Expanding Data Imaginaries in Urban Planning

Foregrounding lived experience and community voices in studies of cities with participatory and digital visual methods

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Expanding Data Imaginaries in Urban Planning

AALBORG UNIVERSITY DENMARK

Gehl

EXPANDING DATA IMAGINARIES IN URBAN PLANNING

FOREGROUNDING LIVED EXPERIENCE AND COMMUNITY VOICES IN STUDIES OF CITIES WITH PARTICIPATORY AND DIGITAL VISUAL METHODS

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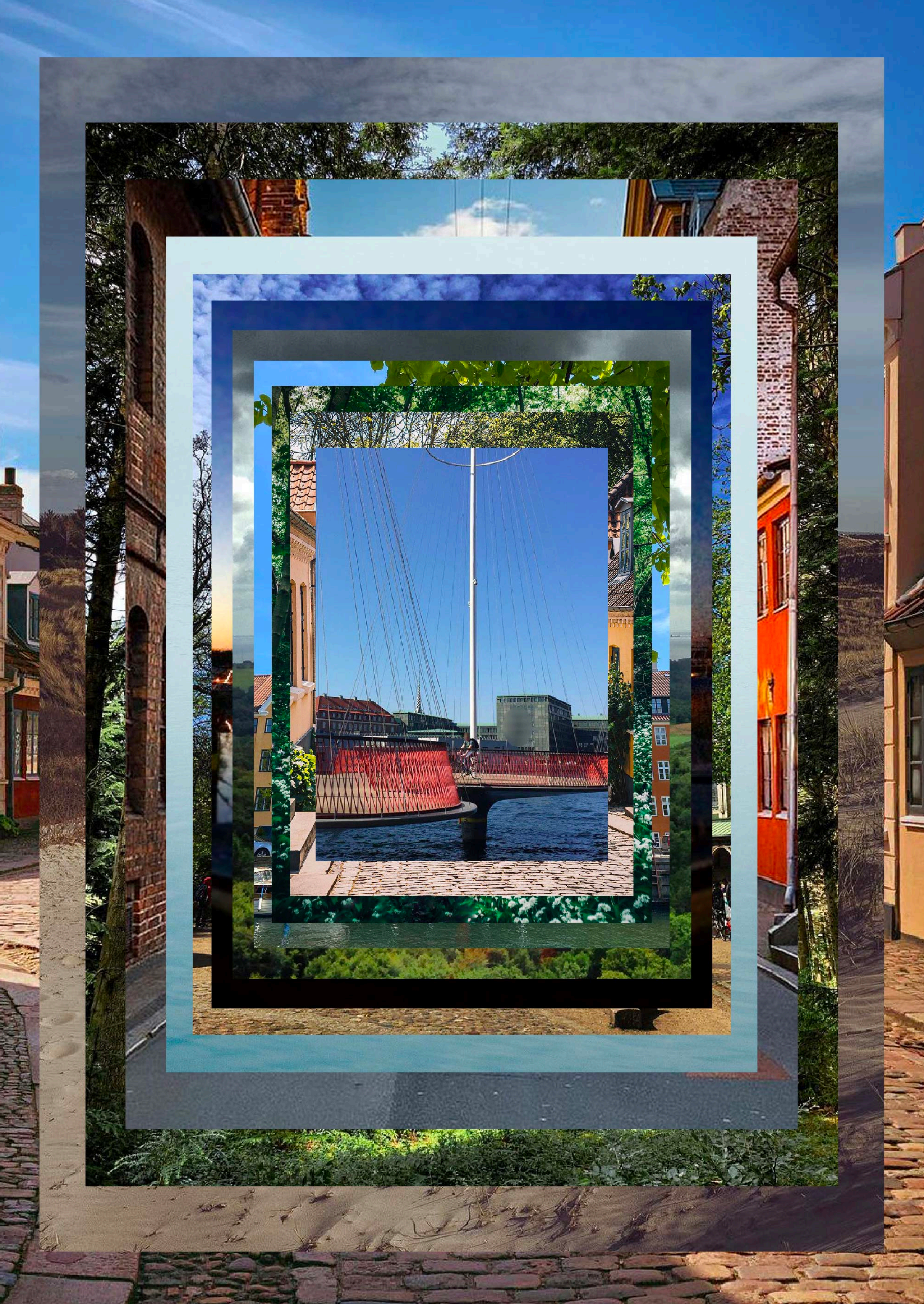

Preface

This PhD project began with the simple observation that while data plays a bigger and bigger role in how we plan and design cities, scholars and planners alike seem to focus mainly on the textual and numerical, while visual forms of data are more peripheral. If data is the new oil, why do only a small pool of researchers show interest in all the images produced daily by people in cities around the world?

My interest in the visual arrived relatively recently. During my bachelor's and master's degrees in sociology, we were taught to be well-rounded empirical scientists with training in quantitative and qualitative methods, from sample surveys and statistical regression to interviews, focus groups, and field observations. To be sure, we looked at and contributed to visual materials created by researchers as *outputs* all the time, from maps and data visualizations to illustrations and research protocols. However, rarely did anything in the curriculum use visual data created by citizens as *input* for analysis. Visual data methods were not part of the toolbox with which we were taught to empirically investigate how citizens experience cities or perceive urban issues.

By chance, I attended a summer school in Amsterdam in 2017 and met Sabine Niederer and her colleagues from the Digital Methods Initiative and Density Design. It was then that I first encountered researchers asking: What might the vast amounts of digital images produced and circulated every day tell us about how people relate to their environment and perceive issues such as the role of nature in cities? The closer I have gotten to visual materials through this PhD project, the more I have learned that the hesitancy among scholars and planners for imagining the visual as part of their data practices has less to do with a lack of interest and more to do with a lack of innovative methodologies that make working with large, unstructured visual datasets relevant to urban research. Accordingly, this is what this PhD research contributes.

With this dissertation, I invite you to accompany me on my journey down the rabbit hole of how computational technologies and participatory methods enable urban research with various visual data: big and small, image-based, and cartographic. The invitation here is to immerse yourself deeply in the situated, complex, and multifaceted nature of visual materials produced by citizens and join me in exploring how we can use them to foreground lived experiences and community voices in studies of cities.

Welcome to the wonderful world of visual urban data!

Acknowledgements

In 2019, at the Women in Film Annual Gala, the Black actress, producer, and comedian Issa Rae was honored with the first-ever Emerging Entrepreneur Award. She gave a phenomenal acceptance speech that took everyone by surprise, speaking to how women tend to downplay themselves. “We are socially conditioned to be humble,” she said, before stating that, as a hip-hop fan, none of her favorite artists are humble. Far from it. So, in the spirit of her favorite rappers, she gave a speech that abandoned all the humbleness with which she would normally speak, starting: “Entrepreneur means: I did that shit by myself!” She continued by listing the names of people with whom she had worked, only to state with comic relief, “Y’all some suckers. I could have done this without you”. The room broke into laughter and applause. Satirically delivered, the ethos was, of course, that great achievements always result from collaboration and build on the groundbreaking work of those who have gone before you. Similarly, this PhD has been dedicated to the co-construction of knowledge, and I have been lucky to work alongside some of the brightest and most creative minds within urban planning, digital methods, visual methodologies, and participatory research, to name a few. I truly could not have done this without my colleagues, friends, and family, whose guidance and support have my sincerest appreciation.

My gratitude goes to Gehl and Innovation Fund Denmark for investing in this research. A special acknowledgement goes to my academic supervisors, Anders Koed Madsen, Sabine Niederer, and Anders Kristian Munk, who guided my academic work and gave me the confidence to continue the research when it tested me the most. In addition, I would like to extend thanks to colleagues in the Techno-Anthropology Lab at Aalborg University, as well as to MIT and Sarah Williams for having me as a visitor. A big thank you also to all colleagues at Gehl, from San Francisco to New York and Copenhagen, and to supervisors Jeff Risom, Liselott Stenfeldt, and Birgitte Svarre, who helped me anchor my research in the planning practice and challenged the applicability of my ideas. I will also extend special appreciation to Drude Emilie Ehn, Nina Cecilie Højholdt, and everyone on the R&D team whom I have been lucky to work alongside.

Moreover, I want to give a profound thank you to my friend, Cecilie Astrupgaard, for being the best support. Finally, I had not predicted that this work would lead me to meet the love of my life – but what a blessing. I want to give a profound thank you to Alexandra, whose love and radical thinking helps me be my best.

Paraphrasing Issa Rae, a doctoral dissertation means “I did that shit!”.

But I was never by myself.


Tackling
Childhood
Obesity
Designing invitations
for new food behavior

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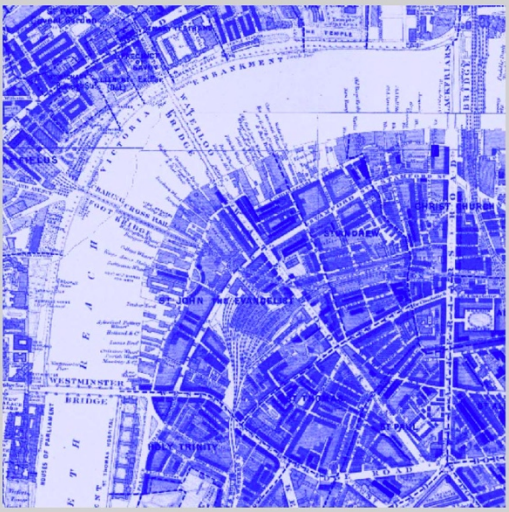

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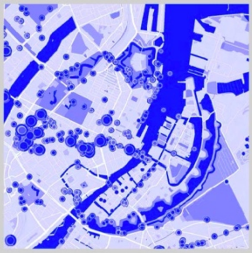

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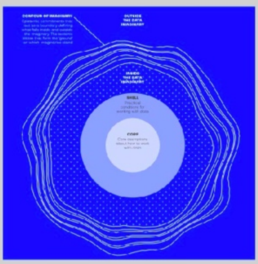

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PART I

PART I

Theoretical framework

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Chapter 01

uction

Introduction

Design and governance of cities has historically been shaped by visual data and technologies in profound ways (Kurgan & Brawley, 2019). These range from colonialist map-making, cartographic drawings in the Renaissance, and impressionist paintings of the relationship between city and landscape, to photography, satellite images, Geographic Information Systems (GIS), artificial intelligence (AI), and other emerging digital technologies. Such visual inscriptions techniques have for centuries been incremental to how we understand urban life and are able to plan cities (Halpern, 2015; Latour, 2011). As visual technologies and data change so does our opportunities for understanding cities. With visual culture becoming increasingly *digital* and *participatory* (Colombo & Niederer, 2021; Gubrium & Harper, 2016), the question is how visual data can be used to rethink the empirical foundation of data-driven urbanism and enable new and alternative 'modes of knowing' cities. Examining this, the dissertation at hand synthesizes more than three years of research focused on studying cities with visual data, tools, and methods, putting *the visual* at the center of methodological innovation in urban research. It presents an Industrial PhD project conducted within the Techno-Anthropology Lab at Aalborg University and Gehl, a global urban design and strategy company with a 20+ years history of designing "cities for people" and studying urban public life. Hereby situated in between research and practice, the project is motivated by a dual observation that analytical use of visual materials is peripheral and underexplored in studies of public life in both urban research and urban planning, as shall become clear in this PhD dissertation. This is curious for at least three reasons:

First, as I have already touched upon, visual technologies have historically shaped the way we inscribe the urban world as empirical material that can be circulated, debated, and used to inform decisions about urban problems (Kurgan & Brawley, 2019; Latour, 2011). In 1854, John Snow for instance famously produced maps of cholera deaths in London that created a new understanding of the source of the outbreak and informed initiatives to solve it. Similarly, Charles Booth used street-by-street surveying in the 1880s to examine the causes of poverty in London. From this he produced maps which showed that poverty had less to do with lack of churchgoing and drunkenness, as was the perception, and more to do with under- or unemployment, hereby reorienting debates about the issue away from morality and towards more practical solutions (Vaughan, 2018). Demonstrating the power of a different medium, Jacob Riis used flash photography in the 1880s New York to document life for millions of immigrants in slums, which lead to improved living conditions of the tenements (Kurgan & Brawley, 2019). Visual technologies hereby have historically framed urban problems and what solutions we can imagine for them. More than simply holding capacity to represent cities, visual data in this way also operates on the world by guiding interventions in it.

Figure 1.1: Left: "Five Cent a Spot. Unauthorized Lodgings in a Bayard Street Tenement", photo by Jacob Riis. Source: Preus Museum. Copyright: No copyright restrictions. Right: Snapshot of Charles Booth's poverty map of London. Licensed under a Public Domain Mark, sourced from LSE Library.

The nature of this framing however is not neutral but deeply political (Halpern, 2015; Kurgan & Brawley, 2019). And while visual techniques and data have been used for good, they have also been used for oppressive purposes. An example of that is Robert Moses' slum clearance maps from the 1950s which consistently displaced people in neighborhoods of color in New York City. Visual technologies are thus linked to transformations in governmentality. This has also been posed by John Pickles (1995), who argued that in producing knowledge about the world, maps do more than simply represent territory, but indeed co-produce it. The link between visuality and governmentality, or between knowledge and power, has also been discussed by Michel Foucault (1977), who showed that during different periods, distinct modes of visibility are produced by power in order to control society. This relationship was also epitomized in the architectural design of the 'panopticon', which demonstrated Jeremy Bentham's link between visuality, rational management of space, and governmentality (Halpern, 2015, p. 9). Today, this is manifested with installation of surveillance cameras in city streets, and increased use of facial recognition in public, leading to discussions that we live in a form of 'surveillance capitalism' (Zuboff, 2015).

Second, there is an intricate historical relationship between *vision* and *reason,* or *observation* and *rationality* , as outlined by Berger (1972), Latour (2011), and Halpern (2015). Halpern explains that within a Western tradition, vision "operates metaphorically as a term organizing how we know about and represent the world; a metaphor for knowledge, and for the command over a world beyond or outside our subjective experience" (2015, p. 23). Think for instance of how commonly we associate vision directly with our ability to understand something, exemplified with sayings like "I *see*" and "this *shows*". This is also discussed by James Scott in 'Seeing like a State' (2008) and Chris Jenks in 'The Centrality of the Eye in Western Culture', in which he states that "looking, seeing and knowing have become perilously intertwined' (1995, pp. 1–2). Development of new visual technologies, Halpern shows, has historically changed the way scientists, planners and policy makers are able to observe and provide evidence about the world (2015, p. 23). An example is the invention of photography, which with its documentative powers ushered in a new idea of rationality and objectivity, since suddenly it was deemed possible to document the real world 1:1. Scientists like Donna Haraway (1988), of course, have opposed the illusion of a disembodied gaze that is able to 'see everything from nowhere', arguing that observations are always situated somewhere. Even photographs show something from a certain perspective. Yet, notions of 'evidence' is a sticky concepts and is in scientific discourse often tied to what is observable for the eye (Daston & Galison, 1992).

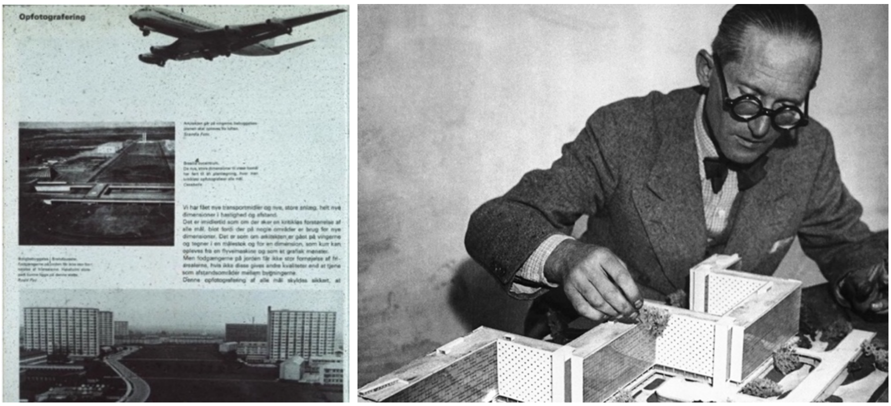

Figure 1.2: Left**:** Aerial photography article with caption "it is as if the architect now has wings and draws at a scale that can only be experienced from an airplane". Right: architect Le Corbusier bent over a model of Ville Radieuse, imagined as a standardized city. Image credit: 99percentinvisible.org[1].

New visual instruments, standards, and techniques, moreover, have not only changed scientific ways of knowing but also co-produced ideas of rationality and objectivity. As an example, think of aerial photography which enabled a view of cities from above, but also powered the modernist ideals emerging in the mid-20th century which proposed that effective and rational planning could come

[1] https://99percentinvisible.org/article/ville-radieuse-le-corbusiers-functionalist-plan-utopian-radiant-city/

from taking a bird's eye view of the city, as exemplified in Le Corbusier's 'Ville Radieuse' and construction of symmetrical and standardizes cities like Brasilia.

Visual technologies hereby make cities visible and governable in particular ways. This is not only something researchers have been aware of. Architects and planners have for long been attentive to the importance of making different aspects of urban life legible through visual inscriptions. It was for instance in reaction to the modernist ethos of master planning dominating the era that Danish architect Jan Gehl in the 1960s started making observations about public life. While critical of how designs like Ville Radieuse lacked human scale and produced wastelands instead of quality public spaces, Jan[2] realized that to put public space on the agenda in planning, he had to start registering it to make it visible to others.

Sembra ma non è un «beatnik»

Da diversi giorni abbiamo notato un giovane straniero aggirarsi per la Piazza del Popolo. Abbiamo subito pensato: « I beatnick » in Ascoli?

Ma il suo fare aveva qualcosa di particolare. A parte le misurazioni ed i rilievi con strani apparecchi ottici, lo straniero prendeva in continuazione appunti su tutti i passanti. Insomma chi era?

Poche parole di presentazione e di saluto e subito si è scoperto l'arcano. Si tratta dell'architetto danese Jan Gehl, che avendo ricevuto una borsa di studio per studiare la forma e la vita delle piazze italiane da un punto di vista architettonico e sociologico, ha incluso la nostra Piazza del Popolo nei suoi itinerari.

Il giovane e simpaticissimo architetto, che si avvale della collaborazione della gentile consorte laureata in psicologia, si va chiedendo perché mai — nei centri storici italiani — con tanti viali e belle strade nuove, la popolazione insista a passeggiare sulle antiche piazze.

