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Sensing in the wild: A DCODE DRS Lab exploring a more-than-human approach to distributed urban sensing

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Abstract: The Sensing in the Wild Lab is a speculative experiment in designing a decentralised urban sensing system from a more-than-human perspective. It is part of DCODE, an H2020-ITN project that explores the future of designing with AI. During the Lab participants assume different identities – roleplaying as children but also as moss, as municipal authorities, as CCTV cameras, as pigeons, and as undocumented immigrants trying to evade the authorities – and are asked to feed into the sensing system data that reflects their particular perspectives and interests. The data participants share, in the form of an image and text uploaded to a dedicated WhatsApp channel, helps to reveal both frictions and alignments among actors. In this, the Lab offers municipalities an opportunity to shift their thinking about the future smart city from a "system of systems" that is optimised for a few city dwellers to a much more distributed, inclusive meshwork in which data is contributed, circulated, and negotiated by humans and nonhumans alike.

Keywords: smart city; speculative design; more than human; creative methods

Team: *Convenors*: Roy Bendor, Chris Speed; *Researchers*: Carlos Guerrero Millan, Seda Özçetin, Mugdha Patil, Grace Turtle; *In collaboration with:* Amsterdam Institute for Advanced Metropolitan Solutions; Open Future; Arkitektura Saila, Euskal Herriko Unibertsitatea.

1. Introduction

Governments around the globe are taking measures to digitise cities by developing and deploying urban sensing systems. Alongside this, there is an increased focus on investment in open data initiatives such as the European Union Data Act (Vogelezang, 2022). While such initiatives indicate a promising outlook for the responsible digitisation of cities, the tethering

of urban technologies to big tech conglomerates such as Siemens, Microsoft, Cisco and Google risks flattening the diversity and rich cultural tapestry of cities, raising concerns about the role of these systems in shaping emergent socio-technical phenomena (Hollands, 2008; Townsend, 2013; Mattern, 2021; Sadowski & Bendor, 2019).

In response to this situation, the *Sensing in the Wild DCODE Lab* for the DRS 2022 conference held in Bilbao was set to explore alternative distributed modes of sensing in dialogue with data interoperability, data sovereignty and data governance. The Lab also investigated emerging forms of social organisation, particularly that of Distributed Autonomous Organisations (DAOs) and did so as a speculative experiment. It was intended to tactfully explore alternative pathways to distributed urban sensing within different geographical and disciplinary contexts. Specifically, the Lab sought to provide a platform for critical and creative engagement with current and future urban data and the sensing technologies used to configure, manage and organise life in the city.

Key to the Lab was the development of what we refer to as 'speculative roles' in the creation and facilitation of the workshop, including a *data medium, network therapist, crystal ball gazer,* and *human-machine ombudsbot*. These roles were crafted in response to the emerging need for post-industrial design capabilities that can meet the challenges of a more-than-human world (Forlano, 2017; Giaccardi & Redström, 2020) and, by extension, engage with human and non-human agency in the making of cities (Forlano, 2016; Sheikh, et al, 2022).

1.1 Why do we need distributed sensing?

The type of data captured, encoded and made visible, by whom, and for what use, have a complex social, cultural and political history in relation to power and control in city-making (Brayne, 2020; Greenfield, 2013; Halpern, 2015; Halpern et al., 2017; Townsend, 2013). Recent years have seen emergent strategic investment and initiatives concerning open data and data interoperability in the making of cities by the European Union, policymakers and technology providers alike (eur-lex.europa.eu, 2022). Nevertheless, these practices often lead to certain ways for translating the physical world into information, knowledge, and so forth that conform to hegemonic notions of value, representation and expertise (Costanza-Chock, 2020; Loukissas, 2022). Therefore, it is important to address the plurality and diversity of urban experiences that are threatened by current data collection and management practices.

