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***Abstract*— Current trends in serendipity research and collaborative ethics point to the importance of cultivating bottom-up approaches to designing for datafication in urban centers. The focus on pattern recognition in big scale data analysis, combined with an exponential growth in and infrastructural support of ubiquitous information and communication technologies (ICTs), has led to concerns about whether smart cities will turn urban environments into sites that leave little space for diverse and unplanned encounters. We take the position that smart cities need to take citizen agency into account and explain how to conceive the smart city in terms of serendipitous opportunity and community engagement. We do this by elaborating on the idea of situated serendipity, and how this kind of serendipity is co-constructed by technologies, citizens, and the urban setting. We subsequently present a methodology in line with recent work with sensory ethnography, to better understand the meaning and value of serendipity in the smart city. Ultimately, we propose a new way to imagine the 'living lab' as a cultivator of serendipity, through techniques developed in the fields of design, innovation, improvisation, citizen science and participatory ethics.**

Keywords*— *smart city, serendipity, sensory ethnography, responsible innovation

I. Introduction

In this paper, we suggest that current trends in serendipity research and collaborative ethics point to the importance of cultivating bottom-up approaches to designing for datafication in urban centers. The focus on pattern recognition in big scale data analysis, combined with an exponential growth in and infrastructural support of ubiquitous information and communication technologies (ICTs), has led to concerns about whether datafied, smart, cities will turn urban environments into sites shaped entirely via predictive algorithms, leaving little space for diverse and unplanned encounters. Moreover, efforts to use data analysis to optimize the use of resources may have the goal to make cities more sustainable, but have led to concerns about how to ensure that smart cities are also responsible cities, which conscientiously maintain the democratic rights of inhabitants [1]. When it comes to smart city design, the benefits of prediction given to us by increasing datafication are countered, that is, by correlating concerns about disabling citizen engagement with their own urban environment [2].

We therefore take the position here that the datafied city [3] needs to take citizen agency into account. The perception of citizen agency, or the power to act within the smart city, may well be one that is tinged with feelings of being stuck in a socio-technical "filter bubble" [4]. Becoming a "smart citizen" [5] implies that city dwellers need to reconfigure themselves as datafied citizens who know how to navigate both the city as well as the data landscape that is part of this city; being "smart" with the data that is available to them. Without agency there is no sense of influence, participation, or control (to opt out, for instance): the citizen becomes a data subject. Greater understanding is needed as to how citizens can enact agency through this reconfiguration of themselves into smart citizens. We argue that the smart city ought not be a top-down implementation of design, but rather seen as an opportunity to increase direct citizen participation in urban design through serendipitous engagement with datafication efforts in urban contexts.

We begin by explaining how to conceive the smart city in terms of serendipitous opportunity and community engagement. We do this by elaborating on the idea of situated serendipity, and how this kind of serendipity is co-constructed by technologies, citizens, and the urban setting. We then present a methodology in line with recent work with sensory ethnography, to better understand the meaning and value of serendipity in the smart city, while further elaborating on our position that without granting agency to citizens and their experiences of situated serendipity, policy-makers and smart city practitioners miss a valuable opportunity to engage smart citizens in their drive to realise smart, datafied, cities. Ultimately, we propose a new way to imagine the 'living lab' as a cultivator of serendipity, through techniques developed in the fields of design, innovation, improvisation, citizen science and participatory ethics.

II. Serendipitous Situations: Happenstance as a situated process

Serendipity can be defined as discoveries that are made - in scientific contexts and beyond - "at the intersection of chance and wisdom" [6]. More than passive luck, serendipity is a category of good fortune that requires action and recognition from an agent. But serendipity results from an unforeseen idea or encounter and is often only retrospectively perceived as fortuitous. This is why understanding how serendipity occurs is quite a challenge [7]. In this paper, we follow a growing trend in serendipity research and take a process-oriented approach to the notion of serendipity (e.g. [8] [9] [10] [11] [12]). This allows us to understand serendipity not as an unexpected occurrence, but rather as a moment in a larger ongoing process in which different socio-technical actors interact. This, in turn, helps reflect on what kinds of situations elicit and afford serendipity, and how one would go about better understanding such situations and even design for these situations.

We focus on situations as urban encounters on three levels: the physical, the mental, and the affective or sensorial. Moving through the city, people may have fruitful chance encounters with the built environment, become inspired, or be unexpectedly, positively moved affectively. In the datafied city, people could also have these serendipitous encounters as they interact with digital data and technologies within and about their urban context, provided, of course, that they have access to these technologies and data. The smart citizen's participation in the co-construction of this particular socio-technical environment creates a situation in which serendipity can unfold. Further, using serendipity as both a medium and a means for engaging citizens through datafication efforts will lead to their own development as smart citizens as well as producing usable results for how to develop better, more inclusive, living labs in urban contexts.