Saremmo interessati, al termine delle sue indagini, di conoscere se ha svelato l'arcano del nostro inguaribile « passeggiar piazza ». (Foto Riga)

Figure 1.3: Left: "He looks like, but he is not a Beatnik" reads the title of a local news article remarking of Jan Gehl's persistent presence in Piazza del Popolo, Rome, 1965. With his wife Ingrid, a psychologist, the couple amassed observable 'best practice' evidence of people's interactions in, and with, public space. To the right: A collection Jan's notebooks full of observational notes. Credit: Gehl

Using sketch mapping, drawing, and photography to observe trends in urban public life, he started doing registrations in public space: He would sit down in a plaza in Italy for days and hours and take notes of how people were using the square. Were they men or women? Would they move through the space, or stay? Did people sit on benches, or on the curb? In 1971, such observations were published in the famous book called 'Life Between Buildings' (Gehl, 1971). Here, he delivered careful observations of what urban conditions create a good public life, while using photos like the ones below as evidence for people's movement, attitudes, and preferences in the city. In contrast to the modernist birds-eye-view, Jan's work fundamentally shifted the perspective to see the city from eye-level. "Life Between Buildings" was pioneering and has significantly contributed to principles such as 'human-scale' design that many architects use today. The book,

[2] In this PhD I refer to Jan Gehl as 'Jan', not to confuse him as an individual with the company Gehl.

meanwhile, would not have been as effective without the photos and maps that supported observations and consolidated an idea of what human scale looks like.

Figure 1.4: Left: 'Safety in numbers' Women crossing a street in the U.S. Credit: Jan Gehl. To the right: 'Something to lean on' Piazza del Campo, Sienna, Italy, Courtesy of Lars Gemzøe.

Such use of visual technologies continues to proliferate in planning today but represent an overly observational gaze on the city. It is one in which professional planners look upon the city and document the activities that they see (Gehl & Svarre, 2013). In a digitized world, however, the observational capacity is shifting as visual digital technologies are becoming widely accessible and citizens increasingly navigate cities through and with visual technologies. In fact, we live in an increasingly visual culture where citizens are interfacing with and producing digital visual materials such as maps and images at an unprecedented scale (Manovich, 2020; Marres, 2017a; Rose, 2016). As visual ethnographer Sarah Pink writes:

> "(...) more than ever before, camera and screen technologies are also almost everywhere. They involve an expanding range of forms and modes of imaging, including smartphone, wearable, surveillance, and other embedded and mobile photographic devices" (2021, p. 1).

This leads to the third motivation for why urban scholars and planners should care about the visual in studies of cities: There are now as many 'viewpoints' as there are people with smartphones in their back pockets. It is estimated that 92,5% of photos taken today are captured with smartphones, and only 7% with cameras and that around 6,9 billion images are shared every day on WhatsApp, while 1,3 billion images are shared daily on Instagram (Broz, 2023). Digital visual technologies are moreover not only used by citizens to report on their experience but are a part of the urban experience itself, shaping how citizens orient themselves in cities today and attach to places in various ways. This has been described by Germaine Halegoua (2020) who argues that digital technologies are crucial to how people embed themselves in urban space (more on this later). For example, we increasingly take photos of our surroundings as a part of our urban life and use photos and maps to navigate the city (see figure 1.5 with personal examples).

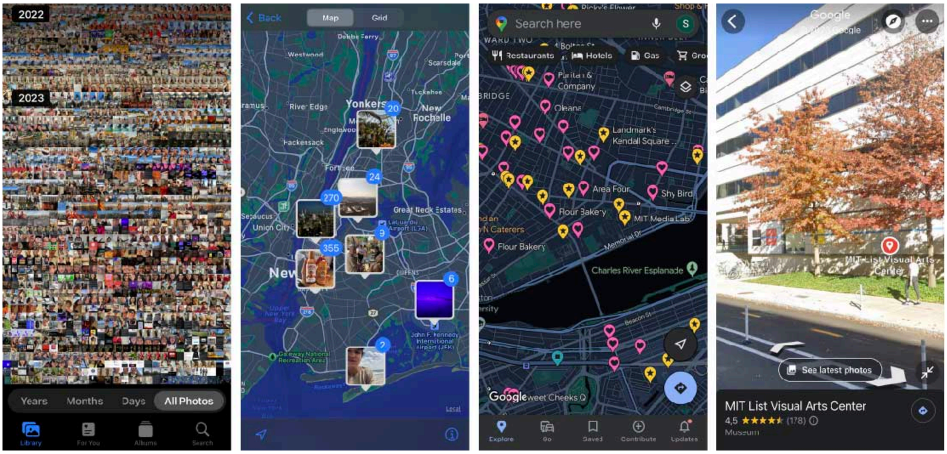

Figure 1.5: From left to right: Camera roll in Photos app. Photos app displaying locations of images captured in New York. Google Maps app with saved locations in Boston. Street-view panorama within Google Maps of MIT Media Lab in Boston. Author photos.

People increasingly use location-based apps for anything from dating to car sharing and look at photos and reviews of food on Google Maps before choosing a café, while contributing to these visual data traces in the process. Citizens' experiences are in other words inexplicably interwoven with visual digital technologies. And as posed by Goodchild (2007), Elwood (2008), Loukissas (2019), Colombo et al. (2017), the resulting visual data are increasingly *digital*, *location-based* and *participatory*, meaning that we find ourselves in a deluge of citizen-generated visual data that is spatially situated.

These are the sorts of visual data that I am interested in here, where I am curious about what such citizen-generated visual data might offer to our understanding of cities. Compared to the works of John Snow and Charles Booth who collected survey data and used the visual simply as *output* to display data, I propose that the growing availability of images offer opportunity to collect visual materials as *input* to analysis; as data material[3], rather than outputs and communication techniques. And different to Jacob Riis' and Jan Gehl's work, in which the main person behind the camera was the professional photographer or planner, I suggest that

[3] I build here on Lisa Gitelman's (2013) notion of *data* as curated aggregations of empirical materials into larger or smaller datasets that can be synthesized and processed as empirical input to an analytical inquiry.

citizen-generated visuals hold potential for enabling a 'way of knowing' cities that foregrounds community voices and situates understanding of urban issues in diverse and local lived experiences. Meanwhile, data-driven urbanism has not yet taken advantage of this type of digital visual data for showing how the city is experienced by different communities and people. Visual data produced by citizens continue to be at the periphery of most urban research, as reviews in Chapter 2 and Chapter 4 will demonstrate. This is also the case in urban design and strategy consultancy Gehl, the company co-founded by Jan Gehl in 2000, where this PhD has been situated for three years as an industrial research project.

We might say that visual data produced by citizens is underexplored in urban research, and that it is not a part of the 'data imaginary' in professional planning; understood as the collectively held narratives, visions and epistemic commitments that contribute to the production and perpetuation of the role of data in urban planning (Markham, 2021; Rieder, 2018). This dissertation contributes to expanding this imaginary through a two-fold research problem that seeks to innovate and strengthen the use of digital and participatory visual methods in studies of cities. To do so, the project makes an exploration of methodological potentials of citizen-generated visual data its primary research question.

> **Primary research question**
>
> How might different forms of visual data, created by citizens, be leveraged in digital and participatory ways to situate our understandings of urban issues in local lived experiences?

Rooted in between practice and academia, the project also uses its industrial position as an opportunity to study the professional planning practice up close. It therefore makes a study of Gehl's data culture a part of its research interest from the ethos that innovation of new data tools and methods has greater impact if they are developed together with the practitioners who we envision to use them, while at the same time finding that such co-creation gives opportunity for producing insights about how such data practices work. Drawing on the concept of 'data imaginaries' mentioned above, I am interested in how imaginaries around data in Gehl shape the 'making and governing' (Mager & Katzenbach, 2021) of possible data futures in data-driven urbanism. This informs a second question:

> **Secondary research question**
>
> Which epistemic commitments and discursive closures shape the data imaginary in Gehl, and how can participatory, digital visual methods expand this imaginary to include more diverse data futures?

When this is phrased here as a secondary research question, it is important to emphasize the difference in weight that the two parts of the research problem carry: The PhD research has mainly focused on examining the first question and has produced five journal articles that provide different perspectives on this question. As outlined later in this chapter, this includes three articles that document empirical projects using social media images, participatory GIS, and photovoice method to foreground local lived experiences in studies of cities. Concentrated in just three chapters, Chapter 8, 9 and 10 respond to the secondary research question by delivering a qualitative analysis of the 'data imaginary' in Gehl that anchors a discussion about potentials of the tested visual methods in context of how they help expand existing visions around data in the company.

Guided by this two-fold research problem, the PhD positions itself at the nexus of Visual Methodologies, Urban Studies, and Science and Technology Studies (STS). It takes separate but connected empirical strategies to answering the two research questions. Before I unpack these empirical strategies, let us first situate the study in three ways: First within a framework of the 'Digital City' and the sort of data-driven urbanism I intervene in. Second, within the industrial context in Gehl as a global urban planning company. Third, within my position as an industrial researcher in Gehl.

Digital cities and data-driven urbanism

In 'Digital Sociology' (2017b), it is proposed by Noortje Marres that the ubiquitous nature of 'the digital', understood as the growing and changing role of computational infrastructures in all aspects of social life, means that the digital can be seen as a new kind of "total social fact"; as an irreducible phenomenon that affects all areas of social life (Marres, 2017b, p. 13). In her seminal work 'Digital City' (2020), Germaine Halegoua similarly conceptualizes digital technologies as a ubiquitous part of living in cities today. Importantly, she opposes a framing of digital technology as a distraction or disassociation from place and urban space which proposes that the digital and visual mediation of cities via online images inherently alienates people from the physical environment. Such critiques can be related back to German Marxist Walter Benjamin, who in the 1930s problematized that in an era of mass cultural production where art objects can be photographed and circulated, audiences increasingly "see" and experience art through photos, rather than experiencing them directly *in situ*. According to Benjamin, such mediation meant the loss of *aura*; the loss of the authenticity and unattainability of the 'real' artwork, compared to the photograph of it as a mere copy or reflection of the original.

While such critique has been repeated in relation to the uptake of the digital in contemporary urban society, Halegoua (2020) proposes a different framing of digital platforms and technologies as an inexplicable part of the city today. Instead of seeing the digital simply as a 'mirror' of the physical city, she proposed that digital and visual technologies are fundamental to how people (re)embed themselves within urban space today via a form of digital placemaking. A similar perspective has been promoted by visual ethnographer Sarah Pink, who writes about the 'digital wayfarer' and describe "how digital technologies, and image making participate in a world where online and offline are entangled, as part of the digital materiality that characterizes contemporary environments" (2021, pp. 31–32). Halegoua's (2020) conceptualization of the 'digital' also means a rejection of the naïve humanism that sees people as autonomous from technology and negative associations between digital technology and experience which pose that digital platforms are essentially anti-social and alienate people from each other. Instead, we can think of digital platforms as sites of urban and social experiences in their own right. This is also the understanding of the city that we get from post-phenomenology, which has suggested that digital and visual technologies today fundamentally augment our experience and shape the world around us (Ihde, 1995; Verbeek, 2005). Inhabiting cities, in this lens, means acting, experiencing, and making meaning of urban life through digital visual technologies. This is a framework of cities, urban experience, and digital technology that I build on in this PhD, and which frames my own empirical work.

Adding to this, I take inspiration in Marres, who argues that 'the digital' today transforms not only urban life but also changes our instruments for producing knowledge about cities, presenting a new site for negotiation, contestation, and imagination of "different ways of knowing society" (2017b, p. 21). With the growing availability of digital data, we have for instance also seen the rise of 'data-driven urbanism', which I define here as any practice within planning, architecture, city governance, or urban research where collection and analysis of data about public life is central to understanding urban problems and making decisions about the future. As will be discussed in the Soft City Sensing article presented in Chapter 2, such data-driven urbanism has often been synonymous with Smart City agendas and use of digital data as objective records of flows of people in cities. Alternative approaches to data-driven urbanism can however be found in data practices from for instance Digital Methods (R. Rogers, 2013) and visual digital methodologies (Colombo & Niederer, 2021) which extend an understanding of visual digital materials similar to Halegoua and show interest to how such materials are used in processes of placemaking that people engage in today. This is the sort of data-driven urbanism that this PhD contributes to.

Gehl as a case study

Gehl was co-founded in 2000 by architects Jan Gehl and Helle Søholt, building on Jan's longstanding research on the relationship between public life and public spaces, formalized in "Life between buildings" from 1971. Today, Gehl is global industry leader in urban planning, offering consultancy on urban design and strategy. With offices in Copenhagen, New York, and San Francisco, Gehl has projects all over the world and employs an international, interdisciplinary team that includes architects, urban designers, landscape architects, graphic designers, sociologists, anthropologists, data scientists, developers, among others (what I in this PhD call "Gehl planners" indeed references this interdisciplinary collective).

Figure 1.6: A consequence of the 2008 'World Class Streets' report, Times Square, New York was piloted as a pedestrian-focused public space, before being made permanent in 2016. Credit: New York Department of Transport. Left: Before any intervention. Right: After design interventions.

The company is known for 'making cities for people' and using quantitative and qualitative research about how people use public space to inform urban strategy and design and communicate how the built environment affects complex issues within health, sustainability, and equity. An example often used in the core story about the company is the transformation of Times Square in New York, where Gehl did registration counts and showed that while 90% of the people passing through the space were pedestrians and only 10% were people in cars, the designation of physical space was opposite: 90% of the space was car lanes, and only 10% was sidewalks (Gehl, 2008). Such quantifications of public life were effective in convincing the client to invest in more space for people, which resulted in a redesign of the square that got rid of car lanes and introduced wider sidewalks and invitations for people to sit. This way of using data to make aspects of public life visible to developers, policy makers and other clients has given rise to the tagline "we measure what we care about". Today, Gehl is known for bridging design and strategy with data methods such as surveys and observations used by the company to inform and validate design and strategy interentions.

Figure 1.6: Jan Gehl and Gehl Publications spanning 50 years. Credit: Gehl.

This has led to a rich tradition of human-centered design and acknowledged theoretical and methodological contributions to the understanding of public life in cities: Since its publication in the 70s, "Life Between Buildings" has been translated into more than 45 languages and republished again and again. Additionally, the company has continued to document their methods for studying cities in other books (Gehl, 2013; Gehl & Svarre, 2013; Sim, 2019).

With this history, three factors make Gehl a particularly interesting place to anchor this research and make the company a valuable case to study. First, the company has a long-standing history of connecting design and strategy to data-intensive methods, which should make the company well-equipped to take in and experiment with novel visual and digital data methods, since it is in the DNA to bring in social science research. Second, Gehl has an interdisciplinary staff and culture, where sociologist, programmers, finance administrators, planners, architects, data scientists, and others work alongside one another. Third, towards the end of the 2010s the company made a strategic decision to invest in digital transformation and research by establishing an R&D Team (where this PhD has also been anchored), whose goal it is to test digital technologies and tools and innovate the company's data practices. Referencing Flyvbjerg (2006), we might construe of Gehl as a "most likely" case in the sense that the company should be most capable of integrating new data methods. We can therefore learn something critical about how the planning industry at large is likely to respond to visual and digital data methods, by studying how the planners in Gehl see value in them. And as a 'most likely' case, the visions that shape the data imaginary in Gehl are likely to be recognizable for other planners and data-driven consultancies as well.

BRIDGING THE RIGOR-RELEVANCE GAP

Taking the anatomy of industrial research, this PhD is slightly different from traditional projects in ways that warrant a few clarifications about the nature of the produced knowledge and my positionality. While it has been argued from the perspective of system theory that research and practice are fundamentally unbridgeable because academics and practitioners emphasize *rigor* and *relevance* differently (Kieser & Leiner, 2009), the premise here is to indeed construe this rigor-relevance gap as bridgeable. This is supported by Crosina & Bartunek who argue that the academic-practitioner relationship is a dualistic and interdependent one: "A duality views the two elements [academics and practitioners] as interdependent and no longer separate or opposed, although they remain conceptually distinct" (2017, p. 2). A motivation for carrying out this PhD as industrial research is in this ethos to extend the influence of research beyond academia into industry and society and hereby let the research have impact beyond the ivory towers of science (Gunn & Mintrom, 2017). To do so, the PhD has not been carried out in isolation. Instead, it is the result of co-creation processes and has been based on a "mode 2" relationship between university, industry and society, characterized by collaborative knowledge production, rather than a one-way knowledge translation (Greenhalgh et al., 2016). This is exemplified at different stages throughout the dissertation and has for instance involved bringing researchers and planners together around co-designing a photovoice application as documented in Chapter 7. It is also exemplified in the public exhibitions that I have co-produces with other researchers and local communities in the Urban Belonging project, reported in Chapter 5 and 6, which brings research into dialogue with a wider public. The STS study I deliver in Chapter 9 of Gehl's data imaginary is also the result of such co-construction of knowledge and collaboration with Gehl's planners.

To enable such co-construction of knowledge, I have spent all three years of the PhD as an employee in the company's R&D team. Being transparent about my positionality, I see myself as a part of the company and am invested in its data culture, even if I at the same time have occupied a position as a researcher with academic affiliations and commitment beyond the company. The close relationship with the industrial context naturally can make the scientific process complicated to navigate (more on this in Chapter 8). But it also creates dynamic and situated knowledges and cultivates a dualistic rather than dialectic research-practice partnership (Greenhalgh et al., 2016). This has particular advantages in relation to answering the PhD's two research questions: In response to the primary research question, it means that the visual data projects explored have been anchored and tested in the real, applied contexts of global urban planning. The methods have been developed in dialogue with company innovation goals, interdisciplinary discussions, and pushback about applicability that has added quality to the research and results. In response to the secondary research question, my position in the practice has given unique opportunity to unpack the data imaginary in Gehl and observe how it shapes the company's data practices.

Empirical strategies

Now that I have situated the research, let us unpack the empirical strategies used in the PhD to examine the two-fold research problem. In response to the *primary* research question, I carry out three empirical experiments with visual data methods and use them to exemplify and discuss the potentials of visual digital data in urban research. In response to the *secondary* research question inquiring about the data imaginary in Gehl, I deliver a situated STS study through qualitative observations.