1.2 Why do we need a more-than-human perspective?

Humans' overwhelming presence in cities may deceive us into thinking that cities are made up of, and belong to, humans and thus must be designed and governed from human-centred perspectives. While it is humans who build cities, mainly for themselves and mostly for the privileged and able-bodied (Hendren, 2020), it is not only humans who occupy, belong to, and shape the city. The many nonhuman lifeforms – from pigeons to bees, trees to flowers – and nonhuman machines – from buildings to cars, lamp posts to trash cans – also occupy,

belong to, and shape the city. Our cities, in other words, are more-than-human (Sheikh et al., 2023).

It is therefore necessary to take a new approach to design and city-making. Understanding that humans are just one of the actors in a complex and rich system calls for new collaborations that can better represent and organise the plurality of values and frameworks to be included in different urban decision-making processes. From this perspective, the roles and practices proposed in the Lab aim to help designers and non-designers to perform as mediators, advocating for less visible nonhuman agents (Forlano, 2017).

1.3 DCODE as the context for the lab

Sensing in the Wild is a *prototeam* project within DCODE[1], bringing together 4 design researchers in collaboration with the Amsterdam Institute for Advanced Metropolitan Solutions (AMS), and Open Future. The main aim of *prototeams* is to develop scientific knowledge to prototype future design roles that may reorient professional design practices.

AMS provided the team with concrete examples of urban sensing infrastructure including an overview of the benefits, risks and opportunities associated with urban sensing systems as critical urban infrastructure. Open Future contributed with a conceptual and theoretical frame on commons-based democratic data governance in light of the emerging regulation of data intermediaries such as the EU Data Act of 2022.

In relation to such situational and theoretical contexts, the team developed speculative future design roles that acted as a lens through which specific data acquisition and analysis could be tested. These roles are summarised in table 1.

Table 1. Description of prototeam roles

Lens	**Role**	**Description**
Agency (*Sustainable Socio-economic models*)	Human-Machine Ombudsman (ombudsbot)	Develops mechanisms for awareness and contestation for every agent in the network to exercise their agency
Negotiation (*Democratic data governance*)	Network Therapist	Works with agents to build healthy relationships with the network through ongoing dialogue, negotiating expectations and fears
Plurality (*Future practices*)	Data Medium	Explores the plurality of data sources and the representation of diverse experiences and stories represented within a system

[1] DCODE (Fundamentals of Design Competence for Our Digital Future) is a Horizon2020 Innovative Training Network (ITN). The aim of the network is to develop a fundamentally new understanding of how design, as an interdisciplinary field of research and practice, can anticipate the digital transformation of society powered by Big Data, Machine Learning and Artificial Intelligence, and form a holistic understanding of the different interests and agencies involved – human and artificial – to create the conditions for responsible and sustainable futures.

Anticipation (*Trusted Interactions*)	Crystal ball Gazer	Curates data to anticipate future probabilities and changes within a system

1.4 The aims of the Lab

The ambition for the Lab was to experiment in a living social context and understand the complexities and plurality of the city as a site for probing more-than-human urbanity. The Lab was guided by the following questions:

- What if urban sensing systems moved from control-based, closed and centralised modes of sensing to more commons-based, open and distributed modes of sensing?
- How then might urban sensing systems capture and maintain the diversity, layered history and rich cultural tapestry of place in their design and use?

Furthermore, the Lab sought to engage with local future city-makers – architecture students and faculty from the University of the Basque Country in the city of San Sebastian (neighbouring Bilbao) – to draw attention, discuss, and reflect on existing and speculative sensing technologies. In doing so, participants were given the opportunity to reflect on city-making practices in light of current and speculative sensing technologies, while providing the team with insight on the suitability of the experimental method.[2]

2. Structure and Process: how Lab activities were planned

2.1 The overall structure of the workshop

The workshop was designed as a game, drawing from Roger Caillois (2001) taxonomy of play, and from Agusto Boal's (1992) *Games for actors and nonactors*. Playfulness offered the team a way to observe, analyse and understand human-nonhuman relationships and behaviours while using speculative sensing technologies that already include structured rules, intuition, deliberation and decision-making. The full-day workshop consisted of five stages 1) Onboarding: introduction of the workshop; 2) Warm-up: creation and embodiment of roles; 3) Data collection: going "into the wild" to collect and report data; 4) Network therapy: reflecting on the collected data and what it means for the platform; and, 5) Feedback: an overall evaluation of the workshop with participants. A more detailed description of these stages will follow in section 3.