The first question to answer is, how might we catch and analyse situations in which serendipity is experienced? We suggest to focus on the interrelation between the citizen (who experiences serendipity), the involved technology and data, and the urban setting. With this focus, we seek to take up current critiques of approaches to citizen involvement in smart city planning and move past current models of living labs. Prior research projects have notably worked to harness the innovative potential or ingenuity of citizens in the context of living lab smart city research, and to do so they have made use of what has been called a citizen-centric approach, using user-centered design methodologies to design for, with, or by foreseen users [13] in co-creation projects with citizens of to-be devised digital technologies (e.g. [14]). Basing design practices more on citizen-technology interactions would make design not only more user-centered, but also - one could argue - more prone to adapt to user-led serendipitous insights. Yet, realizing citizen-centric design in smart cities is not always executed responsibly, nor does it tend to encourage the full engagement of living lab participants. Reference [15], for instance, criticise "citizen-centric" smart city projects for creating a "scaffold of citizen participation" that is limited to neoliberal conceptions of the citizen, constrained by corporate and state concerns [15]. Rather than being fully engaged, citizens in such contexts are given a predetermined range of choices to be tracked, and yet have little influence on how those choices are perceived, let alone the choices themselves. Thus, their engagement is constrained in a nearly paternalistic fashion [15], and such lack of true engagement has resulted in citizens rejecting outright smart city plans (for example, Alphabet's project 'Sidewalk Labs' in Toronto, Canada, was recently ousted for similar reasons[1]). Tracking the affective conditions for serendipity, we suggest, provides a method for avoiding this tendency because it relies on participants to determine what is important about the relationships between the data they are contributing, the tracking of that data, the personal affective experience and the urban built environment that the data describe.

Technologies or technological artefacts, including data, mediate and simultaneously co-constitute particular situations. Even in our efforts to unearth serendipity and the situations in which serendipity unfolds, we need to attend to the role played by digital technology as mediators of citizen or user experience. What are the constraints and affordances of these technologies, how can these be interacted and engaged with? And how can users see and shape the nature of the data that is being tracked, in order to perceive the influence they exert on this data in real-time? Similarly, questions can be asked of the physical setting or context that quite literally sets the scene of serendipity. A better understanding of serendipity in the smart city therefore requires a close look at the interrelationships between citizens, smart objects (including data) and the urban environment, and at how particular constellations of these actors interrelate in specific serendipitous situations. This means devising a methodology that maps serendipitous situations within the following: (1) the citizen-technology-data interrelationship, (2) the citizen-urban context interrelationship, and (3) the citizen-technology-data-urban context interrelationship. Moreover, this mapping should happen through truly inclusive engagement of citizens who take part in this methodology, so as to not make this into yet another "technology-push" project that is likely to fail.

Our proposed method, thus, includes the following: the tracking of affective experiences of citizens who wander within set bounds of the urban environment or living lab; relating that data to the physical and sensorial urban environment in which the experience takes place; interaction between the citizens who are being tracked and the interpretation of the data they are

[1] See https://www.wired.com/story/alphabets-sidewalk-labs-scraps-ambitious-toronto-project/ for more information.

contributing, so that they have direct impact on the method during the living lab as well as on the results produced.

III. How to Map Serendipitous Situations in the Urban Landscape

A. The citizen-technology-data relationship

Serendipity depends on perspective and perception; think of for instance the idea of "the prepared mind" that Pasteur is credited for describing as favoured by chance. This "preparedness" is contextual: it may reside in a person, but can also be evoked by their environment, whether this is a built environment or a digital one [16]. Reference [3] reconfigure datafication in terms of datafied space, both to come to terms with the fact that we live in and move through increasingly digital, data-rich environments, and to offer a method to better understand how citizens give meaning to their affective experiences within this space. We use a similar perspective here: by situating the citizen-technology-data relationship in a datafied, smart city space, we are able to conceptually position this relationship as one that has spatial and mappable qualities. This also means that by tracing how citizens interact with technologies and data as they move through the city (both actually and virtually) and by asking citizens to interpret their movement in terms of how they experienced their datafied space, we have an entry point to start collecting insights into how user-technology interactions afford serendipity.

To collect these reflections, we propose employing a digital sensory ethnography that asks participating citizens to use self-tracking technologies, which allow people to map their affective journeys through the city. Sensory ethnography "attends to the experiential, affective, material and social elements of the persons and environments (...) [that] are [designed] for" [17, p. 5] and "it explores the sensory embodied experience and ways of knowing of both the researcher and research participants as they collaborate to bring these into focus" (Ibid.). Sensory ethnography focuses on how people experience their environments (see [17] for a study into the "sensory aesthetic" of someone's home, and [18]'s study that uses sensory ethnography to understand digital touch communication). It is less about perception and more about affect; how does a particular environment make one feel, how is meaning perceived through the different senses?