FIRST STRATEGY: EXPERIMENTS WITH VISUAL DATA

When I speak of 'visual data' in this PhD, I am strictly referring to visual materials that have empirical manifestation (i.e. not the mental or ephemeral images in people's heads). More importantly, I construe of visual data only as the use of visual materials as empirical *input*[4] to an analytical question. I don't reference the visuals that I might myself be producing as a researcher when I for instance make data visualizations and maps or take photographs of participants in a workshop, although I ascribe a lot of value to these visual practices as part of my research methodology (more on this in Chapter 3). As emphasized with this Introduction, I moreover focus here on visual data produced by citizens, since my research interest centres on examining how we can situate understanding of urban issues in citizens' lived experiences. This also means that I am not studying data

[4] To be sure, the same materials can constitute input and output. Renderings produced by Gehl could be seen at as output; as an image produced to communicate about the future of the city. Such visuals would become 'data', the minute someone begins to collect and synthesize them into a dataset (Gitelman, 2013) as input to an analysis.

produced by sensors and computers, thus excluding for instance satellite images and Google Street View images. Additionally, I do not focus on moving images. With these demarcations, my approach to answering the primary research question has taken a 'maximum variation' strategy (Flyvbjerg, 2006) and explored a diversity of digital and participatory visual methods. These include; (a) social media image analysis; (b) participatory GIS; and (c) digital photovoice.

Whereas social media analysis involves reappropriating and analyzing images from platforms like Instagram or Twitter (R. Rogers, 2013), participatory GIS and photovoice utilizes digital technology to involve local communities in mapping or photographing their environment in response to particular prompts and discussing maps and photos together in workshops (Gubrium & Harper, 2016). What these three methods have in common is that they center visual data that are *digital*, *geolocated* and generated by *citizens* in different *participatory* setting, hereby offering different but related digital and participatory opportunities for urban research that I seek to explore (more on this in Chapter 3).

Meanwhile, these methods have also been chosen in collaboration with Gehl from the ethos that development of methods should be grounded in the practices we seek to impact. I have involved Gehl in selecting these visual methods as sites of experimentation by different logics. First, I used a 'follow management' strategy and selected social media as a case together with Gehl's Chief Innovation Officer, Jeff Risom, who when the PhD began expressed interest in testing applications of social media data. Second, participatory GIS was selected from a 'follow the tools' strategy, based on the observation that in early 2020, Gehl started using a new tool called Maptionnaire to make spatial questionnaires. I latched on to this tool investment and observed how Gehl began to use it, while exploring its potentials use in my own participatory GIS project with citizens. Third, photovoice method was selected from a bottom-up 'follow the team' logic. I held a workshop with the R&D Team, presenting different sources of visual data, and here the team decided that it would be most exciting and new to test the capabilities of photovoice.

Over the years, these three methods have been tested in Gehl in different projects and applications around the world. Reported in this PhD, however, are three empirical cases that all study data from the geographical context of Denmark, ensuring some comparability. One experiment investigates around 39,000 Instagram photos from Denmark in 2020, combining image scraping, computer vision AI, and Visual Network Analysis to study place attachments during the first nine months of COVID-19. A second experiment reports on the use of participatory GIS in the Urban Belonging project, in which members from seven marginalized communities in Copenhagen were invited to map their experiences of belonging, individually and collectively. A third experiment reports on the use of photovoice in the Urban Belonging project, where communities were invited to document when, where, and why they feel a sense of belonging in the city by taking photos with a photo-app developed for the project, while discussing them together in workshops. The dissertation presents these experiments as journal articles that each offer individual perspectives and answers to the primary research question. This is supplemented by two additional articles, as shall be outlined in just a bit.

SECOND STRATEGY: SITUATED INTERVENTIONIST STS.

To explore the secondary research question, the PhD uses its position in Gehl, as a unique opportunity to study the planning practice up close. Having spent more than three years in the company's R&D Team in Copenhagen and New York, I have had exceptional access to observe, document, and discuss with the company's planners how and why Gehl uses different data methods to study cities. I use this to study the data imaginary in the company, building on Rieder's (2018) notion of data imaginaries as collective narratives, visions and epistemic commitments that contribute to the production and perpetuation of the role of data in society. To unpack this, I take inspiration in the framework of *situated interventionist STS* put forward by Teun Zuiderent-Jerak (2015), which presents a way of thinking about the involvement of social scientists in the practice they study as intervention that can productively open for generation of sociological knowledge. This framework proposes that empirical experimentation in particular constitute a type of intervention that enables interrogation of the taken-for-granted and common-sense categories employed by practitioners in a knowledge practice. In this ethos, I have designed my empirical experiments as interventionist strategies that bring different visual methods in 'critical proximity' (Madsen & Munk, 2019) to professional planning practice. In doing so, they disturb, irritate, or supplement established 'ways of knowing the city' (Kurgan & Brawley, 2019) in Gehl and make it possible to observe what visions they have for the role of data in their practice.

Assembling documents, doing interviews, participating in meetings, and collaborating on projects, I have built a hybrid collection of observation materials from my three years in Gehl. Observations of how the planners discuss the value of the participatory GIS tool Maptionnaire has for instance revealed that the knowledge culture is committed to an objectivist ontology of spatial data that limit capacity for taking in citizen-drawn maps. Such situations and examples are analyzed qualitatively to unpack the data imaginary in Gehl in response to the secondary research question. This is presented in Chapter 8, 9, and 10.

Articles and dissertation structure

PRESENTATION OF ARTICLES

The thesis is presented as an article-based dissertation, comprising five scientific articles which constitute the primary contribution of this PhD. These articles do not make up a perfectly consistent theoretical or methodological whole but can be read in any order and present independent perspectives on the potentials of visual data in digital and participatory modes of knowing cities. I also do not claim that these articles cover everything that could be relevant on visual methodologies. The dissertation explores just three types of methods, and surely there are many more Yet, when brought together here, their contributions become more than just the sum of their individual parts: Together, they carve out a space for digital and participatory visual research in studies of cities, where the role of visual methods remains underexplored and siloed along separations that unnecessarily associate computational approaches with a quantitative agenda, and visual ethnography with a purely qualitative approach. Traversing such separations, the articles bring together diverse methods and situate them in a shared methodology around digital and participatory visual research. Here, I give an overview of the articles with emphasis on how they contribute to answering the PhD's first research problem about how different forms of citizen-generated visual data can be leveraged in digital and participatory ways to situate studies of urban issues in lived experiences.

Article 1: "Soft City Sensing: A turn to computational humanities in data-driven urbanism".

Published in Cities in 2022. DOI: https://doi.org/10.1016/j.cities.2022.103671

Authors: Anders Koed Madsen, Anders Grundtvig, Sofie Burgos-Thorsen

This article establishes a theoretical framework for critiquing how data-driven urbanism has become synonymous with the Smart City discourse and what the article terms 'hard city sensing'; an approach that frames digital data from the social web as an opportunity to track how people move about in the city and optimize city management and governance. The article proposes that we might dis-entangle data-driven urbanism from this seemingly locked position with a 'soft city sensing' approach that uses the granularity of digital data and the way social media data is inscribed with subjective experience to understand how people perceive and make sense of urban life. The article then reviews two decades of empirical projects that have used digital traces to study urban issues. It identifies four ways of working with digital traces out of which three pave the way for new ways of problematizing the city by emphasizing granular and phenomenological potentials in digital data. The review also shows that most digital data projects use textual data from platforms like Twitter, while visual digital data are rarely studied. Differentiating between 'hard city sensing' and 'soft city sensing' approaches, the article draws a theoretical line in the sand that helps position my own empirical projects: It indicates that the forthcoming articles contribute to a 'soft city sensing' interest of using visual digital data to foreground citizens' lived urban experiences.

Article 2: "Studying COVID place attachments in Denmark with Instagram photos and computational visual methods".

Publication status: Submitted in 2022. In second review in Cities.

Authors: Sofie Burgos-Thorsen, Anders Kristian Munk

This article presents the first empirical experiment in the PhD, which uses Instagram photos associated to the COVID-19 campaign #BareDanmark to study online place attachments in Denmark during the first nine months of the pandemic. The article brings a review of trends in social media analyses of cities, and shows that such projects tend to be limited by three commitments that shape the imaginaries of such data-driven urbanism, namely 1) bias towards textual social media; 2) fixation on geotag-ontologies; and 3) seeing the subjective nature of data as a bias. The article then argues that these commitments limit the potential of social media data for renewing the empirical ground of digital urban studies. Instead, it suggests that social media images could be used to study place attachments and explore how people experience cities, bridging ethnographic research questions with the computational agenda. To exemplify this, the article presents a digital methods study of around 39,000 Instagram posts collected in 2020, combining computer vision AI, data visualization, and network analysis.

Article 3: "Data feminist cartography: Five provocations for participatory mapmaking as engagement method in planning".

Publication status: Submitted in 2023. In review in Place, Gender and Culture.

Authors: Sofie Burgos-Thorsen

This article presents the second empirical experiment carried out in the PhD, centered around participatory mapmaking, also called participatory GIS. The article first outlines a set of theoretical critiques of cartographic power that has come from fields like Cultural Geography, Critical Cartography and GIS, where the 'post-colonial', 'post-representational', and 'participatory' turns have been productive in critiquing mapmaking and calling for innovation of more collaborative practices that involve diverse groups in mapping urban issues. The article then documents the use of participatory GIS in the Urban Belonging project, which engaged seven marginalized communities in Copenhagen in mapping experiences of belonging, individually and collectively. Through this case, the article delivers new insights into how underrepresented communities in Copenhagen experience the city. And drawing inspiration in Data Feminism (D'Ignazio & Klein, 2020a) and Counter Mapping (Dalton & Mason-Deese, 2012), it makes five provocations for how to expand the participatory potentials of collaborative mapping as a citizen engagement method in urban planning.

Article 4: "What is an inclusive city? Reconfiguring public participation with digital geospatial photovoice to unpack experiences of belonging among marginalized communities".

Publication status: Submitted in 2023. In review in Visual Studies.

Authors: Sofie Burgos-Thorsen, Sabine Niederer, Anders Koed Madsen

This article documents the PhD's third empirical experiment, which uses digital and geospatial photovoice method in the Urban Belonging project. First, it reviews trends in existing research, showing that photovoice projects have been slow to leverage digital and spatial technologies for reworking the method in ways that enable geospatial analysis and collect structured metadata that can be used in workshops to bring different groups together around unpacking urban problems. The article then reports on the use of a new photovoice application, UB App, in an empirical study of how seven marginalized communities in Copenhagen experience the city. With a dataset of 1459 geolocated photos, annotated by participants in the app and co-interpreted in workshops, the project delivers a three-fold analysis: First, it unpacks community-specific patterns in how the city creates experiences of belonging for different groups. Second, it zooms in on a visual theme around 'urban nature' and unfolds how participants re-negotiate what counts as valuable nature through photovoice images. Finally, it examines how participants experience certain places and situations differently. The article hereby demonstrates a form of photovoice that leverages GIS and digital methods capabilities in ways that open new analytical opportunities.

Article 5: "The Urban Belonging App: A photovoice toolkit for studying place attachments with digital and participatory methods".

Publication status: Submitted in 2022. In second review in Methodological Innovations.

Authors: Anders Koed Madsen, Sofie Burgos-Thorsen, Maarten Groen, Drude Emilie Ehn, Carlo de Gaetano, Sabine Niederer, Kathrine Norsk, Thorben Simonsen.

This article documents the design and development of the UB App, the photovoice smartphone application co-designed in the Urban Belonging project by researchers, planners from Gehl, local community organizations, and citizen science experts. Drawing on Design Justice (Costanza-Chock, 2020), the article describes how the app's design specifications were co-created in a participatory design process that brought together different voices and interests to co-create the design criteria for what data collection the app makes possible and how to make the app as inclusive as possible. The article then explains how these criteria were translated into app features. Next, it demonstrates how this opens new empirical opportunities for community engagement through examples of its use in the Urban Belonging project. It is exemplified how the focus on photo capture animates participants to document experiences in a personal and situated way, while metadata such as location and sentiment invites for quali-quantitative analysis of both macro trends and local contexts of people's experiences. Similarly, the possibility to invite participants to react to others' photos within the app means that data can be used to study how people see the city differently.

This article is used to exemplify how this PhD has not only engaged in innovating new methods for processing and analyzing visual data, but has also co-created a new open-source tool that empowers a digital, geolocated photovoice method.

STRUCTURE OF DISSERTATION

The five articles constitute the main contribution and together address the primary research question. Meanwhile, the other chapters in the dissertation (the 'wrapper' text), serve as dual purpose: The wrapper frames and situates the articles in relation to visual methodologies frameworks. The wrapper text also addresses the second research question, using Gehl as a case to qualitatively study how visual methods play into the data imaginary of urban planners. The dissertation is hereby comprised of a mix of articles and dissertation chapters that weave theoretical frameworks together with independent empirical and methodological experiments, and an STS study of the data imaginary in Gehl. The structure is as follows:

Part I of the dissertation situates the research within relevant theory. Chapter 2 brings the Soft City Sensing article, which reviews major trends within contemporary digital data projects about cities (not specific to visual data). This is followed by Chapter 3, which situates social media analysis, participatory GIS, and photovoice as methods within a genealogy of visual research, while outlining the digital and participatory capabilities of these three methods.

Part II presents the PhD's data experiments and toolmaking as four journal articles. Chapter 4 brings an article documenting my use of Instagram data in a nation-wide study of place attachments in Denmark during COVID. Chapter 5 delivers an article about the use of participatory GIS in the Urban Belonging project. Chapter 6 documents the use of photovoice in the Urban Belonging Project. Chapter 7 finally brings documents the co-creation and design of the UB App, the photovoice application used in study in the Urban Belonging Project.

Together, Part I and II answers the primary research question.

Part III answers the secondary research question by delivering a qualitative analysis of the data imaginary in the planning practice, based on observations made throughout my three years in the company. Chapter 8 first outlines the theoretical framework around the concepts of 'situated interventionist STS' and 'data imaginaries' with which I approach the study of Gehl's data culture. This chapter also touches upon my observation method and data collection, discussing how I have navigated my role in the company along an insider-outsider continuum and what observation materials this has resulted in. This is followed by Chapter 9, which uses materials from the observational collection to unpack the data imaginary in Gehl. Seven observations are made about epistemic commitments that shape the imaginary in the company, and it is discussed how these commitments, also function as 'discursive closures' that shut the planners off from some of the exciting possibilities afforded by digital and participatory visual methods. Each observation in the chapter is linked back to my own experiments documented in Part II. Chapter 10 discusses the seven observations about Gehl's data imaginary within a framework of data futures and positions the experiments in Part II as speculative interventions that show how it is possible to expand Gehl's imaginary to include more diverse data futures.

Part IV presents concluding remarks in Chapter 11, followed by summaries in English and Danish in Chapter 12. Chapter 13 delivers an epilogue about the new frontiers of digital visual research, and Chapter 14 collects references used throughout the wrapper (excluding references in articles).

To kick off, the next chapter dives directly into the first article of the dissertation, which takes a broad lens at investigating how digital data have been leveraged within urban scholarship in the two recent decades to study cities. Let's go!

Chapter 02

Publication

Cities journal

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Soft City Sensing

A turn to computational humanities
in data-driven urbanism

Soft City Sensing

Abstract

Data-driven urbanism is often entangled with the smart city and practiced in a way that prioritizes control over physical objects and downplays the human and political aspects of data. We label this approach 'hard city sensing' (HCS) and we argue that the rise of the 'digital city' offers the empirical foundation for more humanistic approaches. Driven by the ambition to untangle data-driven urbanism from HCS, this paper reviews two decades of scholarship that has used digital traces as an empirical ground for understanding urban phenomena. The review identifies four distinct ways of working with digital traces of which three pave the way for new ways of problematizing the city. Instead of abandoning the idea of data-driven urbanism, we propose the framework of 'soft city sensing' (SCS) as way to re-engage with it with inspiration from these pioneering works. However, this requires a willingness to revisit key epistemological commitments that currently serve as standards for how to "properly" do data projects. We therefore urge qualitative urban scholars to ponder the possibilities of furthering their urban interest by 'thinking with algorithms' while retaining their interpretative ambitions just as we identify a need for urban decision-makers to expand their criteria for what serves as valid data inputs to urban planning.

Keywords: soft city sensing; urban studies; big data; social web; digital city; computational humanities

Introduction

> "The city as we imagine it, the **soft city** of illusions, myth, aspiration, nightmare, is as real, maybe more real, than the hard city one can locate on maps, in statistics, in monographs on urban sociology and demography and architecture" - Raban (1974, our emphasis)

What is a city? How do we get to know and improve it? The answer to these questions vary depending on disciplinary perspectives. To the these questions vary depending on disciplinary perspectives. To the traffic engineer the city could be a collection of movable objects to be controlled and efficiently managed. To the sociologist it could be a set of demographic patterns that make it possible to mitigate stratification. To the ethnographer it could be semiotic signs and interpretations that indicate how urban culture is weaved together. These are just three of many examples that illustrate an important point. 'The city' is an elusive phenomenon and we need a multitude of frames to make its different aspects tangible (Cukier et al., 2021). The fact that different disciplines have developed distinct conceptual and empirical approaches helps us view the city from many angles and retain its multiplicity. Fortunately, the field of urban studies has maintained an elective character that fits its object of analysis (Harding & Blokland, 2014). This ensures that a diversity of interests have a language and a toolkit through which they can couch their perspective on the urban. In the words of Kurgan & Brawley (2019) multiple 'ways of knowing cities' co-exist. However, this eclectic character has proven difficult to translate into the executive rooms where decisions about urban futures are being made. Here, the city is often seen through standardized measurements and representations. Quantitative urban data—and the visualizations through which they are communicated—serve as the primary engines behind the professional vision of the people who have the power to define and solve urban issues (Goodwin, 2015). Historically, this is illustrated by Scott's (2020) exploration of how state bureaucracies in the modern era learned to see cities through technologies such as the census and bar charts. In our own era, we are similarly witnessing how sensors and interactive urban dashboards occupy a central role in the way proponents of smart city governance envision urban problems and their solutions (Kitchin, 2014b). Across these examples it seems fair to say that 'data-driven urbanism' has to a large extent become entangled with a distinct epistemology and philosophy of planning where data is seen as an instrument to predict and control large-scale urban infrastructures. This is what we loosely propose to call "hard city sensing" (HCS).