[2] The first iteration of the workshop was presented during the DCODE Summer School in Delft. The team facilitated two 2-hr sessions with 12 and 9 participants mainly consisting of design academics and postgraduate students.

In the game, participants were part of the *Uncommon Crowd*[3], a fictitious distributed urban sensing DAO platform, which provided the context to situate and enact the speculative roles and act as a vehicle for data collection and curation.

2.2 Developing the format

During the early stages of development of the project, the team sought to critically and creatively engage with data capture, translation and use via urban sensing systems, and in such a way that challenged dominant uses of sensing systems, by exploring speculative forms of commons-based sensing and the consequent tension between computability and incomputability (Finn, 2017). As a starting point, the team scouted De Wallen (Amsterdam's Red Light District) as an experimental setting to support the development of the workshop. The area's rich culture, history and diversity allowed the team to refine the research questions and settle on values and drivers that would inform the forthcoming experiment and exploration into distributed sensing.

2.2.1 Agent identity cards

Speculating on how to advocate and work with new values, supported the development of a diverse group of archetypical personas (hereafter called 'agents'), that would be relevant to a commons-based urban sensing system. These included Stewards, Non-human life forms, Non-human Machines, Residents, Guests and Investors (see Figure 1). Naming these characters as agents served to introduce them as members of the *Uncommon Crowd,* where they were on a quest to contribute new data to the platform, thus providing the context for participants to embody their roles as part of the game.

2.2.2 Mapping

In order to situate the workshop, the team created a conceptual urban map of Bilbao with suggested points of interest and interventions. The map helped participants navigate the city as well as providing a starting point to stage 'encounters' between the agents and their physical context. Points of interest included objects, places, spaces, activities, social interactions, feelings and behaviours (see Figure 2). Agents were encouraged to find these different examples during the next stage.

[3] In the game, *Uncommon Crowd* is a platform data-commons, Decentralised Autonomous Organisation (DAO), launched in 2025 in resistance to centralised urban crowd-sensing systems that, while being publicly accessible, remain closed and controlled entities. The *Uncommon Crowd* advocates for increased self-determination in the use of urban sensing systems. The platform allows for the responsible sharing of data between its members, providing users with greater access to information while producing and curating more unique datasets that help them plan for and anticipate changes to their daily life experience of the city.