As argued by [3], "personal self-tracking data may be bestowed with affective meaning" [3, p. 33], which means that by asking citizens to reflect on their use of self-tracking devices and on their data encounters as they traverse the datafied city space, we may also gain access to reflections about serendipitous experiences. In practice, this would mean asking participants to track and record their travel through a city, and afterwards interviewing them about their travel, the recorded data, and their reflections about how the act of tracking influenced their experience of their movements through the city. Tracking devices can include GoPro cameras mounted on bike helmets (as was the case in the [3] case study), but also screen recordings of travel routes, coupled with for instance real-time WhatsApp focus group discussions [19] in which citizens share and record affect, or post-travel real-life focus group sessions set to discuss how particular situations made them feel. This way, we gain access to firsthand accounts of how digital technologies and data co-construct citizens' experience of the datafied space, and reflections on how the former may inform serendipitous encounters. It will also be informative to see what is being mapped, for instance routes, traffic congestion, public transport, and why.

Mapping citizens' use of digital technologies and their reflections also gives us the opportunity to analyse the data situation as an empirical unit of analysis. Using what [20] refers to as situational analytics - extending [21]'s ideas about Situational Analysis - we would be able to use data mapping to detect "which entities make a difference in a situation" [20, p. 6]. Bearing in mind, of course, that this data situation is not predefined, but rather constructed by means of this analysis. This, in turn, allows us to grasp what makes an affective experience serendipitous - integrating reflections of citizens on their own technology and data use with the actually mapped data, to compare how data flows parallel experiences.

B. The citizen-urban context relationship

In order to grasp what makes an affective experience serendipitous, it is important to gain insight into interpretations and perspectives of the person experiencing serendipity, but also to gain an understanding of the context in which this experience is set - especially as this context co-constructs the above-mentioned "serendipitous situation". Cities can and have been conceived of as physical translations of particular socio-political power relations (e.g. [22]), be it in terms of city marketing (think of [23]'s problematic conceptualisation of the creative city and creative class) or the moral organisation of traffic [24]. Citizens may be traversing the city in a goal- oriented way to get from point A to B, they may be casual flaneurs who navigate the city by loafing, using the city environment as an urban playground, or anything in between. The use that is made of the space of course matters in so far as this use informs serendipitous experiences. The fact that the urban environment also includes a digital atmosphere or ambient [25] may enrich possible experiences of serendipity, as this ambient may afford an interesting juxtaposition between the built and digital environments.

C. The citizen-technology-data-urban context relationship

The juxtaposition of built environment and data ambience may afford serendipitous situations when citizens interact with both and find that this exchange leads to a fruitful chance experience. In a sense, this means that this particular citizen would not only have to be "open" to experiencing serendipity, but that they are also able to recognize the meaningfulness of this juxtaposition. In other words, the datafied serendipitous situation requires a citizen's interpretation of their sensory or affective experience and also of their datafied experience within

the city context. By combining reflections on both of these from the perspective of the citizen it becomes possible to assess how the citizen-datafied space relationship affords serendipitous experiences. Furthermore, by basing the analysis of this serendipitous situation on a digital sensory ethnography with citizens, we ensure that the assessment and analysis of this situation maintains and even augments citizen agency, giving them tools for future use as they become increasingly smart citizens of increasingly smart cities.

IV. Conclusion: Reframing the Living Lab through Serendipity

The importance of affect has been recognized in a number of fields, including research on phenomena such as insight and serendipity (see, for instance, the recent declaration in Nature Human Behaviour, 'The Rise of Affectivism' [26]). Combining affect and serendipity as the means for tracking citizen experience of the datafied, smart city, leads to a methodology that integrates user engagement into the development of the very tracking and datafication processes they are, in other contexts, often being subjected to as participants in a living lab. We thus avoid the paternalistic, top-down approach to smart city-oriented living lab experiments, and gain real insight into how citizen-users would shape the datafied urban environment, as well as providing citizen-users themselves with the tools to reflect upon and evaluate their own roles as 'smart citizens'. As [27] has pointed out, introducing new technologies into society creates an experimental situation, in which users of emerging technologies are (willing or not) participants in a social experiment about how that technology might influence them and their values. The smart city, as it emerges, will inevitably and continually be such an experimental context; methodologies such as ours, that explicitly promote serendipity as both a tool for understanding how we navigate our urban environments and also a beneficial result of the interactions between people, technology and the built urban environment, allow us to reshape this naturally occurring 'living lab' toward real engagement and true inclusion.

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