Our critical ambition in this paper is to use insights from computational humanities to *untangle* data-driven urbanism from this trajectory. The backdrop for this ambition is that the emergence of the 'digital city' (Halegoua, 2020) has resulted in a situation where urban activities leave qualitative and granular traces that affords data-intensive analyses with roots in humanistic epistemologies (Kitchin, 2014a). Analyses that are qualitative and explorative while simultaneously being data-intensive. We contribute to said untangling by critically reviewing two decades of scholarship that have pioneered the use of digital traces as an empirical foundation for producing urban insights and cartographies. We see these studies as indications of the way new data possibilities can productively be grasped within the field of urban studies. The review identifies four distinct ways of working with digital traces in an urban context. The approach we call 'sensor surrogates' does not take advantage of their qualitative and explorative affordances. The 'phenomenological grid' is an approach that takes advantage of the qualitative affordance, but not the explorative potential. The approach we call 'situated boundaries' takes advantage of the explorative affordance, but not the qualitative. Finally, we use 'Soft City Sensing' as a label for the papers that take advantage of both affordances simultaneously.

After having identified these approaches, we discuss the extent to which they pave the ground for new ways of problematizing the city and perhaps even stimulate a need for inviting new experts into data-driven urban planning. We argue that each of the three latter approaches carry such potential in their own distinct ways. Instead of criticizing idea of data-driven urbanism from a distance, we thus propose to re-engage with it with inspiration from these pioneering works. We use SCS as a headline for such reengagement which involves analyzing and framing the potentials of digital data in alternative ways than what the HCS toolkit offers. However, we also stipulate that any future institutionalization of SCS depends on a willingness to revisit central epistemological commitments that currently serve as standards for how to "properly" do data projects. Our hope is that this critical review and sketch for a future SCS agenda invite both qualitative urban scholars and urban decision-makers to rethink their stance on datafication. Whereas we urge the former to ponder the possibilities of furthering their urban interest by beginning to 'think with algorithms' while retaining their qualitative and interpretative ambitions, we ask the latter to expand their criteria for what serves as valid data inputs to urban planning.

Hard city sensing: data-driven urbanism under the smart city umbrella

We use the concept of data as a reference to inscriptions that allows selected aspects of the world to be analyzed and reorganized by computational techniques (Mayer-Sch¨onberger & Cukier, 2013). We live in a world where this definition no longer just includes spreadsheets in Excel, but a plethora of images, texts, and relations on social media. This means that data-driven urbanism—which we define as the ambition to understand urban phenomena with reference to patterns in data—has the potential to engage professions and disciplines with urban interests and epistemologies that are rooted in the humanities. However, the dream of data-driven urbanism has historically been hard to disentangle from bureaucratic statecraft and it has recently manifested itself in the vision of the 'smart city' (Kitchin, 2017). While this concept is arguably vague and carries many connotations, Kitchin (2015) suggests that most of its incarnations share a dream with the bureaucracies described by Scott (2020). The dream of utilizing new data sources and algorithmic techniques to realize a more efficient and responsive form of urban planning. Often with an outset in predefined urban entities such as roads or administrative neighborhoods. According to critics of this development, the result has been that data-driven urbanism rests on three problematic assumptions about what data is and why it is useful in an urban context. We will touch briefly upon each in turn.

First, data and algorithms are reduced to tools for gaining *control* over complex physical urban systems (Caprotti, 2019). A central ambition of smart-city projects has been to model and predict urban processes, such as the flow of traffic or the potential breakdown of infrastructural systems (Batty et al., 2012). As a consequence, it has been central for data-driven urbanists to develop infrastructures of ubiquitous computing in the form, for example, of fiber cables, high-performance computers, and networks of urban sensors (Caprotti, 2019). In this technological infrastructure, data and algorithms are primarily used to track physical objects in space. Both academics and dedicated smart city initiatives from industry leaders - such as IBM and Siemens - have prioritized the development of IoT solutions to big urban problems like traffic, energy management, and public safety. Even a company like Google—which sits on a plethora of traces from the social web—takes a similar physicalist approach to its smart city initiatives in their Sidewalk Labs.

Second, this mode of data-driven urbanism results in analyses that lose track of the human aspect of the city. As put by Vanolo (2014), the resulting representations of urban space are characterized by "plenty of hi-tech symbols [...] without any visible human presence" (Vanolo, 2014, 892). In line with this, Marvin and Luque-Ayala (2017) notes that most smart city projects are designed in a way that excludes stakeholders and viewpoints that could challenge the initial problem formulation by the project owner. As long as such dissonant voices are not inside the presumptions of the software used to represent the city, there is little chance that they will have an impact on the problematization of the city and the conclusions drawn about its development. The human aspects of the city are squeezed out of the operating systems in a way that risks reverting urban planning to ideals that are more reminiscent of the modernism criticized by Scott (2020) than the human-centered urbanism that has flourished in its wake.

Finally, as data-driven urbanism follows this path, it risks jeopardizing important democratic principles (Caprotti, 2019). The goals that predictive analytics are supposed to help achieve are often defined before problems and solutions from citizens are taken into account. Cardullo and Kitchin (2019) discuss this situation as a form of "civic paternalism" underpinning many smart city projects. Although such projects are often introduced as apolitical and non-ideological, they downplay political disagreement in a way that enables urban managers to steer their cities in their preferred direction (Kitchin, 2014a, 2014b, 2015). They carry interests beneath a mask of neutrality—a tendency that has also been discussed more broadly under the heading of "technological solutionism" (Morozov, 2013).

We use the label 'HCS' as a loose reference to projects that frame the potentials of data with roots in these three assumptions, and we have just seen that urban scholars have during the last decades formulated relevant criticism of this powerful paradigm. However, whereas these critiques have been successful in exposing the opaque ideologies on which its rests, Kitchin (2015) have also pointed out that their authors have been reluctant to "undertake applied research aimed at creating smart city initiatives" (Kitchin, 2015: 134, our emphasis). For the most part, they have formulated their critique at a safe distance from data technologies without any interest in conducting experiments on how data-driven urbanism could be done differently. They rarely take advantage of the fact that our current data situation opens opportunities for alternative ways of measuring that could perhaps fix some of the problems identified.

The result is a form of critical scholarship, which tends to be overly dismissive of the role of digital technology in urban planning and sometimes even indicates that being data-driven is in itself problematic (for important exceptions to this trend see e.g. Kurgan, 2013 and Williams, 2020). As mentioned in the introduction, we introduce SCS as a more interventionist line of critical scholarship (Zuiderent-Jerak, 2015) that draws on thoughts from computational humanities to actively intervene in the way data and algorithms are imagined and used in an urban context.

Disentangling data-driven urbanism: a turn to computational humanities

We use the concept of "computational humanities" as an umbrella term for the work of scholars who have, during the last several decades, used digital data sources and algorithmic techniques to create new methodologies for qualitative and exploratory analyses. Under headings such as "digital methods" (Rogers, 2013) and "digital humanities" (Berry, 2011), these scholars have especially seen empirical potential in the digital traces accompanying the rise of the social web. Whereas the smart city has prioritized a sensor-based data infrastructure that is optimized to model and predict the flow of objects in urban space, computational humanities have demonstrated how we can gain insights into human dynamics and sensemaking through digital traces such as pictures, reviews, and "likes" on web-based platforms. Rather than seeing data and quantification as being in opposition to the study of humans and culture, scholars in this field have used the "computational turn" (Berry, 2011) as an opportunity to invent a type of data science grounded in the epistemology of their own humanistic mother disciplines. In this way, they have attempted to take seriously the fact that many of digital traces were intentionally produced to convey meaning by their authors.

Envisioning data-driven urbanism from the perspective of computational humanities therefore opens for a different form of critical engagement with the HCS framework than the distanced critique discussed above. Rather than unpacking the hidden ideologies inherent in dominant versions of data-driven urbanism, the interventionist strategy we propose is to collect new types of urban data traces and produce urban representations that support alternative formulations of urban problems and thereby a different mode of planning. We motivate this proposition by highlighting two reasons why scholars working in the computational humanities have found the new data environment to have potential for their disciplines.

REASON 1: QUALI-QUANTITATIVE TRACES AND SEMANTIC TECHNIQUES

Although it has been customary to make an equation between data and the quantitative sciences, many data sources are now simultaneously qualitative and quantitative (Venturini & Latour, 2010). A commentary thread on Facebook contains qualitative text and quantitative measures, such as the amount of likes on a given comment. An image on Instagram is a qualitative whole that consists of quantified pixels open for algorithmic investigation. Furthermore, the open source community has developed accessible algorithms that can be used to detect patterns in large volumes of quali-qualitative data. Techniques such as natural language processing make it possible to engage in "distant reading" (Moretti, 2013) of large corpora of texts, and developments in computer vision open the possibility for automatically identifying objects and people across large sets of images. Accordingly, algorithms can be used to conduct data-driven studies of how people perceive the world and the symbolic forms in which they communicate.

Goodchild (2007) indicated quite early that these types of traces could serve as an empirical foundation for cartographies of urban space that do not reduce people to physical points in space. People rate the urban environment on Yelp, depict it on Instagram, and indicate their willingness to engage in it on Facebook events. Because the symbolic systems of such digital platforms matter to the way we understand and navigate cities (Halegoua, 2020), they are valuable sources for understanding how urban life is made sense of by those participating in it. However, it has not been a priority for data-driven urbanism to realize this epistemic potential. In the years where computational humanists turned their gaze to traces of the social web, Townsend's (2013) influential book on smart cities explicitly dismissed these same traces as banal chatter and argued that at some point "the Internet of people gave way to the Internet of Things" (Townsend, 2013, 3). Rather than discussing the potential of qualitative traces, Townsend's (2013) book is filled with examples of how the possibility of tracking physical urban infrastructure—from snowplows to sewers—can provide useful feedback to urban planners and citizens. While maintaining a reflexive and critical stance toward this development, Townsend (2013) equates data-driven urbanism with the type of HCS discussed above. This equation has grown so strong that people working on urban data have to a large extent missed the opportunity to experiment with the ways in which new forms of quali-quantitative data can make human life legible for urban planners.

We think of the suggestion to turn data-driven urbanism toward computational humanities as an attempt to pick up a torch that was already lid in the 1960s and 1970s, where Whyte (1980) invented empirical techniques to record public life in New York City Streets and Gehl (2011) began measuring life between the buildings in Europe. Also Lynch's (1960) early experiments with mental maps carried a similar ambition of making cartographies of the human city. As digital traces stem from people's experienced reality, they can be used to map similar subject-centered itineraries that mark key features of the city from below. The goal is to tune into urban life rather than to model, predict, and control it. While this could be done exclusively through established qualitative methods, data-driven techniques from the computational humanities can provide a useful supplement in this endeavor. While such techniques cannot replace existing qualitative methods, they can guide qualitative analyses in a way that is similar to the way early ethnographers used map overviews to select and foreshadow their field sites before they ventured out in the world (Munk & Jensen, 2015). In short, big urban data can be immensely qualitative.

REASON 2: GRANULARITY AND INDUCTIVE ALGORITHMS

A second reason why scholars in computational humanities have found potential in the digital data environment is the possibility of combining granular data traces and techniques for pattern recognition into explorative tools (Nelson, 2020). While quantitative analyses have usually consisted of applying regression models to test pre-defined hypotheses, the possibility of using machine learning to underpin a more explorative data science has generated an interest among scholars used to work based on "grounded theory" or similar approaches. Rather than being constrained to divide humans into established classifications such as gender, age and race, digital data have opened the possibility for conducting so-called post-demographic studies where classifications emerge from patterns in data, rather than guiding the way they are analyzed (Rogers, 2013).

In an urban context, this approach could be translated into using a combination of granular geo-tagged data and explorative techniques to identify interesting urban areas and boundaries. For instance, if there is a tendency for events in a certain area to attract the same Facebook users, one could draw a data-driven polygon around that area and study it in detail. This would be an alternative approach to the widespread tendency to start spatial statistics from pre-defined urban grids such as streets, ZIP codes, elective districts, or other spatial divisions that often serve as the unchangeable reference against which interesting variations in data is observed. The idea that urban planning should take departure from such recognizable units has been a longstanding staple in the profession (Dewey, 1950; Galster, 1986), and it was explicated as a planning principle in the charter for New Urbanism two decades ago (Congress for the New Urbanism, 2000). However, this way of a priori choosing the relevant grid severely diminishes the flexibility of potential problem formulations.

Although urban statistics have usually not been conducted in such an explorative manner, we posit that the explorative potentials embraced by computational humanities could also provide new empirical foundations for established theoretical trajectories in urban studies. For instance, the 'disticts' Lynch (1960) ended up identifying with his narrative methods did cross administrative boundaries. Also, in his classic text, "The City is Not a Tree," Alexander (1968) suggested that one of the problems of urban theory was its lack of ability to understand urban space as a set of dynamic and potentially overlapping units. While acknowledging the motivation to work with pre-established and mutually exclusive grids, he illustrated how many relevant aspects of urban life could only be grasped when the cartographer freed herself from predefined grids and embraced the ambiguity and situatedness of spatial boundaries. More recently, Kitchin and Dodge (2007) introduced the concept of the 'ontogenetic city' to make the similar point that space is not a container with pre-given attributes but a phenomenon that gains its form, function, and meaning in practice. We interpret this as a call for working with *softer* and more malleable urban boundaries and we argue that the combination of granular digital traces and inductive techniques enables us to pursue this agenda further.

Soft City Sensing: charting the contours of an alternative urban data paradigm

Our proposition is that data-intensive analyses with boots in the epistemic soil of the computational humanities can help make visible important aspects of urban life that fall outside the scope of HCS. We tentatively label such analyses 'SCS' to indicate that they (a) move beyond a physicalist ontology by attempting to inscribe the softer semantic aspects of urban life (e.g., people's sensemaking, experiential realities, and normative positions) and (b) refrain from having problem definitions dictated by pre-established urban grids and classifications and actively use the granularity of data sources to define different areas as relevant for different urban issues. However, we are by no means the first to suggest that the emerging quali-quantitative digital data environment carries potentials for such urban analyses. For instance, Williams (2020) recent call for 'data action' in urban studies makes a similar point as ours. We therefore introduce the framework of SCS with an outset in a review of academic works that have, during the last two decades, turned to the social web as an empirical source for studying and representing urban life. These studies show us the contours of a type of data-driven urbanism that have the possibility to realize the qualitative and explorative affordances of digital traces. The question is whether they do so and how?

REVIEW METHOD

Our review contains a close reading of 45 papers that we selected for review through complementary strategies. Our main strategy was to search SCOPUS for academic papers that employed digital traces from social media as an empirical ground to analyze urban life[5]. We used this SCOPUS search in combination with a snowballing strategy where we followed the references and links from papers that we thought illustrated SCS potentials. We read the titles and the abstracts, chose the most relevant articles and added them to our corpus of texts to review. Finally, we used the "cited by"-function at Google Scholar, that shows which articles that are referencing back to the source article. By doing so, we snowballed the other direction in time and now only received articles that were newer than the source article. About half of the papers came from the Scopus search and the other half from the snowball method. While not exhaustive, the 45 papers in our review provide a broad overview of how data from the social web have been

[5] The Scopus search query was: "TITLE-ABS-KEY (("social media" OR "user generated content") AND ("city" OR "cities" OR "urban" OR "neighborhood"))".

reappropriated in urban studies since it gained widespread popularity around 2009. Fig. 1 shows the data sources used in the reviewed papers.

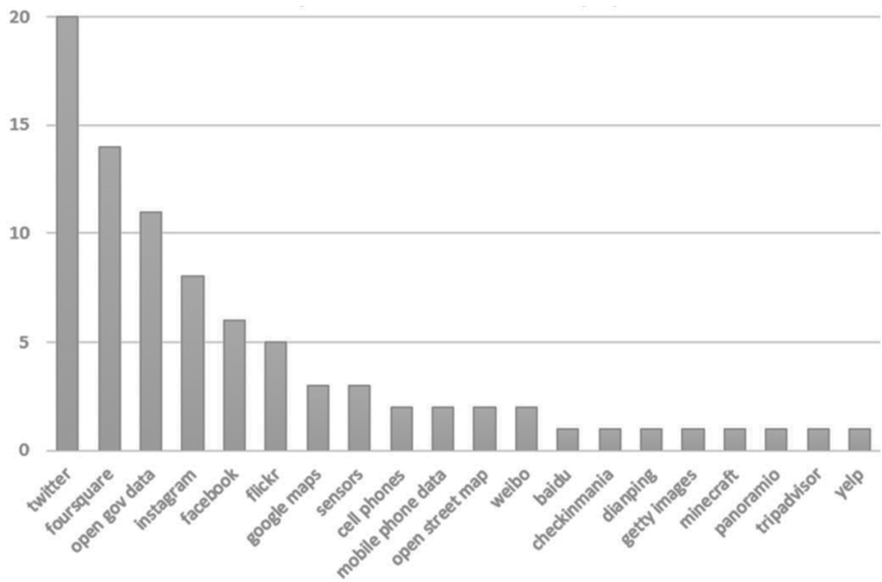

Fig. 1. The data sources used in the 45 reviewed papers and the number of papers using them. Note that a paper can use more than one platform**.**

Two meta-observations of the corpus are especially noteworthy. First, there is a bias toward Western and Anglo-Saxon platforms. Even though data from social media sites such as 微博 (Weibo) and 微信 (WeChat) are used in a few of the articles, these platforms are not well represented in our sample. Second, a majority of data in the reviewed papers came from Twitter, Foursquare, and Facebook (we return to the open gov data later). This finding points to a text-centric bias in the reviewed papers. Also, the studies in our review sample that work with data from visual platforms such as Instagram or Flickr often do not make analytical use of the images. This under-prioritization of visual platforms and data in our reviewed papers mirrors broader trends in the literature pointed out by other scholars (see e.g., Highfield and Leaver (2016) and Thorsen and Munk (forthcoming)). Our review analysis consisted in plotting the 45 papers on two dimensions that each mirrors the two reasons why scholars in the computational humanities have taken an interest in digital traces.

We think of these as two affordances of digital data that are important to take advantage of to practice SCS. The vertical dimension in Fig. 2 below concerns the extent to which projects use traces from the social web to inquire into the *qualitative and semantic* components of urban life. Projects scoring 1 on this dimension use such traces as a surrogate for sensor data. If the answer to the question ‘could this study have been done with an RFID sensor or a static camera?’, was ‘yes’, then we placed the project low on the vertical dimension. An example could be the use of geolocations of tweets to study how people move in the city without regard for the semantic components of the tweet.