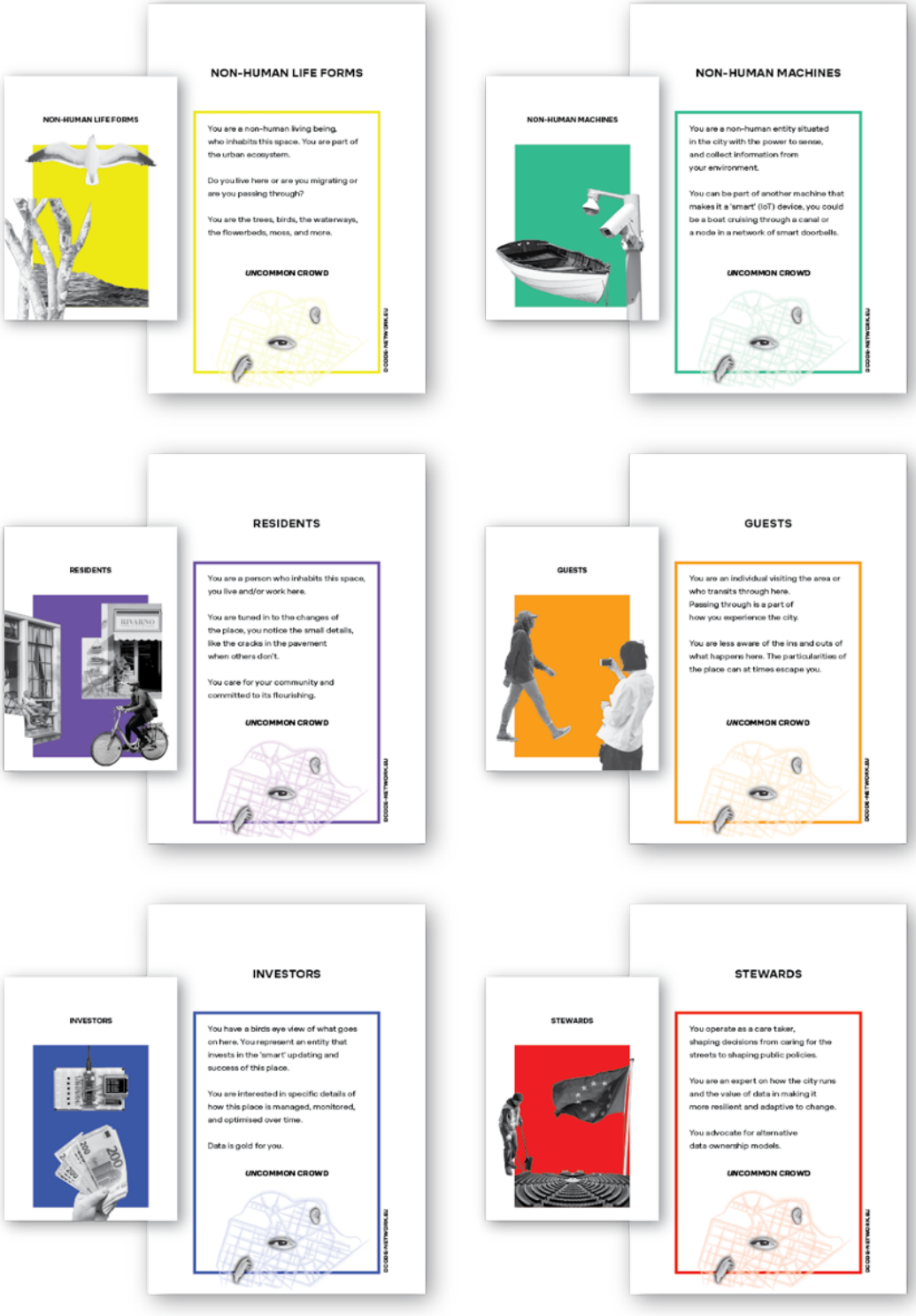

Figure 1. Set of Agent Cards and their descriptions

Figure 2. Points of interest for staging an encounter for data capture

The map provided participants with instructions for 'staging an encounter' in a place they perceived interesting and relevant, and a set of prompts for reporting data to the group via WhatsApp (see Figure 3). When staging an encounter, participants were asked to answer the following questions from the perspective of their particular agent:

- What do you sense? (in relation to that place)
- Imagine if it could tell you anything? (e.g., how, what, when)
- Describe how it might help you get what you want?

