receiving feedback on the workings or placement of sensors; (iii) processing citizens' complaints; and (iv) facilitating communication between citizens and the municipal data or customer management department. Access to the sensor a citizen wants to report on can be facilitated via scanning QR-codes or filling in the object-ID of the sensor in-app. QRcodes and object-IDs are common practices in municipal asset management, used for example for the on- and offline identification of light poles. Other desirable functionalities are specifications and descriptions of the municipality's sensors and a map with locations of the sensors in the city, reminiscent of SensRNet's sensor map.32

Discussion

Prima facie the mobile applications seem like a good solution, but it entails a problem of exclusion, namely the exclusion of all citizens without a smartphone or a smartphone capable of running the mobile application. The deployment of the CoronaMelder-app in 2020 for example, led to the exclusion of 2.3 million possible users.³³ Nonetheless this issue is far from untoppable. The mobile app covers the main share of users, so the exclusion of

³⁰ Fixi, "Fixi - map," accessed on

25/03/2022. https://www.fixi.nl/#/issue/new+map.

³¹ BeheerVisie, "MeldDesk in het kort," accessed on 25/03/2022.

³² Kadaster, "Use Cases (NL)," UC2.01, accessed on 26/03/2022. https://kadaster-labs.github.io/sensrnetthe smaller share constitutes no reason not to deploy the app to facilitate citizen participation. Rather, the deployment of the app could be supplemented by means targeted at the excluded group. We suggest two options: (i) a browser-based version of the app which is accessible from personal computers. As such a share of the excluded group that does not have a smartphone but does own a laptop or some other personal computer gains access to the digital citizen participation options. The second option (ii) consists in a fully offline way of citizen participation. As a part of the sensing modules, a 'dial button' can be added through which direct contact with the municipality's service center can be established. This add-on, trumping the current 'suggestion box' module, would allow citizens without a smartphone personal computer а to participate. or Supplementing the app with (i) and (ii) would lead to such a good coverage as one can reasonably ask of RSL's projects.

5.2 Inclusive research and inclusive development

In the conversation with RSL, note was taken on the research practices currently employed to include the public's opinion in the deliberation process underpinning the development. We observed room for improvement in the set-up of said research: the neighborhood-based collection of citizens' opinions is direct, but biased by the demography of the neighborhood. From this set-up we cannot deduce the presence of conclusions being impaired, but there is room for improvement nonetheless. Investing in more inclusive ways of research consisting of samples from neighborhoods all over

home/UseCasesNL/#uc201-burger-krijgt-inzicht-in-sensorenop-de-kaart.

³³ RTL Nieuws, "Geen CoronaMelder voor ruim 2 miljoen mensen: telefoon te oud," published on 21/08/2020, last updated on 21/08/2020. https://www.rtlnieuws.nl/tech/artikel/5178642/coronamelderoude-telefoon-update-corona-app-werkt-niet-iphone-android.

https://www.beheervisie.nl/meldingenmanagement/melddesk -in-het-kort/.

the city will surely calibrate the sensors even more according to the needs of citizens than is currently the case. A representative share of all citizens of Amsterdam should be involved - especially the people in the focal point of the City of Amsterdam's sensor practices, like the CMSA or cameras for security purposes. Another advantage of widening the research base is that by increasing the diversity and number of participants, excuses like a lack of motivation or interest to partake in the study can be compensated for by reaching more people who are concerned about these matters.

Relatedly, during the discussion with RSL it was mentioned that a team of sensor-hobbyists contributes to the development of the sensors. However, it was made clear that the group is not demographically representative of Amsterdam's population. Measures to diversify this group would also contribute to a more inclusive design perspective. The diversification in turn has positive consequences for the road towards *design justice*: the diverse group can design technology with more groups in mind rather than (implicitly) excluding certain groups in the design process.³⁴ Think of including people with mental or physical disabilities, for example. Their perspectives will shed light on the useability of the sensors. For the visually impaired, to give but a crude example, the Simple Sensors is all but useless as is. To make the design and the immediate area of the sensor usable for the visually impaired, one has to consider acoustic (or olfactory) rather than visual communication. Also, the mobility question is different for the visually impaired as well; think of reachability in the form of guide tiles.

Discussion

The problem the Simple Sensors project strives to solve, namely the lack of civil participation and

insight into the workings of crowd monitoring sensors, serves as an obstacle to its development. Some groups may be skeptical of crowd management in and of itself, which is why they do not feel called upon to supply such a project with feedback. This lack of participation perpetuates not only the current state of sensing technology - which could benefit from their feedback - as well as their own skepticism. A possible way to improve on this situation is by targeting representative people in specific neighborhoods. They could play a role in connecting skeptical citizens to RSL and the City of Amsterdam.