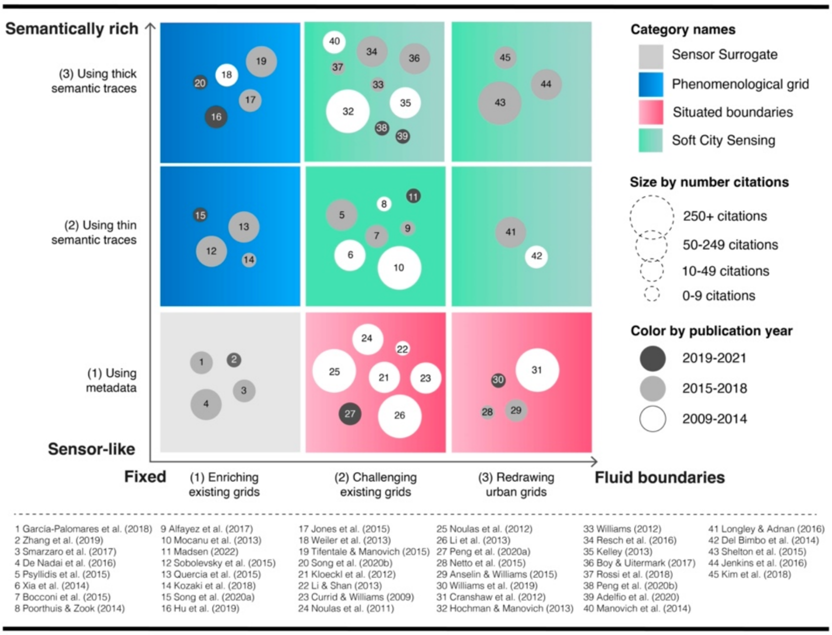

Fig. 2. The two-dimensional typology guiding our lit review. Forty-five papers were plotted based on the extent to which they took advantage of the phenomenological and granular affordances of data from the social web. The references to the papers are listed at the bottom of the image.

Projects scoring higher on this dimension are, to the contrary, interested in the lived life signaled by the digital traces. In such projects, the traces left by people through engagement with a digital platform could never be substituted by an “objective” sensor or camera. Insights into the intention behind the traces and the interpretation of the motivations of the urban agent are core to these studies. Such insights are achieved either through “thin” traces such as clicks and social buttons (e.g., likes and tags) or through “thick” traces, such as pictures and textual material. The latter projects score 3, while the former score 2. The horizontal dimension on Fig. 2 concerns the extent to which the papers use the granularity of digital traces to *redraw situated urban boundaries*. Projects scoring 1 on this dimension organize and interpret digital traces with reference to a pre-existing urban grid, which could be made up of administrative units like zip codes or more physical divisions such as streets or rivers. Projects scoring 3 on this dimension use spatial patterns in digital traces to re-draw situated urban boundaries with relevance to the phenomenon studied. They take such boundaries to be fluid and they can be drawn with an outset in traces that are social, aesthetic, or based on sheer movement. In the middle of these positions are the projects scoring 2, which criticize the relevance of existing grids without actively producing new ones themselves.

In the process of placing the papers on the two dimensions, each of us coded a selection of papers individually without consulting each other. To perform the coding, we read the papers with special attention to the methodology section, the data descriptions as well as the images and visualizations reported in the papers. Then, we placed the papers on the two dimensions and discussed differences between our coding results. In this process, we revisited and reframed the typology and developed the mode of scoring outlined above. Fig. 2 shows the final distribution of the reviewed papers and the four distinct ways of working with digital traces, to which our review gave rise. One comprises a small group of papers we call "soft sensor surrogates" (gray). They work with data from the social web without taking advantage of any the two affordances. We also identified two ways of working with digital traces that only took advantage of one of the two affordances that guided our review: "the phenomenological grid" (blue) utilized the qualitative potential in digital traces whereas "situated boundaries" (red) utilized their granularity. Finally, we identified a group of papers that took advantage of both affordances, and we labeled these "SCS" (green). Below, we describe these four distinct ways of using data from the social web and subsequently discuss the extent to which they open new ways of representing and problematizing the city.

SENSOR SURROGATES: KEEPING NEW DATA ON THE BEATEN PATH

Sensor surrogates denote a group of studies that translate digital traces into indices of the physical city that could also have been obtained through sensors or surveillance cameras. The *intentions* and *experiences* behind the data points are not in focus. Furthermore, these studies make the choice to aggregate data on predefined spatial units, such as blocks (De Nadai et al., 2016), land zones (García-Palomares et al., 2018), city regions (Smarzaro et al., 2017; Zhang et al., 2019), or counties (Li et al., 2013). The methodological choice is to refrain from using any of the two affordances of data from the social web to move out of the two dimensions in our typology. Despite working with the social web as their data source, these studies carry on within a frame that is remiscent of HCS rather than exemplifying a 'turn to computational humanities'. García-Palomares et al.'s (2018) study of city dynamics through Twitter is a paradigmatic example. To study the link between land use and urban activity in Madrid, the authors collected three million geo-tagged tweets to build a map that shows how some predefined zones, such as parks and retail areas, maintain constant activity throughout the day, while others fluctuate more. The authors explicitly states that their empirical strategy is to use tweet densities as a *surrogate* of population densities, which they aggregate on a grid borrowed from the Madrid transport authority (see fig 3 below). Despite acknowledging their semantic and qualitative potential, tweets are deliberately translated into moving points on a map. They are reduced to a proxy for people's position in the city. The humans behind the tweets are conceptualized as physical bricks moving in a recognizable spatial grid. We found three other sensor surrogate papers in our review. De Nadai et al. (2016) used social media activity to map activity in urban venues, and Smarzaro et al. (2017) reduced online reviews to chart the availability of different types of services across the city. More surprisingly, Zhang et al. (2019) also falls in this category. Even though the authors explicitly state the potential of using images from the social web to study people's subjective preference for the cityscape, this potential is not realized in the study. Instead of interpreting the intentions behind images, the paper uses machine learning to detect the objective physical characteristics that make a place visually unique. Characteristics that could just as well have been studied through images from a surveillance camera.

THE PHENOMENOLOGICAL GRID: FROM SYNTAX TO SEMANTICS

The nine papers falling under the heading of 'the phenomenological grid' all take advantage of the quali-quantitative affordances of digital traces while plotting these data within an established urban grid. These papers move up the vertical axis by taking advantage of either *thin* or *thick* semantic traces but stay low on the horizontal axis. In the thin traces category, Quercia et al. (2015) measured the safety and walkability of streets in Central London by counting Foursquare and Flickr activity. Without using the full qualitative potential of these data sources, the authors used metadata such as the gender of the user and the tags on the picture in their mapping. (Quercia et al., 2015). However, the richness of the user-generated material and the agency or intention behind each trace left by a user were not used to generate insights about their lived experiences. Adding more phenomenological nuance, Hu et al. (2019) used neighborhood reviews to perform a semantic analysis of the way different neighborhoods are perceived and problematized by their visitors (including issues of safety, cultural diversity, and life convenience). As seen in Fig. 4, the result is maps of New York City neighborhoods, which we think of as a contemporary version of mental and cognitive mapping.

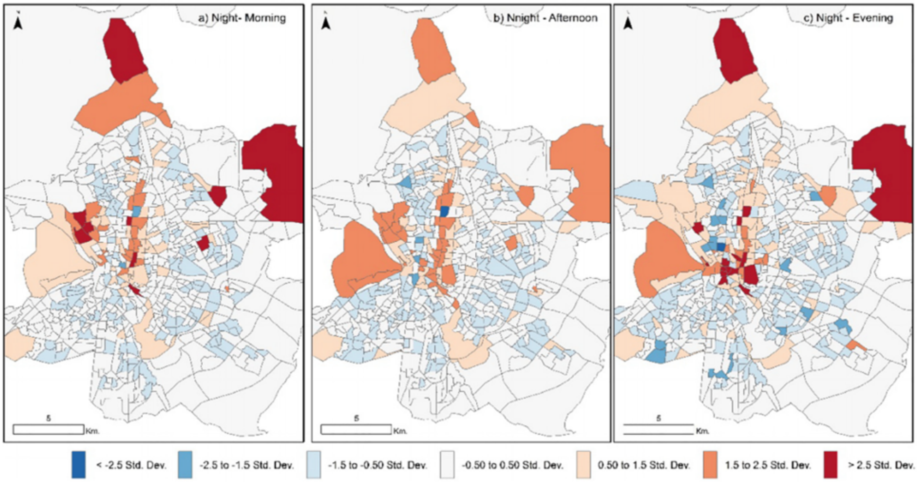

Fig. 3. Predefined areas in Madrid are colored based on the intensity of tweet activity throughout the day. The map is used to inform urban planners about the dynamic "pulse" of the city (by Garcí a-Palomares et al).

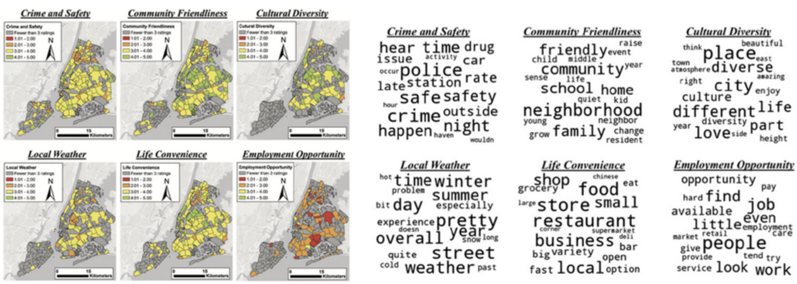

Fig. 4. The maps on the top use semantic patterns in neighborhood reviews to illustrate how people associate specific areas of New York City with specific urban issues. The word clouds below illustrate the words they use to describe these issues (by Hu et al).

Notwithstanding their differences, the phenomenological grid and sensor surrogates share the important trait of aggregating data within standardized spatial units. One consequence of this choice is that their visual outputs are—on the surface—very similar. The two maps in Figs. 3 and 4 are color-coded choropleth maps that compare predefined city zones. While the motivation for doing so, in the phenomenological grid papers, is to allow comparison between social media and other urban data collected within the same spatial units, it bypasses the chance of investigating how social traces might offer alternative and issue-specific ways of drawing city boundaries.

SITUATED BOUNDARIES: REDRAWING BOUNDARIES TO FIT URBAN ISSUES

While papers in the phenomenological grid stay within established spatial divides to experiment with semantic mapping, the 11 papers in the situated boundaries category do not take advantage of the qualitative affordances of digital traces, but instead use their granularity to challenge standard urban boundaries. For instance, Cranshaw et al. (2012) used an algorithmic analysis of patterns in check-ins from Foursquare and Twitter to map the lived life in Pittsburgh. As shown in Fig. 5, the authors identify "livehoods" (red and blue colors) that cross existing administrative neighborhood borders (the black lines). For instance, the administrative neighborhood of Shadyside is argued to comprise two distinct clusters of urban life, with the western part dominated by older, richer people, and the eastern part dominated by younger, indie-looking people, whos urban life have a lot in common with the the adjacent neighborhoods of East Liberty.

While this map redraws urban boundaries and thereby exposes how existing administrative grids fail to fit the issue studied, the study does not dive into the qualitative content of the underlying data when describing these livehoods. The blue and red clusters are based on check-in patterns. They represent movements and co-locations between humans and could have been created using WIFI triangulation or other forms of granular tracking. While the authors do use these patterns as an outset for doing interviews, the qualitative methods have the character of an add-on to the geographical patterns. Other papers follow a similar strategy. For instance, Netto et al. (2015) used patterns in geo-coded tweets to produce proxies for actual trajectories that people follow when moving through the city. They used these data-driven trajectories to argue that administrative residential zones are not useful units when attempting to understand social segregation in Rio. Rather than conceptualizing segregation as something pertaining to residential neighborhoods, the authors re-ontologized the city as a network of encounters that pointed to alternative planning problems that cannot be properly understood through the established grid (Netto et al., 2015).

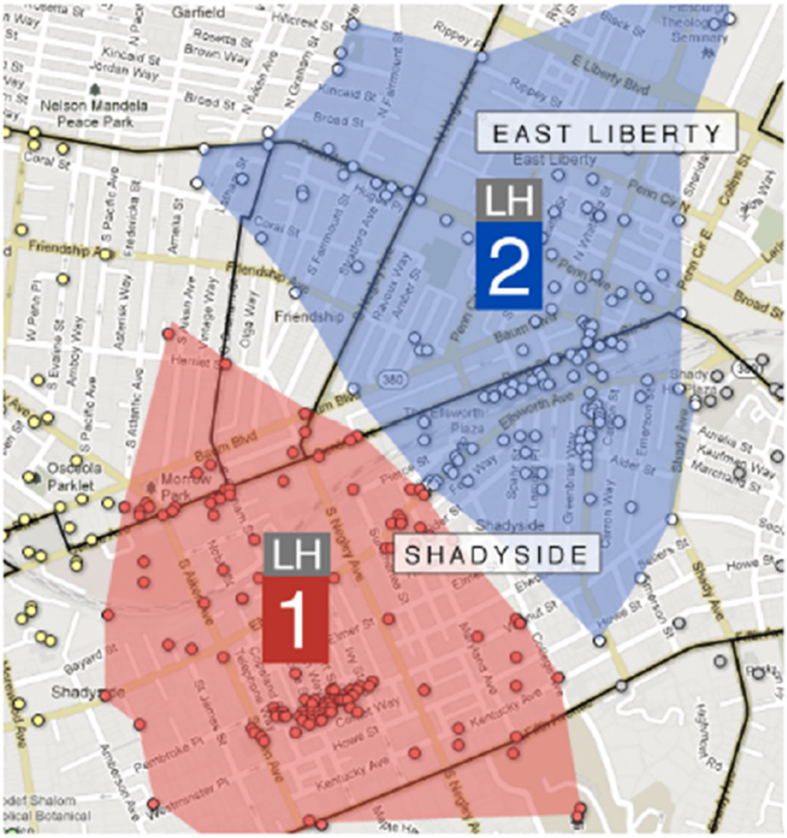

Fig. 5. This map plots check-ins from Foursquare to illustrate how "livehoods" (red and blue)—areas in which specific types of life unfold—cross administra-tive divisions (black lines) in Pittsburg. (by Cranshaw et al).

SCS: EXEMPLARS OF AN EMERGING RESEARCH AGENDA

We use the label SCS to denote the papers that simultaneously move out on both dimensions and thereby take advantage of both the affordances that have been highlighted as interesting by scholars in the computational humanities. A paradigmatic example is a study by Shelton et al. (2015), who used geo-tagged tweets to visualize the *mental* boundaries through which people in Louisville make sense of their city (Fig. 6). More specifically, they did so by analyzing the semantic and geographical patterns around the use of the word "ghetto" in said tweets. The map uses data from the social web to portray a semantic urban space, and it deliberately frees itself from pre-existing spatial grids when delineating "the ghetto." Contrary to ambitions in HCS projects, this study does not solve the problem of efficiency or prediction, but rather one of prejudice. It is built with the deconstructivist purpose of disproving the living urban myth that 9th Street is a relevant boundary separating the east and west of Louisville. This finding can inspire local urban planners to rethink the identity of the city and pave the way for new urban narratives about its composition.

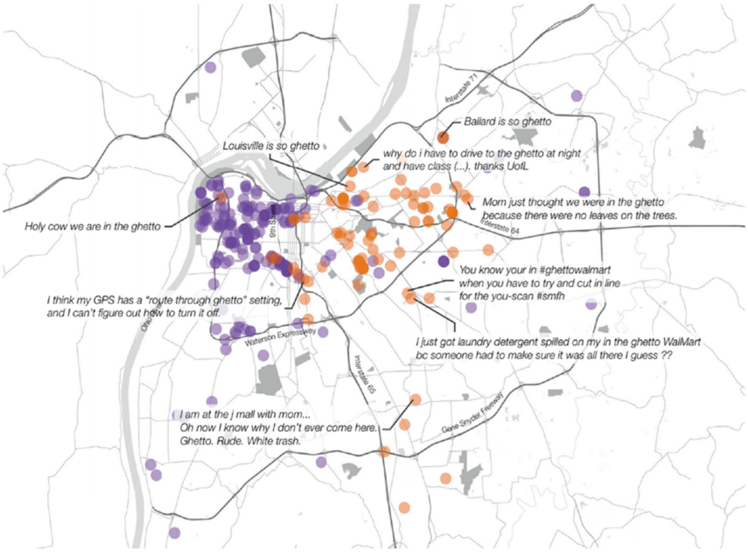

Fig. 6. The dots represent tweets from west-end (purple) and east-end (orange) Twitter users in Louisville. The addition of text to the tweets on the map enables the authors to explore where and why users cross the "9th Street divide." (by Shelton et al).

Another example of SCS is the way Jenkins et al.'s (2016) used a semantic analysis of textual data from Twitter and Wikipedia to identify areas in Midtown, New York City, that carry distinct atmospheres of entertainment. In line with the Louisville paper, the resulting map of New York serves to deconstruct established modes of thought. It challenges the idea that place atmospheres are geographically linked to physical venues (such as theatres), and it uses this insight to challenge a mental boundary that has guided destination management in New York for decades.

The kind of problem a city is…and could be!

In the previous section, we mapped the reviewed articles according to the way they empirically and analytically make use of social web traces to inquire into urban problems. In this section, we dive deeper into each of the identified typologies and unfold the arguments and propositions they make about how these data can be used to study cities. More importantly, we also outline the epistemological consequences of these commitments for how the city can be framed as a research problem and who can participate as urban experts within the given frames.