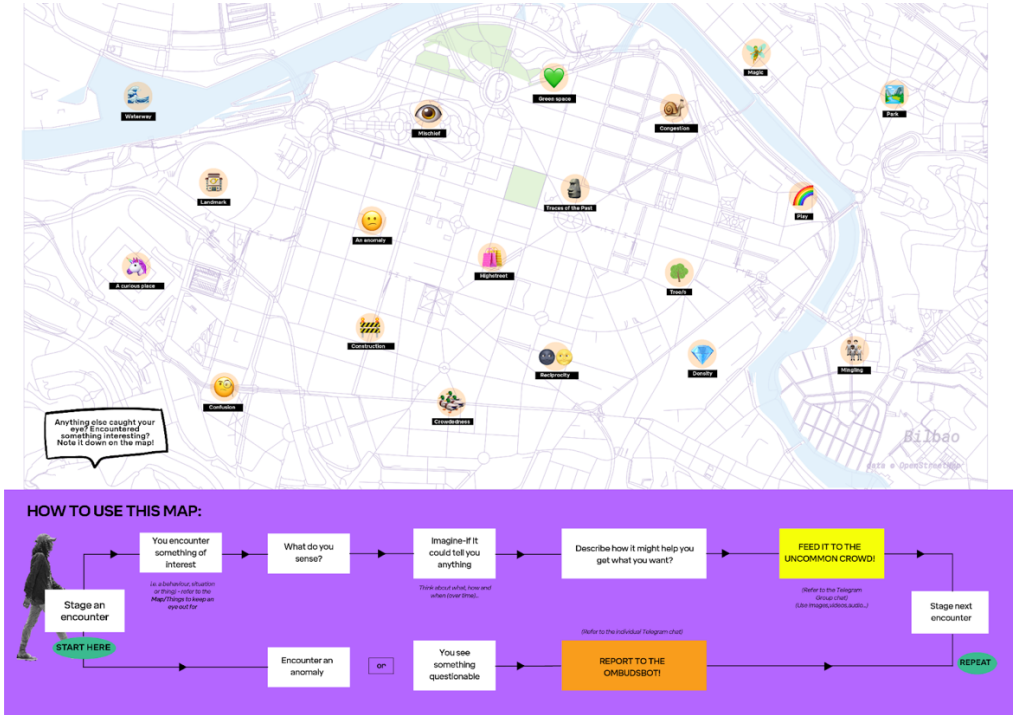

Figure 3. Map of Bilbao with Instructions

2.3 Expectations about the kind of data participants may contribute

The Lab aimed to expand the scope of 'sensing' so as to encourage the diversification of data acquisition by different agents, but also to surface the negotiation of information by asking what was made visible, by whom and to what end. Accordingly, during the workshop, agents

were tasked with gathering diverse data types (audio, visual, sensory, etc.) based on their (roleplayed) needs and desires; representing data that may have been previously either overlooked or under-represented; and negotiating the implications and opportunities associated with the representation and use of diverse urban data. By doing so the team hoped that participants would be able to reflexively engage with their agency when collecting data from the perspective of their performed roles as agents, thus bringing into question what can be encoded (and decoded) by urban sensing systems, and those engaging with them (Guyan, 2022).

2.4 Remaining concerns before facilitating the Lab during DRS

The main concern was whether Uncommon Crowd, developed in the context of Amsterdam, would be flexible enough to be explored in another location, Bilbao, and if it would surface enough urban tensions to work through. Furthermore, in previous workshops, participants were not only familiar with but also open to more-than-human design methods. Would architecture and urban planning students have similar attitudes? Would the time allocated for the workshop be sufficient for creating interest and engagement? And finally, would participants be able to overcome language barriers?

3. On site experience

3.1 Onboarding

The Lab, facilitated by 4 design researchers, took place at Bilbao Tourist Office and involved 12 participants for the duration of 6 hours. During the onboarding process the team provided participants with information about the nature of the workshop, their roles and the overall objectives (see Figures 4 and 5).

Figure 4. Workshop materials: Info sheets, consent forms, maps, agents, cards.

Figure 5. Onboarding: Before the activity started, participants were introduced to Uncommon Crowd and the game instructions were described.

3.1.1. Agent roles

Participants were randomly assigned agent roles using the cards shown in Figure 2. These, while providing basic information about agent categories, allowed participants to start crafting a background story, desires, needs, politics and even speculative personalities in the case of non-human actors.

3.1.2. Group chat

For the "sensing-in-the-wild" activity, participants were assigned into two different WhatsApp groups to which they could report data. Each group consisted of one representative for each agent role. The team created and managed the WhatsApp groups, monitored data and prompted participation when needed.

In addition to the group chat, participants were given a number to contact the ombudsbot in the following situations:

- Detection of an anomaly in public space: based on the points of interest, participants might sense that something (as data) was missing from that space or activity, face some erratic situation from a digital or physical perspective, or find something is confusing for them from the position of their role.
- Report irresponsible behaviour: Having access to data flow, agents could report certain data, measures or information for being too personal, invasive, surveillant or excessive, among other factors.