5.3 Accessibility of the data flow

A third point is the responsibilization of the process of the data flow out of the Simple Sensors throughout the municipality and beyond. As Van den Hoven's work on informational harm argues, information can not only be used to directly harm malappropriation people (by or increasing inequality), but also to indirectly harm them through unjust further processing. Van den Hoven especially warns us of unjust transfers of data across social spheres. Data has since long been a good fit for trade, as well as a resource utilized for other purposes. In the case of the Simple Sensors, the data is not strictly personal data, but aspects of one's mobility are still being registered and used as input for the municipalities' processes.³⁵ The question this then leads us to is: how can one enable the citizen to use (if desired) and exert control over the collected data as well? What is at stake here is that by virtue of being a citizen traversing in public space, the one lacks agency with regard to the mobility data about oneself, which is enclosed in the sphere of the municipality (and possibly companies with access to the data). We can see why this is a

³⁴ Sasha Costanza-Chock, "Design Justice: towards an intersectional feminist framework for design theory and practice," Proceedings of the Design Research Society 2018 (June 2018): 6.

³⁵ Jeroen van den Hoven, "Privacy and the Varieties of Moral Wrong-doing in an Information Age," Computers and Society 27, no.3 (September 1997): 35.

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problem: the data processed by the municipality are about *me* and intuitively I should have something to say about what happens to that data.³⁶

While Simple Sensors takes steps to mitigate this problem, these steps do not address control or involvement per se. Connected to this is the button that is part of the design of the mmWave sensor to shut off the sensor for a limited time. Temporarily opting out is not the same as involvement in the process of the data flow, however. The 'download data' module comes closer to addressing the problem, but gives citizens a copy of their data rather than control over the data flow. We propose thinking of a 'solution' to this predicament in terms of group rights rather than individual rights. It is infeasible to track oneself as a data point through the flow of data and hence sharing the data via a download or airdrop option is irrelevant to control over the data concerning one's person. What is feasible however, is to provide access to the data flow for citizens as a group. Inspired by the planned modeling of SensRNet (see figure 2),³⁷ one could go one step further than providing citizens access to the publishing node containing visibility of sensors on a real-time map, but making the aggregated data flow open access as well. Not only transparency and accountability concerning what is registered but also the transfer destinations, like third parties or municipal departments are of importance for just data processing.

Lastly, it is not completely thought through how anonymous information could possibly be (re)identified. Although the mmWave does not collect personal data, we can think of scenarios in which identification could occur. Suppose that someone crosses a Simple Sensor on a square but passes a camera at the street that follows, this person could then be identified if the datasets were combined. Although we did not specifically ask questions about this scenario, RSL did not come with a statement of how such events could be prevented. Our recommendation is, therefore, to create clearer protocols on data analysis and data sharing. This could help to better secure people's privacy.

Discussion

It could be replied that open data realizes only an illusion of equitable data usage across the parties that have access to it and hence entails a reinforcement of inequalities between big and small parties.³⁸ If, for example, the raw data, outside of business intelligence applications or dashboards of some sort, is useless to the average citizen, then data access is worth nothing to them. Nonetheless, this could be made a matter of moral principle: we should opt for the open data solution and accept the reinforcement. Citizens deserve to have access in principle, regardless of practical consequences.

5.4 Limits of sousveillance

Through the Simple Sensors, RSL aims to create the conditions for sousveillance. The technology makes crowd monitoring and data collection technologies visible and explainable. This can equip citizens with a better understanding of municipal data practices and consequently allows them to hold those in power accountable through elections or by providing feedback. Whilst Simple Sensors can generate the benefits of sousveillance vis-à-vis surveillance, the technology does not not escape the limitations of sousveillance *per se*. As stated in III.a, scholars have critiqued sousveillance for installing an illusory sense of control while citizens have very little influence on crowd monitoring practices. This limitation applies to

³⁶ Van den Hoven, "Privacy and Varieties of Moral Wrong-doing," 36.

 ³⁷ Kadaster, "SensRNet Systeembeschrijving," accessed
 at 25/03/2022. https://kadaster-labs.github.io/sensrnet home/SystemDescriptionNL/.

³⁸ Jonathan Cinnamon, "Data inequalities and why they matter for development," Information Technology for Development 26 no.2 (2020): 221.

Simple Sensors as well. Although the technology may enhance accountability and citizen involvement, the technology has its limits in that it does not change the fact that citizens *are* observed. Nor does it impact directly where and when this observation occurs or the heightened visibility and selfregulation induced by crowd monitoring technologies - but Simple Sensors may aid in igniting debates about this. Though it seems like Simple Sensors address this issue in temporary on/off buttons, such modules do not enable direct and active citizen control over monitoring technologies.