First, the sensor surrogate papers illustrate that the two affordances of social media data explored here—granularity and semantic richness—are not necessarily leveraged in a way that translates into reformulations of urban problems. By reducing the city and its inhabitants to physical entities, the sensor surrogate papers centre on the same when-and-where questions about how people move about in the city that characterizes HCS. These studies do not open new urban problem formulations or involve new types of experts in their solutions, nor do they suggest ways to escape or reformulate what Kryssanov et al. (2001) once called the "autopoietic city". A city where humans are just one of many relevant physical objects to model and control from a bird's-eye view (de Waal, 2017). To be fair, the possibility of alternative problem formulations is not at all the reason why these studies turned to the social web for empirical data in the first place. The reason is rather that the authors found established methods too "slow and expensive" (Smarzaro et al., 2017: 1463) or "hard to scale up" (Zhang et al., 2019: 2). In these studies, the fascination with social media traces is framed as the possibility of harvesting a lot of data quickly and cheaply. This also explains why, for example, Li et al. (2013), De Nadai et al. (2016), and Smarzaro et al. (2017) make the methodological choice to source their data across multiple platforms. While this choice limits the possibility of diving into how people express themselves on each particular media (and thereby conduct meaningful qualitative studies), it is a good strategy for getting as many geotags as possible. In these studies, the social web offers a "big- N opportunity" rather than a phenomenological one.

Second, the situated boundaries papers similarly couch their problem frames in behavioural terms. However, their insistence on harnessing the spatial granularity of data changes the way behavioral problems are phrased and, consequently, the types of experts that it makes sense to invite in to help solve them. First, people's behavior is not assumed to be explained with reference to administrative zones. For instance, the Livehoods project offers alternative spatial divisions to the established administrative grid. A consequence of re-ontologizing the city in this way is that the relevant experts on urban life are no longer the decision makers associated with specific administrative units, such as Shadyside. Rather, the experts is the crowd from which the new urban boundaries are sourced. This is why the Livehoods project uses interviews with people on the street to understand the background of the clusters and their development over time. By showing this potential, the situated boundaries papers flip the script on who need to be involved in solving urban issues. Situated boundaries call for the engagement of local knowledge in ways that bureaucratic grids do not. Though the papers in the situated boundaries category do not take full advantage of the opportunity to include the voices of citizens directly from the traces they leave, they do open new debates about the spatial and administrative units within which to address a specific issue. Something that can also be done with standard sensors related to the ubiquitous computing of the smart city.

The phenomenological grid papers give rise to quite different problematizations than those discussed above. By framing urban space as a semantic network of meaning, the urban problem becomes one of sensemaking and lived experience rather than one of behavior. Notably, the character of this phenomenological re-problematization changes the higher these projects move up the metaphysical axis. This is clear in the comparison between two papers in the phenomenological grid that both explore the urban issue of safety. Quercia et al. (2015) used the thin measure of posting activity to create a quantitative and binary distinction between safe and unsafe streets, whereas Hu et al. (2019) used thick traces to make a more semantically enriched argument about what safety means to different people in different neighborhoods. The map in Fig. 4 fully utilizes the semantic thickness of review texts to map relations between topics, sentiments, and review scores associated with different spaces.

Such thick semantic projects escape the tendency to frame urban issues—like safety— as well-defined, binary, and quantified problems that can be measured as a number (creating a narrow space for urban solutions to be found in top-down urban planning, policy, or management initiatives that reduce or increase said number). Learning from design theory's distinction between well-defined and ill-defined ‘wicked’ problems (Buchanan, 1992), we might suggest that projects in the phenomenological grid differentiate themselves by not assuming an a priori understanding of urban issues. Instead, thick semantic projects like Hu et al.'s (2019) study are inspirational in demonstrating that social media data can be used to both qualify what an issue like safety means to different people and quantify patterns of how it is experienced. If we agree that issues such as safety can be construed as well-defined problems, then maybe this is not an issue. But if we believe that many of the important urban issues of tomorrow are open-ended, complex, and wicked in nature, formulating more qualified problems will also lead to more qualified urban governance. Such alternative problem formulations is the promise of projects in the phenomenological grid category. Something that ethnographic fieldwork can also do on a smaller scale.

The choice to stay low on the horizontal dimension and aggregate data within preexisting and standardized spatial geo-units makes it possible for the phenomenological grid papers to compare their insights to established urban issues. This process creates what Espeland and Stevens (1998) calls a situation of *commensurability*. It enables semantic and qualitative data to exist in the same ontological world as more recognizable demographic urban data. For instance, Hu et al. (2019: 1052) explicitly perform what they call "correlation analyses between the subjective perceptions extracted from [social media] and the objective socioeconomic attributes of New York City neighborhoods." They deliberately use geographical commensurability to make their semantic insights actionable for city planners, politicians, and developers. The paper feeds on a genre of cadastral mapping that has, for decades, served as a shared reference between different forms of urban expertise. However, sticking to the established grid also causes a reproduction of modes of categorizing the city without much curiosity about how digital traces might offer alternative issue-specific ways of drawing city boundaries. While these papers could have used the granularity of their semantic data to create situated boundaries of safety, this would also risk the commensurability that makes these maps understandable and useful for the stakeholders in urban planning. In that sense, the phenomenological grid shift the problem framing, but not the experts. The decision-makers and bureaucrats in established administrative units will still have a strong agency in proposing solutions.

The strategic upside of commensurability is lost in SCS papers that move out on both dimensions simultaneously. As noted in the previous section, these studies tend to deconstruct rather than enrich existing cartographies. Whereas the other three approaches in their own ways have synergies with established urban analyses, SCS papers carve out their own agenda. In doing so, they demonstrate the potential of fully utilizing the two affordances of social media data identified in this article. Namely, how it opens for re-drawing of issue-specific urban boundaries from the bottom up, while empowering researchers and planners to map the city as a phenomenologically layered multitude of lived experiences. While this arguably paves the way for innovative cartographies, it also raises the risk of being too alien for practitioners of urban planning. If SCS projects fail to translate data into insights that are actionable for actors in the field, they can become so explorative that they unsettle administrative operationality. In the face of decision making, complexity and ambiguity are enemies, whether in the form of re-drawn spatial units that transcend established grids or soft phenomenological mappings of user subjectivities without any hook to standard modes of analyzing. As many scholars aim for their results to have an impact, it is understandable that few papers in our review move all the way out on the two dimensions in Fig. 2 and use social media data to break completely with established standards in urban analysis. This reveals that the ambition of an SCS research agenda is difficult to pursue and realize as long as the use of social media data and geospatial mapping exercises are evaluated against standards inherited from established data paradigms. Paving the way for an impactful SCS agenda therefore necessitates revisiting some of the epistemological commitments that currently serve as standards for how to "properly" do data projects. We will end this paper by doing just that.

Epistemological pillars of data-driven urbanism

In the previous section, we showed that an expansion of the types of data used in data-driven urbanism has the potential to re-problematize the city in interesting ways. But our proposed SCS agenda comes with the need to rethink some of the epistemological criteria used to evaluate the quality of urban data sources and algorithmic techniques. Well-known criteria from statistics, such as the need for representative samples, validity in the operationalization, and replicability of the study design, are ill-suited to evaluate the knowledge produced in SCS. The relevance of these criteria has been discussed by practitioners of qualitative methods for decades. To construct a new epistemological ground for an SCS research agenda there is a need to learn from this debate. Furthermore, we are also well aware that recent literature has presented compelling arguments for the problems associated with using algorithmic techniques on big digital datasets (see e.g. Boyd and Crawford, 2012 or D'Ignazio and Klein, 2020) and provided interesting reflections on what we can even learn about urban life from digital traces (Schwartz & Halegoua, 2015). We need to learn from these debates as well. Finally, there is a need to take inspiration from the pioneering SCS works reviewed above as well as the way scholars in computational humanities and human geography have recently revisited central epistemological debates.

RETHINKING BIAS

We have already seen that the issue of bias have been prevalent in critical discussions of Big Data and many of the studies in our review also notes that one of the main drawbacks of online data is the bias of the web (Bocconi et al., 2015; Hochman & Manovich, 2013). The fact that each platform has its own distinct user group is seen as a problem in building valid and reliable maps and models. Rather than being interested in how data from the social web reflect situated urban experiences, such data is evaluated on whether it is comprehensive and representative. In fact, we saw above how the sensor surrogate papers deliberately sourced data from many platforms in an attempt to alleviate this problem in the form of a triangulation move.

However, other studies in our review illustrate the potential for revisiting this stance on bias. For instance, in their attempt to define digital neighborhoods, Anselin and Williams (2016) actively utilized the bias of data from Twitter and Foursquare to operationalize digital hot spots as "those areas in the city where one is more likely to use social media" (Anselin and Williams, 2016: 6). The existence of a digital divide among users is used to make a larger claim about the digitality of New York neighborhoods and to identify digital deserts in need of attention. Rather than approaching Twitter and Foursquare as sampling techniques, they are treated as cases with well-known (biased) characteristics. It is the knowledge of these characteristics—not the representativity of the data—that enables the authors to reach their conclusions. This epistemological strategy of leveraging the inevitable bias of online data has also long been seen as a necessary methodological move within computational humanities (Bruns & Burgess, 2011; Madsen, 2012).

However, the discussion of bias does not just concern data sources. Recent literature has discussed how the training and use of algorithms determine how they discriminate between things in the world (Gillespie, 2014). If algorithms are trained on a biased subset of data, they will fail to recognize things that fall outside the norm in that specific dataset. The obvious reaction would be to think of this as a problem, but once again, this form of bias can be turned into a strength. Zhang et al. (2019) takes such an approach in their project, where they use online images to train algorithms to recognize visual characteristics of cities. By focusing their research on areas of cities where the algorithm fails, they turn the idea of predictive analytics on its head. The failure to predict indicates that the algorithm has stumbled upon interesting exceptions to the prevailing visual norm of the city in question. Again, this epistemological strategy of leveraging algorithmic bias is also in active use in the field of digital methods (Munk, Olesen, & Jacomy, 2022).

Our suggestion is not to blindly use digital data and algorithms without considering their biases. We find recent studies of racial and gendered bias in machine learning immensely important in the context in which they are put forward (for illustrative cases on bias in Amazons recruitment systems and contemporary image analysis see Crawford, 2021). But what we can learn from the literature on computational humanities, and the works of scholars like Anselin, Williams and Zhang, is that within an SCS framework it is also possible to recast bias as an analytic opportunity. As an imperative for getting closer to our data rather than a reason to undermine and cast aside results. Bias can tell us something interesting about the state of the systems that provide data if we maintain a critical stance. In a future SCS research trajectory, it is thus crucial to replace the inherited tendency to see social media data as an unreliable source that equals bad representativity just because it does not necessarily include everyone in a population. The point is to utilize the fact that each digital trace is produced by a human with relevant subjective experiences, feelings, emotions, and perceptions and to be creative about how we can use techniques from machine learning in an explorative way.

RETHINKING THE EMPIRICAL GROUND

Another strong epistemological stance that needs to be revisited is the idea that the offline automatically trumps the online as an epistemological ground. As a ghost from the days of cyberspace, it is still custom to think of the web as something distinct from—more artificial and fake—than the physical world (Rogers, 2013). This assumption leads to an epistemological strategy of always constructing offline baselines from which to judge the validity of online data. We see tendencies of this strategy in the phenomenological grid, where papers aim to cross-reference the phenomenological aspects of social media data with other city data. The assumption is that subjective experience- and perception-based social media data are not reliable or interesting in themselves, and that their validity and analytical significance emerges and increases from being cross-referenced with "hard" data on which statistical tests of representativity can be performed. This assumption probably also explains why open government data is the third largest data source in our reviewed papers (see Fig. 1). It meets these conditions.

This stance presents a hierarchy in which data from the social web can, at best, be supplements or surrogates for more valid data obtained from the physical world. However, studies on the emergence of digital cities (Halegoua, 2020; Schwartz & Halegoua, 2015) have effectively shown how software has joined the built environment at the center stage of urban life. Drawing on De Certeau and Randall (1984), we suggest interpreting digital acts, such as check-ins, collaborative ratings, and algorithmic recommendations, as tactics that digital citizens use to weave space together in new ways and re-embed themselves in a fragmented and fluctuating urban landscape. The city is hybrid—it crosses the digital and the physical in a way that makes this distinction fruitless as an epistemological quality criteria. To pave the way for an SCS research agenda, we might benefit from rethinking the idea that traces on social media are mirrors of life in the analog world and instead accept that social media constitutes important arenas for our urban lifeworld. This approach to digital traces echoes Lev Manovich's (2020) argument that today's social media not only reflects the analogue cultural experience we have in concerts and when reading books but also makes up a huge part of these cultural experiences.

RETHINKING THE MAP

A third important epistemological discussion concerns the ontological status of maps in urban planning. A distinction can be made between those who strive to produce maps that represent objective realities and those who aim to make the subjective layers of the city visible. The usual epistemological stance on the practice of cartography would suggest the former, but work in critical human geography has reminded us that maps are not 1:1 representations of the world, nor are they ever neutral or objective. For instance, Krygier and Wood (2011) claimed that the work of mapmakers involves proposing different—often conflicting — realities of the world, highlighting some details while omitting others in the process of reducing the complexity of the world to make it navigable. Similarly, Kitchin and Dodge (2007) propose to think of maps as practices rather than products: "Maps are constantly in a state of becoming; they are ontogentic (emergent) in nature" (Kitchin and Dodge, 2007, 340).

We strongly agree with this assessment, even though not everyone does. In fact, there is a differentiating parameter in our reviewed corpus of literature, where many papers present data-driven maps as seemingly objective, neutral, and factual representations of the world, while others assign less ontological security to the maps they produce and present them as propositions that are off-the-moment, transitory and context-dependent outcomes of exploring social media traces. In papers by Weiler et al. (2013) and Xia et al. (2014), where the purpose is to provide users—specifically journalists—with real-time event detection and information about the city's ongoing activities, the cartography of social media traces is never fully formed and the work of producing maps is never complete.

Once again, this approach is mirrored in contemporary work within computational humanities, where data visualizations and maps have explicitly been produced with the aim to disturb—rather than solidify—existing knowledge claims (Madsen & Munk, 2019; Munk et al., 2019). We suggest replacing the aspiration to produce objective maps of the urban world with the ambition of proposing maps as off-the-moment representations of people's lived experiences. In so doing, the quality criteria by which to evaluate the validity of maps are no longer just their factual truthfulness but also the degree to which the propositions they make about lived experience can be recognized by the people whose life worlds they supposedly map. This echoes recent calls to involve people in the making of metrics and maps that concern them (Jensen et al., 2021; Williams, 2020; D'Ignazio & Klein, 2020) and even allow people to talk back to maps when they disagree with them (Niederer, 2018).

Conclusion

This paper started out by arguing that data-driven urbanism has become entangled with the smart city and thereby practiced in a way that prioritizes control over physical objects and downplays the human, semantic and political aspects of data. We labeled this approach to data-driven urbanism 'hard city sensing' and we drew on existing critical scholarship to note its shortcomings. However, we also argued that the emergence of the 'digital city' alters the empirical potentials for data-driven urbanism in a way that makes it possible to untangle it from the HCS framework. In making this argument we took inspiration from the way scholars within the computational humanities have utilized the existence of digital traces to produce data-driven research with a phenomenological and explorative outset. We noted that scholars in this tradition have primarily taken advantage of two affordances of digital traces. One is the fact that such traces are simultaneously qualitative and quantitative. This means that algorithms can be used to find patterns in semantic aspects of the world. The other is the fact that such traces are granular enough to work from an explorative epistemology and source classifications from data rather than pre-defined schemes. We used these affordances as the backbone of a literature review of two decades of scholarship that have pioneered the use of digital traces as an empirical foundation for producing urban insights and cartographies. We see these studies as indications of the way new data possibilities are being grasped within the field of urban studies. By plotting each paper on two affordance-dimensions, we identified four ways of working with digital traces in an urban context. The 'sensor surrogates' approach analyzes digital traces in a framework that reminds of hard city sensing. The 'phenomenological grid' approach takes advantage of the qualitative affordance of digital traces, but not their explorative potential. The 'situated boundaries' approach takes advantage of the explorative affordance, but not the qualitative one. The SCS approach take advantage of both affordances simultaneously. After having identified these approaches, we discussed the extent to which each of them paves the ground for new ways of problematizing the city and stimulates a need for inviting new experts into data-driven urban planning. While we argue that three of the approaches in their own distinct ways carry such potentials, we also noted that their future impact requires urban scholars and decision makers to revisit established epistemological stances on bias in data, the legitimacy of different forms of empirical grounds and the ontology of urban cartographies. Instead of abandoning the idea of data-driven urbanism, we propose 'Soft City Sensing' as a framework for re-engaging with it with inspiration from the computational humanities and the pioneering studies in our review. On the one hand we urge qualitative urban scholars to ponder the possibilities of furthering their urban interest by beginning to 'think with algorithms' while retaining their qualitative and interpretative ambitions. Data-driven urbanism needs inputs from qualitative researchers just as much as such researchers can expand their toolkit with new methods. Even though the involved data and techniques have serious problems when it comes to bias we propose that such problems can be turned into analytical potentials if the urban analyst remains curious about the dynamics of bias and explores such biases to reflect on the societies and tools that produced them. On the other hand, we urge urban decision makers to expand their criteria for what serves as valid data inputs to urban planning. Whereas explorative SCS maps cannot serve the same functions as smart city dashboards, they are valuable tools in the important phase where urban problems are defined. In this phase maps and data visualizations are not produced to provide evidence and answers, but rather as effective tools with which frame meaningful questions about the urban realm and ensure that subsequent interventions are suited to the context in which they are supposed to make a positive change.

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Chapter 03

Digital & visual methods research

Digital and visual methods research

In the previous chapter, the article on Soft City Sensing introduced an overall framework with which to think about data-driven urbanism. It reviewed two decades of digital urban research and showed, among other things, that a majority of projects center textual and numerical forms of data, while visual data tend to be more peripheral in digital studies of cities. This is curious, since visual media, technologies and interfaces saturate urban life and culture, as already discussed in the Introduction, and are central to how people capture, share, and make sense of their urban experiences. As visual media and personal, connected mobile technologies have become ubiquitous in urban societies, visual materials are increasingly integrated into our social interactions and urban environments (Pink, 2013, p. 1). A similar point has been highlighted by Halegoua (2020), as previously discussed, who writes that digital and visual technologies are a profound part of how people embed themselves in urban environments today and form attachments to places. Visual interfaces like digital maps, the camera roll in our phone, and GPS-based apps and platforms in other words play a central role not only in how we represent our identities, cultures, and cities, but also how we experience and navigate them. As Pink writes: "Just as an image might invoke a memory of an embodied affective experience, experiences also inspire images. (…) Images are thus an inevitable part of the experiential environments we live and research in" (Pink, 2013, p. 2). From a research perspective, this does not simply offer an interesting empirical opportunity for studying cities. It also makes digital visual materials, platforms, and technologies an important site of interrogation when researching questions such as how people experience urban life, perceive urban issues, and attach to space.