3.1.3. Maps

Participants were given the maps described in section 2.2 to help them in staging encounters and collecting data. They were joined by a data-collection buddy with a different role. Although they could interact, the goals and data collection of each were individual.

3.2 Warm up

To help participants get into their roles, organisers facilitated a warm up exercise that drew on Boal's (1985) *Theatre of the Oppressed*. Here the term 'exercise' is used to describe any somatic, corporal movement that can aid an individual in becoming more aware of their body and its relationship to other bodies, space, and things. During the warm up, the *crystal ball gazer* leveraged specific exercises such as the Colombian Hypnosis (Boal, 1985) (see Figures 6 and 7), to encourage participants to become more attuned to their surroundings as corporeal sensing devices – not an easy task considering participants chose, among other roles, to enact a CCTV camera, a pigeon, and a streetlight.

Figure 6. Colombian Hypnosis exercise

Figure 7. Character building

3.3 Collecting data "in the wild"

After warm-up, participants were provided with their 'Sensing Maps' and sent in pairs to stage encounters with uncommon data sources in Bilbao (Figure 8).

Figure 8. Explaining data collection

During each encounter, participants recorded their interaction and shared photos, texts, videos and audio messages with the group. Since they were adding data to the *Uncommon Crowd* WhatsApp group, everyone was simultaneously seeing the input from other agents.

While agents were sensing in-the-wild, the team analysed the data in real time. The main point of contact for participants was the ombudsbot, who could be reached through a private chat to address specific questions related to the context, the measurements and the information shown in the main channel. Nevertheless, the *data medium*, the *crystal ball gazer* and the *network therapist* were deeply engaged with the input and conversations on WhatsApp, analysing the data from their own perspectives.

The agents interpreted and made sense of the urban tapestry with materials and narrations that favoured sensorial, personal and experiential approaches over the mainstream and quantified version of the city. During the activity agents were prompted to describe the situations they were sensing and how this experience translated into data for the Uncommon Crowd. Since they all enacted a particular entity with different characteristics and skills, their responses, measures and input were diverse, thus generating new insights about how cities are lived and perceived from more-than-human points of view.

3.4 Therapy

At the same time that data was collected in the wild, the network therapist and data medium went over the reported data, aiming to identify issues or interesting patterns to raise during the subsequent therapy session. The data medium curated a selection of data to be printed out and made available at the therapy session.

After participants returned to the workshop headquarters and gathered around the therapy table, they briefly described their agent roles: i.e., Pigeon, visually impaired person, illegal

migrant, nonhuman machine detecting interaction, CCTV camera, politician, investor, tourist, and lighting pole. After thanking agents for providing data to the platform, the network therapist placed the data on the therapy table to initiate conversations and reflections (see Figure 9). These explored the motivations behind a variety of data collected through the lenses of individual and collective benefits and challenges. When tensions arose between different agents, the therapy session aimed to "stay with the trouble" (Haraway, 2016) by addressing and making visible the dynamics of the network.

The therapy revealed the necessity of including diverse data types as well as potential alignments between different agents. For example, the visually impaired person provided sound and texture data – the sound of a carousel, a cafeteria with dining plates, textures on the ground – underlining how this agent relies on their hearing and touch senses when navigating the world. The network therapist, together with the crystal ball gazer, asked whether the collective would be interested in providing more sound data for the visually impaired person, and the politician, emphasising their position of power in influencing how cities are built, showed interest in allyship. Yet, the visually impaired person drew attention to the importance of collective human action, rather than expecting institutions to solve problems that emerge in everyday life.

Other interesting alignments emerged between the illegal migrant, the tourist, and the lighting unit. For instance, it was suggested that, by following the tourist's data, the illegal migrant could avoid touristic places monitored by the police, while the tourist could find out about hidden gems that don't make it to the tourist guides by following the illegal migrant's data. Furthermore, the data of the lighting unit suggested that the illegal migrant could also use light data to seek refuge in under-illuminated spots of the city, while the tourist could identify new landmarks to explore, since places around important buildings or statues tend to be well illuminated.