It is important to stress that RSL recognises this limitation and that the organization does not have the political power to alter where and when monitoring techniques are installed and employed. These are political issues, and the responsibility for them ultimately lies with the municipality of Amsterdam. Nonetheless, it is an important limitation to recognise: Simple Sensors (and sousveillance in general) are not truly empowering if the political climate within which they are employed perpetuate inequalities and unethical practices. Given the intent of the municipality of Amsterdam to make crowd monitoring technologies more humane and ethical, this limitation may not highlight a severe problem. It does highlight, however, the undiminished importance of critical and political debates regarding crowd monitoring and who it affects alongside the development of technologies that aim to involve citizens and approximate sousveillance.

6. Conclusion

rowd monitoring technologies are a widespread and complex phenomenon. While crowd monitoring serves clear public interests and is a crucial facet of public space management, it also has a profound effect on citizens and is prone to excessive data collection and processing. RSL's Simple Sensors recognise and respond to these issues by investing in privacyfriendly and simple designs and making understandable the operations of crowd monitoring techniques to citizens through these designs. Simple Sensors may equalize power relations and information asymmetries. Simple Sensors also engage with citizens in and inform them about crowd monitoring processes, and potentially enable citizens to exert more control over surveillance technologies. As such, Simple Sensors signify a promising and crucial way forward to more humane and privacyfriendly crowd monitoring.

Recognising and celebrating this significance, we believe that Simple Sensors could enhance their current practices even further. Simple Sensors could increase citizen empowerment by equipping the Simple Sensors with a direct feedback option (such as a mobile app); could make the design process and result more inclusive and representative by actively gathering input from marginalized and underrepresented voices, especially those who may be more skeptical of city surveillance; and could ensure active citizen participation by introducing group level data control alongside options to temporarily disable sensors. Incorporating such measures would be an extra step in ensuring that everyone is involved in and benefited by monitoring practices. Especially when incorporating these measures, Simple Sensors can provide the conditions for generating awareness and making surveillance more citizen- and privacycentered. It is up to all of us to consequently use these conditions for igniting critical and constructive conversations about surveillance and holding those in power accountable to ensure that we are practicing more than merely the illusion of control.

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8. Appendix

Figure 1: The main components of the Simple Sensor³⁹



The sensor module 'sees' moving objects (such as people) as a collection of points in space



The data module: the measurements of the sensors are translated into data, and the numbers are shown to the public



The transmission module shows the transmission interval, including to what organization the data is sent



The threshold module shows when certain thresholds are being crossed

Figure 2: SensRNet's sensor network model. Our directions of improvement would apply to the secretion of data in the publishing node, visualized in the top right



https://responsiblesensinglab.org/projects/simple-sensors.

³⁹ Responsible Sensing Lab, "Simple Sensors," accessed on 29/03/2022.

Figure 3: The Simple Sensor modules

	TENHER ENER	Biteriew)	evironment dincise sensor	air quality sensor
B B M M M M	real-time data	Transmission interval	real-time data	theshold indicator
	Press toplay		Download data	on On/Offswitch
Processite inductor	Ally anterheads	With sysue that more T	Lugeton Cugorations	ee fe districué ses Perliscope
Seat	Solar power	Street dot	Sample demarkation	Us such my sum the sum of the sum being of the sum of the sum the sum of the sum the sum of the sum the sum of the sum of the sum in the sum of

Table 1: Questions for RSL

Framework embedding	Question	Motivation
DEDA	What data are being collected for the project and for what kind of research is it used?	Adapted from the data related considerations of the DEDA: questions 8 till 10.
Sousveillance vs. surveillance	Why is it a good thing that the citizens of Amsterdam receive additional triggers from sensor systems to influence their behavior?	It is worth discussing why management of citizens is a good thing or what purposes it serves according to RSL.
DEDA	Your website describes that research is conducted into the citizens of Amsterdam's attitude to the Simple Sensors. Can you elaborate on this study and are you willing to share the results with us?	Adapted from the communication related questions of the DEDA: 26 and 27.
Sousveillance vs. surveillance	Where do you (not) hope the Simple Sensors will be placed?	Location is an aspect to the practice of using sensing technology that is highly political.
Sousveillance vs. surveillance	In your final concept for the Simple Sensors emphasis is placed on playfulness and the interaction between the sensors and the passersby. What is motivating this emphasis?	The motivation behind this question is the initial sense of wonder in reaction to the inclusion of playful aspects. In what sense is the sensor mechanism improved from an ethical perspective by this inclusion?

Sousveillance vs. surveillance	What information with respect to data collection and processing would be shown on the sensors?	The answer to this question would deepen our knowledge with respect to the citizen-sensor interaction.
Data feminism	Whose perspectives are being taken into account in the design process and the data processing?	Citizens remain data subjects and sources of data, even if the data on their behavior is shared with them in creative ways.
Data feminism	Who do you think profits from passersby's tolerant attitude towards the sensors? The passersby, because they feel safer in public space, or rather the municipality, because their frontstage appearance is the deployment of ethical sensors? The crux of the question is: does a considerable amount of transparency in only a part of the data lifecycle lead to an illusion of transparency where the whole of the lifecycle is concerned?	The ethically aware front stage possibly masks processes that occur backstage where passersby would be less content with.