From a research perspective, visual materials moreover hold certain qualities that make them exciting to use in studies of cities. While visual materials like maps have a natural spatial dimension, photographs are always taken *somewhere* at *some time*, meaning that they present spatially and temporally situated accounts and perspectives on the city. Visual materials are also powerful elicitation devices that are effective at sparking memories, prompting discussion around emotional and embodied experiences of cities (Pink, 2021b), and capturing phenomena and experiences that participants cannot express in textual or oral accounts alone (Gubrium & Harper, 2016). This presents opportunities to see the city through the eyes of citizens, to unfold diverse viewpoints, and to use visuals in workshops to anchor discussions of urban issues in particular situations and spatial settings.

Succeeding this chapter in Part II, this is what the journal articles explore through different case studies: The article in Chapter 4 documents a social media image analysis that used around 39,000 image posts from Instagram to study place attachments in Denmark during COVID-19. The articles in Chapter 5, 6 and 7 report different aspects of the Urban Belonging Project; an investigation of how seven marginalized communities in Copenhagen experience belonging in the city. The article in Chapter 5 uses collaborative mapmaking with the participatory GIS software Maptionnaire and co-interpretation of maps in workshops. The article in Chapter 6 describes the use of digital photovoice in the Urban Belonging project, where a smartphone app, the UB app, was used to engage participant in taking and co-interpreting more than 1400 geolocated photos. Finally, the article in Chapter 7 describes the design of the UB App as a new photovoice tool.

As each article introduces and reviews the individual methods, this chapter presents an overall methodological framework for the digital and participatory approaches to visual methods that are used across these projects. The chapter situates the three methods in a brief genealogy of visual urban research within social science and humanities, discussing how theoretical turns and the uptake of the digital have shaped contemporary methodologies. This is used to outline the key digital and participatory potentials that I see in social media images, participatory GIS, and photovoice, and explore in the research. Finally, the chapter outlines my overall approach to interpreting visual materials, which depends on data feminist theory, participatory design, and data visualization.

A brief genealogy of visual research

In social sciences and the humanities, there is a long, albeit contested, history of using visual materials to study social and urban life. In anthropology (Banks & Ruby, 2011; El Guindi, 2004), human geography (Elwood, 2011; Rose, 2016), and urban studies, scholars have used visual materials as research tools for as long as they have been established as academic disciplines. An early example of community-led mapping can for instance be found in urban theorist Kevin Lynch's (1960) 'The Image of the City', which used cognitive mapping (also called 'mental mapping') to engage locals in drawing how they orient themselves in and experience cities through mental images of paths, edges, districts, nodes, and landmarks. This contribution (in parallel with emergence of 'psychogeography' as the study of the geographical environment's effects on people's emotions and behavior (Debord, 1958)) has laid much of the foundation for the collaborative map-making found in the participatory GIS method that is used in this PhD. Debord's formulation of psychography and Lynch's experiments with mental mapping were pioneering by claiming that there is no singular, objective 'city' out there that can be described accurately. Rather, there are as many versions of a city as there are people experiencing it and having their own mental image of it. Within anthropology, ethnographers have also for long used photography and film in fieldwork (MacDougall, 2005), exemplified in French filmmaker Jean Rouch who used documentary in the 1950s to study African societies (Rouch, 2012). Both Lynch's mapping and Jean Rouch's films had a unique *participatory* element where local interpretations of an environment became part of the knowledge production.

This was radical since at the time social science was dominated by a positivist ethos, which overly rejected visual research methods as unscientific. From the 1960s to 1980s, debates within anthropology and sociology especially focused on whether or not visual materials like photographs and film could validly support the observational project of social science. It was problematized that visual materials were "too subjective, unrepresentative, and unsystematic" (Pink, 2021b, p. 24) and lacked objectivity and scientific rigor. Critiques of the visual especially deemed that the specificity and subjectivity of photographs render them scientifically invalid (even though this might be the exact reason to find them interesting, as I propose in this PhD). In response to this, ethnographers such as Margaret Mead (1995 [1975]), and John Collier (Collier & Collier, 1986 [1967]) worked in the 50s, 60s and 70s to justify a space for visual research in social science. In the 50s, John Collier was one of the first anthropologists to develop the photo-elicitation interview method through fieldwork in Canada (1957), while Paulo Freire started using photographs as discussion prompts among poor, illiterate communities in Peru and Brazil (Gubrium & Harper, 2016). Freire's research, however, was especially pioneering because it experimented with handing out cameras to local residents and letting them take the photos that were later used to prompt discussion in groups.

This way of letting the participants do the photo capturing was rare at the time and has laid the groundwork for the photovoice method emerging later, which this PhD draws on. It contrasted the sentiment at the time that if photography was to be taken seriously in science, it mattered that a methodic researcher was behind the camera and used it for structured observations. Noticeably, it was also in this time in the 60s to 80s that architects began using photography and film as observation methods to study cities, including Jan Gehl (1971), but also William H. Whyte who published 'The Social Life of Small Urban Spaces' (1980) as book and film, and Danish architect Steen Eiler Rasmussen, whose book 'Experiencing

Architecture' (Rasmussen, 1964) used sketch mapping, photography and drawing to observe how humans experience cities according to their different senses.

In these efforts to be taken seriously as scientific method, however, most visual research focused on proposing systematic methods of photography that could produce 'objective materials' and be evaluated against standards of validity, reliability, and sampling. Such work was therefore later critiqued, as Pink writes, for proposing prescriptive frameworks that "aimed to distance, objectify and generalize and therefore detract from the very qualities and potentials that the ambiguity and expressivity of visual images offers ethnography" (Pink, 2021b, p. 13). Within Geographical Information Systems (GIS) studies, Olascoaga (2021) has similarly critiqued how geospatial computing has evolved from being intended in the 50s and 60s as open, participatory software that could invite citizens to join planners in mapping and solving urban issues, to becoming closed-source during the 70s and on when ESRI privatized GIS software and increased the technical and financial barriers to geospatial computing. This has created a culture of expertise, that excludes citizens from mapping, as has since been problematized by feminist GIS (Elwood & Leszczynski, 2018). While such applications construed image-based and cartographic research as a positivist exercise, framing of visual methods began shifting during the 80s as the result of a set of theoretical turns.

Shifting trends in the 80s and 90s

Within media studies and humanities, the 'cultural turn' gathered momentum during the 80s with increasing attention paid to culture as the lens through which to understand social processes (Rose, p. 2). With this turn, scholars started approaching the study of society as research concerned with the cultural production and exchange of meanings. This also entailed construing 'culture' as dependent on "participants interpreting meaningfully what is around them, and 'making sense' of the world", as expressed by Stuart Hall (1997, p. 2), and it was understood that these made meanings or representations, structure the way people orient themselves in everyday life. Within emerging fields such as cultural studies, visual materials was perceived as central to the cultural construction of social life and were increasingly studies, often construed as 'text' to 'be read' (Rose, 2016). A range of qualitative approaches subsequently emerged to structure this reading of images, including semiology, content analysis, psychoanalysis, discourse analysis, and more), as collected by Rose in her book on 'Visual Methodologies' (2016).

Within anthropology and sociology, scholars like Clifford & Marcus (1986) simultaneously started to shift the perspective on ethnography from objective observation towards seeing ethnography as a constructed and narrative-based form of knowledge production. They emphasized the centrality of experience, specificity, and subjectivity to the production of ethnographic knowledge and challenged the long-standing dominance of positivist arguments and realist approaches to knowledge, truth and objectivity in the field (Pink, 2021b, p. 4). Visual methods have since become a bigger part of anthropology, evidenced by the emergence of 'visual ethnography' in the 90s as conceptualized by Sarah Pink (2021b). This field has been consistently evolving over the past decades and has - informed by postmodern debates - especially explored interdisciplinarity as well as sensory and embodied experiences.

Within feminist studies and science and technology studies, debates in the 1980s discussed the politics of visuality and the close link between 'seeing' and 'knowing' that I already have touched upon in the Introduction chapter of the dissertation. It was especially debated how modern and postmodern "ways of knowing" increasingly were characterized by the saturation of images and visual technologies in society; from microscopes to satellites, and beyond (Jenks, 1995; Scott, 2008). In response to this, scholars began to critique 'visuality' as a constructed phenomenon that guides "how we see, how we are able, allowed, or made to see, and how we see this seeing and the unseeing therein" (Foster, 1988, p. ix). STS and feminist studies during the 80s and 90s consequently focused on unfolding the politics and 'centrality of the eye' in postmodern society (Jenks, 1995): This is epitomized in Michel Foucault's (1977) discussion of power and visibility, Deborah Poole's (1997) analysis of modern vision as racialized, and Donna Haraway's (1988, 1991) critique of the scientific observational gaze. Using the metaphor of vision, she insisted on the situated nature of observation, and was critical of science that claimed a disembodied ability to "see everything from nowhere" (1988, p. 589). She problematized the notion of photographs, maps, and other visual technologies as truthful instruments of unmediated observation and suggested that any perspective is always partial (more on this in Chapter 8).

These theoretical shifts inspired new innovation of visual research methodologies in the 90s and 00s: It was for instance during the 90s that health scholars Caroline Wang and Mary Ann Burris (Wang & Burris, 1997), building on Paolo Freires research, introduced a systematic framework for photovoice method. In doing so, they kickstarted a whole tradition of using photovoice as a Participatory Action Research method to involve marginalized or underprivileged communities in taking photos of their surroundings, before using these photos to create group discussions about community concerns that can be communicated to policymakers or used to direct community action (Gubrium & Harper, 2016). While often used in health studies and education research, photovoice has also gained traction in more ethnographic approaches to urban research. Photovoice was for instance used in the 00s to study place making among rural Canadians (Beckley et al., 2007), or to engage Los Angeles residents in documenting their perception of urban environmental justice (González et al., 2007). The 90s also saw the uptake of critical cartography, as John Harley (1989) among others opposed the framing of mapping as an objective, neutral representation of space, and instead proposed to see cartography as a 'technology of power'. Out of this, sprung counter-mapping as collaborative practice for engaging communities in mapping local issues and create spatial narratives alternative to the hegemonic cartography imposed on local groups by institutions and governments in power (Dalton & Mason-Deese, 2012). In this PhD's application of participatory GIS as collaborative mapping, I also draw on this tradition (more on this in Chapter 5).

Today, the term 'visual methodologies' is used as collective label to describe a wide range of research agendas that work with visual materials. What these have in common, however, is that they tend to be purely qualitative, with little involvement of quantitative or computational methods. This also means that images typically have been analyzed one by one and in small numbers. This, however, has changed with the uptake of the digital.

Visual methods in the digital age

Towards the later part of the 00s, visual research across all disciplines was fast encompassing a digital and web-based change to visual culture in response to the growth of the Internet and Web 1.0. Early reactions to the digital within visual scholarship involved incorporating digital media as sites of research, expanding notions of fieldwork to include virtual social contexts (Pink, 2021a, p. 26), and exploring how digital images differed from analog ones (Rose, 2016, p. 5). It involved developing new vocabularies for understanding 'new media' compared to traditional ones (Manovich, 2002), as well as digitizing existing research methods. Photovoice researchers for instance began replacing analogue cameras with digital ones. This was, however, quickly surpassed when Web 2.0 made online visual platforms and technologies ubiquitous across all aspects of society. The uptake of mobile digital technologies has among other things meant that citizens increasingly have access to the visual technologies that previously were only available to researchers or professionals, meaning that researchers and citizens increasingly "have equal access to image producing, editing and sharing possibilities" (Pink, 2013, p. 6). And as visual digital technologies are embedded ever more widely into societal infrastructures they generate a digital culture that is increasingly visual and produces a 'digital deluge' of visual data (Manovich, 2020; Marres, 2017).

This change has been felt too in the realm of urban studies, as the rise of web 2.0 opened new digital and participatory possibilities for studying cities. During the latter part of the 2000s, this - together with the uptake in digital image research tools such as computer vision AI - has launched a wave of new digital approaches to visual research. Within media studies and humanities, Lev Manovich has established the field of Cultural Analytics (2020) which leverages big data analytics and computational image processing to study online visual cultures and compare the visual signatures of different cities, as seen in the 'Phototrails' project (Hochman & Manovich, 2013). Many urban projects have also begun using computer-generated images such as satellite footage or Google Street View panoramas to study features and qualities of the built environment. An example is the 'Treepedia' project that uses Google Street View images and computer vision to map the tree canopy in cities (Li et al., 2015) and calculate shade provision of street trees (Li & Ratti, 2018). Another example, the (In)distinct Cities project by Zhang et al. (2019), uses Panoramio photos from 18 cities to train a classification model and identify predict visual distinctiveness and similarity of cities.

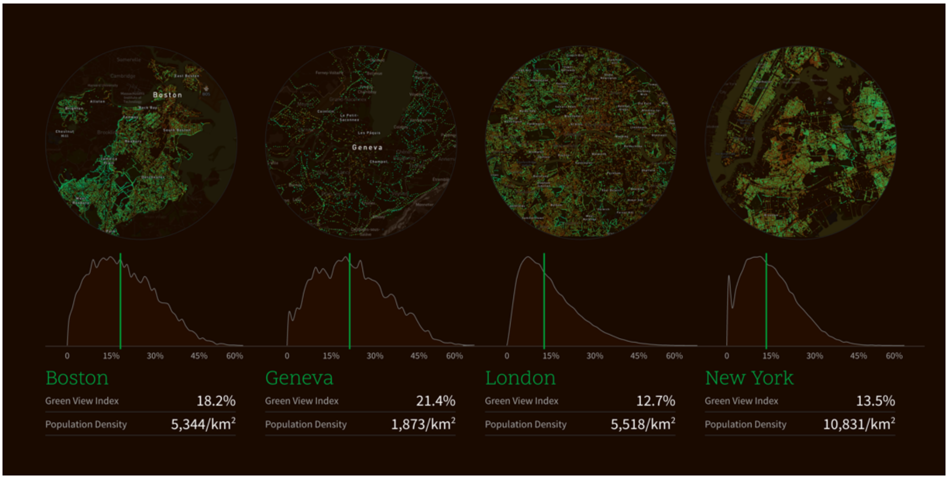

Figure 3.1: 'Treepedia' project by MIT Senseable City Lab. Credit: Free to use press materials via: http://senseable.mit.edu/treepedia (accessed April 23, 2023).

Since the research interest in this dissertation is to study lived experiences with visual data *produced by citizens*, I differentiate my research from these approaches, which can also be seen as the sort of 'hard city sensing' discussed in Chapter 2. Instead, I find inspiration in Digital Methods and participatory digital methods.

Digital Methods

Digital Methods evolved towards the end of the 00s as a form of Interned-based social science research that is alternative to 'virtual methods', seen as the digitization of existing analog methods, as developed by Richard Rogers (2009). In contrast, Digital Methods presents a methodology that thinks through the growing availability of 'natively' digital objects such as search engine results, hyperlinks, hashtags, images, tweets, and so on, and repurposes digital objects and platforms architectures for social research, as Rogers writes:

> "By continually thinking along with the devices and the objects they handle, digital methods, as a research practice, strive to follow the evolving methods of the medium" (2013, p. 1).

Early examples, for instance, included scraping website text or crawling hyperlinks between websites of organizations to analyze the politics of associations between them. Given the networked nature of hyperlinks and other digital objects, such projects often depend on Visual Network Analysis (Venturini et al., 2014) for visualizing data and identifying clusters (this is also a technique used in this PhD). From focusing on hyperlinks and website analysis, digital projects in the 10s started exploring the Web 2.0 (Rogers, 2013, p. 4), where geolocated traces from the social web lead to an explosion of social media analyses (although not all identify as 'Digital Methods').

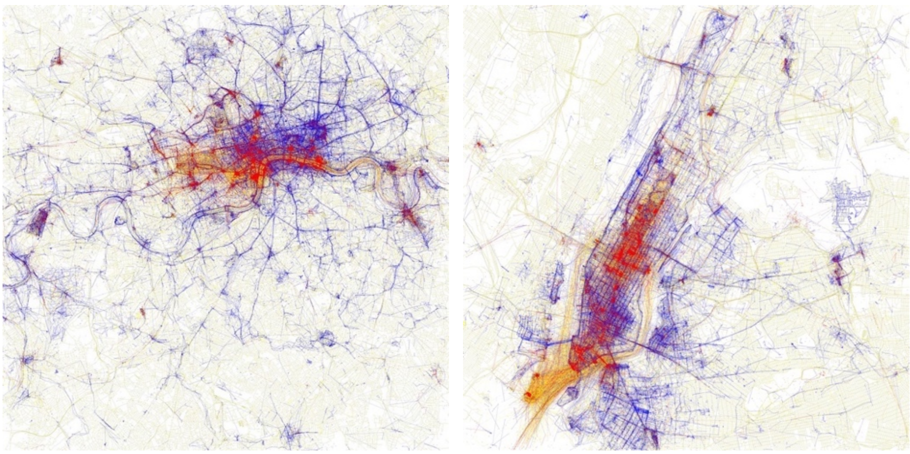

Figure 3.2 Erica Fischer's maps of London (left) and New York (right) via Flickr and Picasa photos: "Blue pictures are by locals. Red by tourists. Yellow might be by either". Credit: Fischer (2010).

In the 10s, before the API closures at the end of the decade (Bruns, 2019), social science saw a plethora of urban projects that reappropriated social media data creatively to study dynamics of cities and urban issues. An early example includes artist Erica Fischer's (2010) maps of London New York, and other cities, which plot locations of Flickr and Picasa photos on a map to show how differently tourists and locals use the cities (see Figure 3.2). Digital research projects hereby also started collecting *visual* data from social media, which researchers used to study dynamics of public life in cities. An experiment with georeferenced tweets and picture tags from Flickr and Instagram was for instanced used to map urban smellscapes (Quercia et al., 2015) and soundscapes (Aiello et al., 2016) in Barcelona and London, by matching image tags with the words related to smell and sound. Similarly, Currid and Williams (2010) collected photos from Getty Images from New York and Los Angeles to study the spatial dynamics of the cultural industries and map the 'geography of buzz' by using posting frequencies to identify popular cultural venues in the cities. These projects especially used the geolocated nature of social media data to introduce an explicit spatial dimension in urban research, which arguably had been missing (or at least more implicit) in pre-digital use of visual research. But while intelligently leveraging the geotags of online images to study spatial dynamics in cities, most social media analyses in the early 10s did not use the images themselves in analysis. The projects mentioned above and Fischer's maps in Figure 3.2 instead utilize image metadata like tags or geolocation to study spatial patterns in cities (what the Soft City Sensing article in Chapter 2 labelled 'hard city sensing').