Furthermore, the therapy allowed the agents to reflect on how they may render the platform more social and care-centric rather than individualistic, and agents took a critical stance as they wondered whether agent and data categories amplify societal divides or help to reduce them. While the crystal ball gazer gave examples of possible collaboration scenarios between diverse agents, the ombudsbot approached such speculations with caution, stating that a rather negative scenario could also be possible.

Figure 9. Therapy session

4. Results and Outcomes

4.1 Experimenting with data capture and curation

Going into the Lab the team assumed that distributed sensing from a more-than-human perspective might lead to new approaches to anticipatory governance and predictive planning in city-making (Maffei et al., 2020). Advocating for increased self-determination by agents, the team leveraged simple mobile ethnography techniques by enrolling agents in a WhatsApp group (see Figure 10). In doing so, the team hoped to experiment with alternative data collection methods suggestive of new pathways to meaningful information for those involved in the collection process.

During therapy the team briefly analysed the data captured in the wild via WhatsApp. Everyone reflected on how sharing data between members on such a platform might help them plan for and anticipate changes to their own, everyday experiences in urban contexts, both in the short and long term (for path prediction, crowd optimisation, and climate adaptation, for instance). Finally, the emergence of conflict and conviviality amongst the agents and unintended uses of the captured data was discussed.

Instead of seeking 'big data' the team opted for more diverse and curated, 'small' data, experimenting with forms of resistance to centralised urban sensing and therefore making space to engage with the implications and opportunities of decentralised sensing at different scales of the city and from different perspectives.

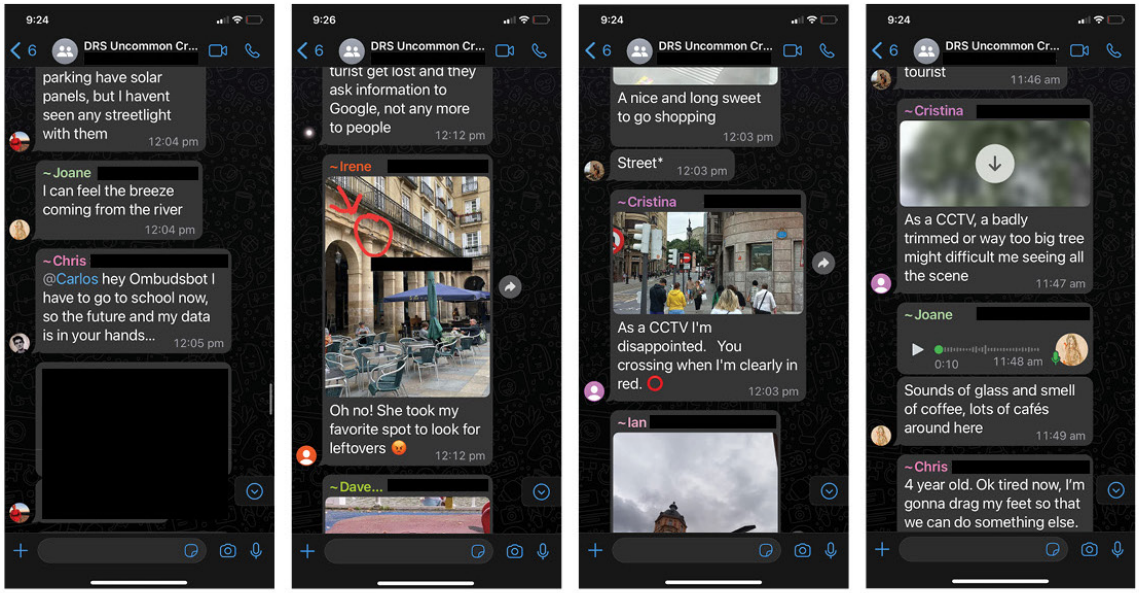

Figure 10. Screenshots from the agents' data documentation on WhatsApp group chat.

4.2 Evaluating the process

At first, participants seemed reserved, either due to the speculative nature of the workshop or because it was mainly conducted in English. However, the performative character building session (see section 3.2 above) helped them enter the role of an unfamiliar character, so to speak, while removing barriers between participants and the design team.