Data feminism	In what sense is the observing party reachable for the observed party and is the observing party willing to be accountable for the sensing process? Is it a possible improvement of the Simple Sensor to include a way to facilitate direct contact between the observer and the observed party?	In the Responsible Sensing Toolkit a lot of attention is devoted to the invasivity of every sensor type and ethical principles for project descriptions. Next to that, the limitations for placing sensors in certain areas are discussed. But what is the envisioned relationship between the observer and the observed? A sense of involvement is one thing, but an egalitarian relationship is wholly something else.
Data feminism and DEDA	(How) is the technology protected against manipulation of the registration process, for instance against collecting more data than is necessary (accumulation) or against collecting data with personal identification risks?	In other words: how can one be sure the sensors will not be appropriated for uses other than the intended uses, i.e. for surveillance capitalism? Partly inspired by DEDA question no. 44.

Table 2: Modular analysis of the Simple Sensor

Simple Sensor module	Relevant for citizen participation	Adequate for addressing citizen participation	Motivation	Where in the Simple Sensors final concept?
Air quality sensor	No	Not applicable.	The air quality sensor is a means for data collection. It is not a module meant to facilitate interaction between citizen and sensor.	Page 35
Citizen adjust threshold	Yes	Yes, since no time limit on the adjustment is specified.	The threshold adjustment clearly invites to be involved in the sensing process. Adjustment here is the power to contribute.	Page 42
Dance moves and street dot	Yes	Attractor of attention: peripheral to the bureaucratic participation process.	Draws attention to the sensor and induces citizens to interact with the sensor.	Page 49
Download data	Yes	No, it is not fully adequate. See the point of advice on accessibility of the data flow for further details.	Downloading the data is an essential mechanism for citizens to be involved in the data collection process.	Page 45

Environmental noise sensor	No	Not applicable.	The environmental noise sensor is a means for data collection. It is not a module meant to facilitate interaction between citizen and sensor.	Page 34
Information surface	Yes	No, information enabling the citizen to participate in the backstage data processing could be added. See motivation.	The information surface could contain information about how to contact the municipality concerning the sensor (QR-code for mobile app and object-ID of identification) next to the information it already contains regarding the modules in place.	Page 48
mmWave sensor	No	Not applicable.	The mmWave sensor is a means for data collection. It is not a module meant to facilitate interaction between citizen and sensor.	Page 33

On / off switch	Yes	No, since the time limit on the sensor's off-time makes the usage of this module only a temporary exercise of power: the citizen has no 'real control.' The citizen also cannot provide the municipality with information as to why the sensor should be turned off.	The on / off switch is the most impactful action in the citizen/sensor interaction repertoire.	Page 43
Periscope	Yes	Attractor of attention: peripheral to the bureaucratic participation process.	Draws attention to the sensor and seduces citizens to interact with the sensor.	Page 46
Press to play	Yes	Attractor of attention: peripheral to the bureaucratic participation process.	Seduces citizens to interact with the sensor.	Page 41
Real-time data (count)	Yes	Yes, since it is a transparency measure related to real-time data collection.	The visualized count reflects an aspect of the data registration back to the passersby.	Page 37

Real-time data (thermometer levels)	Yes	No, since it is a transparency measure related to real-time data collection. It is of interest to the citizen how the baseline thresholds are related to the values 'low,' 'high' and 'alarming.'	The thermometer level reflects an aspect of the data registration back to the passersby.	Page 39
Sample demarcation	Yes	Yes. Communicates scope of perception of sensors. Equips citizens with necessary information regarding monitoring techniques.	Communicates as aspect of the workings of the sensor to the passersby, namely the scope of the sensor's perception.	Page 50
Solar power	No	Not applicable.	Solar power is related to the way the sensor is supplied with electricity, not with	Page 47

Suggestions	Yes	No, the 'notes with suggestions' are not adequate to provide substantial and sustained feedback. How will the citizen know it is surely processed and reported back on by the municipality's responsible departments? See the advice concerning citizen participation in mobile apps (Va.).	An essential entry point for openness to the public's opinions and ideas.	Page 44
Threshold indicator	Yes	No: it is of interest to the citizen how the baseline threshold are related to the indication 'too much.'	The threshold indicator provides a clear means of data communication with the citizen as recipient.	Page 40
Transmission interval	Yes	No: why does the indicated interval have this or that length?	The transmission interval reflects to the citizen a temporal aspect of the background data processing process.	Page 38
Water quality sensor	No	Not applicable.	The water quality sensor is solely a means for data collection.	Page 36