Although the WhatsApp group worked well for reporting data, it was not very effective for engaging with other participants' information or for enticing conversations or reports among the agents at the time of data acquisition. This may have been because participants were mostly concerned with collecting their own data and the load of notifications might have been too high to pay attention to each other. The team mitigated the lack of dialogue on the platform by printing data reports and situating them on the table during the therapy session, allowing participants to see (and engage with) their peers' contributions even if only after the fact.

It is important to mention that although the ombudsbot was contacted to solve general questions about the activity, it was not approached to raise reports or complaints, mediate conflicts or enquire about the ethical or privacy practices of other agents. Furthermore, there were no discussions in the group chat about these topics or any arguments about other agents' datasets. This led the team to reflect on the individual/collaborative aspects of the activity. On a more speculative note, the figure of the ombudsbot (which is clearly inspired by that of the ombudsman) might still be an unfamiliar trope in the domain of digital rights and data-driven systems, where agency and contestation are controlled by and restricted to particular groups.

Finally, working through the data during therapy made the experience more relatable and engaging. Focusing on seemingly conflicting or irrelevant agent roles and the data they collected (as illustrated in section 3.4), revealed unexpected opportunities to infuse the community of agents with more 'care'.

4.3 Imagining a distributed, more than human sensing system

The Lab, from its development to its deployment, explored pluralist and more-than-human approaches to the smart city by highlighting the potentials of diverse data sources and types to decenter human city dwellers. The Lab's open format in combination with agent roles highlighted the significance of imagining new forms of governance that can include the plural values, desires, aspirations and needs of all city inhabitants and that promote collaboration and co-performance instead of competition. Furthermore, the Lab also drew attention to the need to develop new lenses (and new professional roles) through which we may think critically about the ethical challenges that emerge with new technologies, and think creatively about how we may cope with them.

Imagining a distributed, more-than-human sensing system requires taking positions on values, developing roles that champion those values, and advocating for inclusion and representation practices. Reflecting about future approaches, it is instrumental to consider theoretical conceptualisations that were not included during the development of the workshop and that are relevant for taking this research forward, for example, by recognising, the importance of perspectives that do not follow Western ontologies and epistemologies and by considering how these alternative knowledges could provide new forms of plurality in city-making.

Such reconceptualisations would also extend to evaluating non-Western, or differently situated ontological and epistemological positions. For example, Sheikh et al. (2023) have identified complementary lines of thought that increasingly challenge human exceptionalism, while proposals for more-than-human, smart city governance have emerged that draw from indigenous knowledge of 'Place-Thought' (Watts, 2013), and indigenous practices of listening to the land and its species through multispecies ethnographies. In the context of the Lab and its activities, such practices could be applied to foster interspecies communication and multispecies collaboration. Eventually, these actions could provide more diverse and plural data interactions and decision-making processes.

4.4 Possible next steps

Building on the experience of this DRS Lab for Bilbao 2022 and the prior workshops that led to it, the team intends to further explore "care-full" data practices that reconsider how data is captured, categorised and communicated through urban sensing systems. The team hopes to continue experimenting with the development and applicability of the new professional design roles, applied at different scales and within different contexts. The interactions, complexities and contributions of agents could be tested during longer periods of time, allowing

space for more emergent behaviours to take place. Furthermore, iterating the Lab's methods could lead to future investigations on how the speculative design roles, their competences and skills could be embedded into interactive prototypes, generative artefacts and other dialogical representations connected to the curation of more diverse datasets.

In addition, the exploration of different data practices throughout the workshop process surfaced insights that could inform future experiments on distributed sensing. Based on these, the team advocates for new practices where all the actors within a system must be able to negotiate rights in the collection, management and the processing of their data, with respect to their lived environment and experience.

Lastly, by making the workshop and Lab materials publicly available on the project micro-site[4], the team is interested in collaborating with, and learning from, other researchers, activists, or organisations who would like to experiment with the Uncommon Crowd concept.

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