This has meanwhile started to shift with the advance of artificial intelligence such as image recognition models that offer automated classifying and labelling of images according to their content or visual qualities. Demonstrating the potentials of digital visual methodologies, scholars such as Sabine Niederer and Gabriele Colombo have advocated for studying digital images as 'networked' and shifting the analytical gaze from individual image to folders or groups of images (Colombo, 2019; Niederer, 2018; Niederer & Colombo, 2019).

An example of this is a study by Ricci et al. (2017), which combines Digital Methods with issue mapping to help citizens and city institutions in Paris develop policies around urban nature. Using Twitter images to study how urban nature is imagined online, they first use retweet numbers to plot images of urban nature in a grid according to their engagement online. They also use an object detection algorithm to label the content of images and plot the images as a network graph based on similarities in content (Ricci et al., 2017)(Figure 3.3). Such an approach to studying content of images with visual network analysis that clusters images according to shared visual content is used in this PhD in Chapter 4 and is also seen in other projects (Omena et al., 2021; Thorsen & Astrupgaard, 2021). Similarly, Pearce et al. (2018) plots online climate images as a network graph, but also sorts images according to their colors and layer most-liked climate images from different platforms on top of each other (as exemplified in figure 3.3), hereby producing different arrangements of the images that make certain interpretations possible.

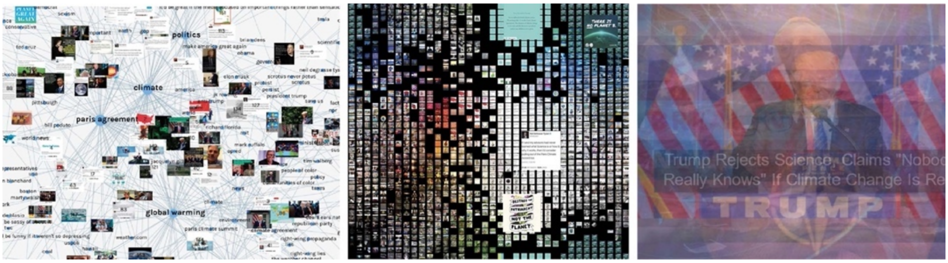

Figure 3.3: Different visualizations used in Pearce et al. (2018) to arrange climate images from social media: Left: network graph plotting images in relation to hashtags. Center: Grid of images sorted according to color. Right: Collage of most-like images from Reddit. Courtesy of Warren Pearce.

Another example is a study by Niederer et al. (2015) which uses Instagram, Panoramio and Google Search data to map the most shared photos and high-ranked images of a local area in Amsterdam, while using various maps (Figure 3.4) of the data in workshops to engage local stakeholders in debating the area.

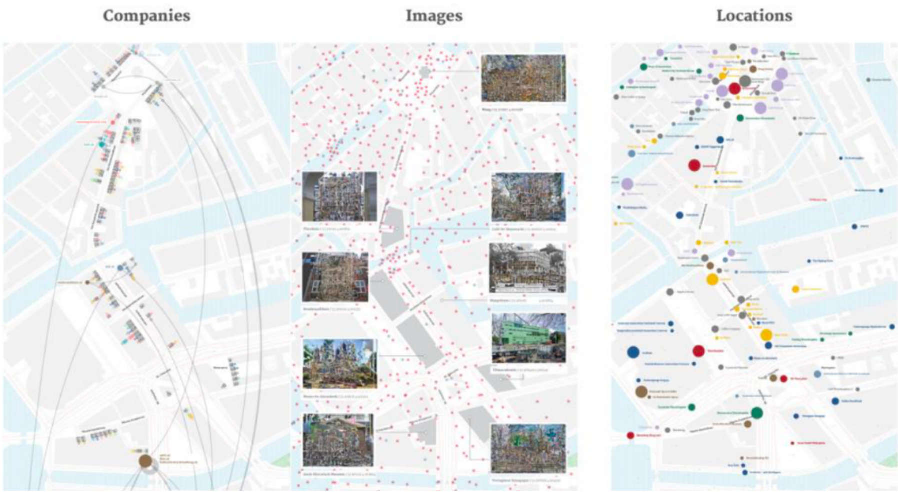

Figure 3.4: Snapshot of fig. 1 in Niederer et al. (2015, p. 217). Courtesy of Sabine Niederer.

Digital methods studies have hereby been productive in illustrating the potentials of reappropriating online visual platforms and their natively digital data for social and urban research. I build on this in the social media analysis in Chapter 4. But whereas 'Digital Methods' projects are focused primarily on reappropriating 'found' online images, I also in this PhD explore visual materials that are generated by participants in a researcher-prompted setting. To do so I draw on digital ethnographic and participatory approaches to visual research.

Participatory Digital Methods & Critical Data Studies

Within ethnographic research, scholars have been especially critical of the growing centrality of big data analytics and automated forms of computational image processing. In fact, visual ethnography as conceptualized by Pink (2021b) is somewhat formulated as a response to the new modes of artificial intelligence and algorithmic "ways of seeing" that is becoming increasingly embedded in everyday technologies and services (Pink, 2013, p. 2). Specifically, Pink opposes that way visual surveillance and big data analytics have become dominant in the way contemporary society is governed. On this, she writes:

> "The visual content of everyday images is equally subsumed under this agenda, making it still more important for sensitive, ethical and situated visual ethnography research to (...) intervene where vast databases of visual images may be harvested and analysed in ways that are decontextualized from the everyday worlds where they were produced" (Pink, 2013, p. 2)

In reaction to this, qualitative scholars like Pink (2021a) and Rose (2016) have called for more ethical, situated, and ethnographically oriented approaches to visual digital research. Such calls, moreover, do not appear out of thin air. They build upon a momentum of critical research agendas such as algorithm studies, critical data studies (boyd & Crawford, 2012), software studies, and others, which emerged in the early 2010s in response to the growing use of algorithms, big data, and artificial intelligence systems in society. Prominent contributions have problematized 'Big Data' as a socio-technical phenomenon, by demonstrating that big data often lack or are taken out of context, and are used with misleading claims about objectivity and accuracy (boyd & Crawford, 2012). Others have critiqued how facial recognition or computer vision AI shape visual politics (Raji et al., 2020), are trained on biased datasets (Crawford & Paglen, 2019; Gebru et al., 2021), and reproduce racial and gendered discrimination when classifying photos (Buolamwini & Gebru, 2018; WIRED, 2018).

Among visual ethnographers, this has led to methodological innovation that has sought to use the digital to increase the participatory capability of visual and digital methods. As documented by Aline Gubrium and Krista Harper (2016), such methods might include the photovoice and participatory GIS methods that are used in this PhD, but can also involve digital storytelling, participatory archival research, and collaborative ethnographic film to name a few. These digital methodologies, Gubirum and Harper write, are "participatory" in the sense that they involve the active participation of community members in the co-construction of knowledge (2016, p. 16), and afford participants an active role in in determining how and why ethnographic research outcomes are produced. This is also the definition of participatory methods that I work from in this PhD.

In relevance to this PhD is especially the emergence of participatory GIS ('PGIS') as community-based participatory research that involves local communities in negotiating social issues in spatial terms (Gubrium & Harper, 2016, p. 152). PGIS might incorporate the practices of counter-mapping or mental mapping that I have already mentioned, but do not prescribe a particular use. In contemporary urban planning, in fact, PGIS has most often been used in formal citizen science or citizen engagement projects, where citizens are invited give input or feedback on anything from cultural heritage issues, to urban planning questions, and policies around environmental zoning and land use (Kahila-Tani et al., 2016; López-Aparicio et al., 2017; Nummi, 2018). Especially innovative is the engagement from various scholars in developing more accessible mapping and GIS tools, that lower technical barriers and make it easier for citizens to contribute local knowledge via mapping. This is exemplified in Olascoaga (2021)'s tools 'Painting with Data' and 'Drawing Participation', and Helsinki-based researchers' development of 'Maptionnaire', which is also the tool I use in the PGIS study in Chapter 5. Meanwhile photovoice research has, as Chapter 6 will show, also incorporated the digital, albeit with less attention to innovating distinct tools for photovoice studies.

Bridging participatory and digital capabilities

The ethnographic and situated approaches to visual digital research advocated for by Pink (2021a) and Gubrium & Harper (2016) self-position as purely *qualitative* research. They leverage the digital mostly to collect data in more streamlined ways, but not to reconfigure the types of visual data that can be collected and processed computationally. Photovoice studies, as Chapter 6 and 7 will show, have for instance primarily leveraged the digital to increasingly let communities use the camera in smartphone to collect photos. Meanwhile, little to no photovoice projected have examined what could be gained from designing photovoice-specific apps that collects structured image metadata, which can then be processed, mapped, and analyzed computationally. This dedication to the qualitative within ethnographic methods stands in contrast to the purely computational approaches exemplified in Cultural Analytics and many applications of social media analysis. This PhD project has sought to traverse such methodological separations between the capabilities of computational analysis and the ethnographic sensibilities of situated qualitative ethnography advocated for by Pink (2021a) and Gubrium and Harper (2016). Instead, I propose that we can imagine digital visual analytics that blends the participatory capabilities of ethnography and the computational advantages of digital data methods, and explore this in this PhD through experimentation with social media analysis, participatory GIS, and photovoice. What these three visual methods have in common, is that they use *digital* visual data that are *spatially geolocated* and *generated by citizens*. They moreover share the trait that visual materials are shared in a *participatory* setting. Meanwhile, the digital and participatory capabilities of the methods are comparatively different, which is exactly the reason why I explore them. On social media, the platform itself constitutes a participatory context, where citizens post, repost, like, comment, tag, and interact in collaboratively creating visual narratives about cities.

And the digital scale of visual data shared on platforms like Instagram mean that an analysis like the one in Chapter 4 can collect thousands and thousands of images and use them to study online representations of urban environments. This is advantageous when the research interest is to be able to remotely study how an event like COVID-19 affects public life across different cities in a whole country. There is however little participatory opportunity to engage citizens in interpreting data and co-producing knowledge, as there is no established connection between researcher and research participants that can be built upon. Simultaneously, social media analysis presents the disadvantage that the researcher has no idea *who* are participating to the online image collection, or *why* they share the photos they do. In photovoice and participatory GIS, the participatory and digital potentials are differently configured. Here the researcher is more in control of who is invited to participate and can also design the questions that prompts that participants respond to by drawing maps or take images. In the Urban Belonging Project documented in Chapter 5 and 6, I utilize this to deliberately reach out to some of the marginalized communities that often do not have visibility and voice in urban planning. In contrast to the Instagram analysis in Chapter 4, which studies around 39,000 images shared by 5000+ different users, the studies in Chapter 5 and 6 engage 33 participants that together produce 1459 photos and 200+ maps. My application of participatory GIS and photovoice methods hereby produce visual data at a smaller scale than the social media analysis. But because these methods involve close collaboration between researcher and participants, there is greater potential for involving the 33 participants in co-producing knowledge. With this as the jumping-off point, the journal articles in the upcoming Part II explores social media image analysis, participatory GIS, and photovoice as methods with different digital and participatory potentials and examine how these present different opportunities for foregrounding citizen voices in urban research and situating understanding of urban issues in local lived experiences.

Approaches to visual analysis

When analyzing visual materials, Rose emphasizes that there is no essential "truth" lurking behind each image, awaiting discovery. As such, there is no single interpretation of meaning that is correct. Instead, she draws on Stuart Hall, who has posed that interpretation is bound to be a debate "(...) between equally plausible, though sometimes competing and contesting, meanings and interpretations" (1997, p. 9). Meanwhile, this does not mean that anything goes, or that all interpretations have equal value. Instead, Rose argues that what matters is to justify your interpretation with an explicit methodology (Rose, 2016, p. xxi). While I agree that analysis always involves interpretation, I do not approach visual images in this PhD as a text to 'be read'. Instead, I use analyze visual materials by combining a data feminist framework, participatory design, and data visualization.

A DATA FEMINIST FRAMEWORK

Catherine D'Ignazio and Lauren Klein (2020) introduces 'Data Feminism' as a framework of intersectional, feminist thinking in data science that encourages researchers to bring attention to the dynamics of inequality, marginalization and oppression that are built into many of the digital technologies and data infrastructure that underpin society today. With principles like 'challenge power', 'rethink binaries and hierarchies', 'embrace pluralism' and others, they bring critical attention to how data can be used by those in power to control territories and resources, police, discriminate and surveil marginalized populations. But more than that, they show that data can just as well be used to expose injustice, improve health and living conditions, and topple governments (D'Ignazio & Klein, 2020). Building on that, I use a data feminism framework in my research with visuals to examine which sorts of problems and what urban populations are made (in)visible as a consequence of the way we datafy cities today, while using my own empirical projects to make alternative configurations of power possible: This starts with the choice to center citizen-generated visual data, and exploring how these can be used to elevate citizen and community voices in planning.

In the participatory GIS (Chapter 5) and photovoice study (Chapter 6), the data feminism framework was central to the research design from beginning to end: These projects are data feminist both in *topic* (they explore questions of marginalization and belonging in cities), in process (they center marginalized communities and involve them in all steps of the data projects), and in *form* (they use visualization to rethink representations of data)(D'Ignazio & Klein, 2020).

In the Instagram study in Chapter 4, the data feminism framework was less explicitly a part of the design. The ethos of questioning power and exposing inequality however still has various expressions in how it uses image data. For example, the analysis is not focused on identifying the most popular locations, most liked images, or most active users (aka the power centers). Instead, it explores connections in the visual content across *all* images, thus giving equal weight to users' images when studying COVID-19 place attachments. It also examines if there according to users' Instagram posts is equal access to good public spaces across big and small cities, and asks: Did Copenhagen offer equal access to urban nature in all neighborhoods during the pandemic?

The data feminist ethos also has expression across all four journal articles by structuring critical reflection around bias and how the tools and algorithms used to collect and study visuals shape the results. Such attention to the importance of the data tools we use, moreover, was a central motivation for developing the photovoice application, UB App, documented in Chapter 7 that protects participants' privacy and enable marginalized groups to document the city.

PARTICIPATORY DATA DESIGN

In this PhD, I approach visual research by involving other human and non-human actors in making sense of images and maps with me; whether it be citizens, urban planners, or algorithmic ways of seeing. The Urban Belonging project was especially designed to be participatory from beginning to end, taking inspiration in the Design Justice framework, formulated by Sasha Costanza-Chock (2020), who argues that the affected communities – and especially marginalized groups – should be a part of data and design projects from beginning to end. My use of participatory GIS and photovoice in the project therefore involved participants in interpreting data in workshops, where visual materials were used as elicitation strategies (Gubrium & Harper, 2016, p. 33) to engage participants in co-producing stories and analysis. In this context, participants, decided what to highlight in a map, or which photo to pull out from a deck of photos and created descriptions. This does not mean that I am myself distant from or not central to the analytical process. By deciding how to present visual materials to participants in workshops, I facilitate and frame the interpretation process they engage in, and in the end create my own analysis building on how participants have highlighted and annotated images and maps.

In my work with Instagram images in Chapter 4, my participatory approach is differently configured. A disadvantage of social media data is moreover – as already discussed - that there is less natural opportunity to engage the research participants beyond data collection, as there is no existing relationship between researcher and participants to build on. But because Instagram constitutes its own participatory setting, I take inspiration in the way Digital Methods (Rogers, 2013) encourages researchers to think along with the 'methods of the medium'. In the Instagram analysis in Chapter 4, I utilize this to give different visibility to images by for example sizing them according to how many likes they have. I hereby let citizens' online interactions with images inform my analytical gaze.

The participatory approach to visual analysis across all three empirical projects also entails working alongside non-human actors as it involves Artificial Intelligence (AI) models and different algorithmic ways of seeing, such as computer vision AI. I propose to see the algorithms used in this PhD as *co-researchers*, and take a Digital Methods (Rogers, 2013) approach to asking how we might think alongside such algorithms in urban research. This is not the same as handing over the interpretative power to for instance computer vision A similar stance is proposed by Colombo & Niederer, who state that "given the rise of machine vision infrastructures, mainly invisible to human eyes, we call for methods that bring humans back into automated visual culture" (2021, p. 2). In Chapter 4's analysis of Instagram data, my analysis of images is carried out in such close collaboration with computer vision AI. Naturally, in such a co-production of knowledge, it is crucial to engage consciously with how algorithms shape the research results. Reflection about this is therefore a part of the discussion in Chapter 4.

DATA VISUALIZATION AS EXPLORATION

As a practice of analytical exploration, design of data visualizations is a key part of my research approach to analyzing images and maps across all articles, as I explore various ways of arranging and rearranging visual materials for analysis. Data visualization is in this PhD more than just an inscription (Latour, 2011) and practice of displaying results once they are found. Instead, as Colombo and

Niederer (2021, p. 1) suggests, visualization design is instrumental to making sense of, reshaping, and reanimating image collections in tableaus, maps, grids, network graphs, composite collages, or some other form of display. As I have demonstrated in this chapter, different approaches to this design open visual materials up to certain interpretations by relating, networking, and clustering images in particular ways. As this decides how visuals can be understood, I use design and data visualization as an experimental part of my analytical practice and explore how different arrangements of image and map data can bring out different analytical qualities. On this, Niederer & Colombo write:

> "such visualizations are not used to form the esthetic culmination of analytical work, but are rather functional tools for digital research that serve parts of the entire research process, from its formulation and operationalization to the engagement of a broader public" (2019, p. 43)

Visualization hereby is also an opportunity to create participatory moments with research participants, planners in Gehl, or a wider public (Colombo & Niederer, 2021, p. 1). As Chapter 5 and 6 shows, I use design of visualizations in the Urban Belonging Project to bring map and photovoice data back to the participants in ways that create moments of join reflection and interpretation.

Figure 3.5: Participatory moments in the Urban Belonging Project, bringing communities together around interpretation of maps and photovoice data. Credit: Author photos.

Such a use of data visualization has also been described as a form of 'Participatory Data Design' by Jensen et al. (2021), who propose that data visualization can be used to mobilize data as a form of 'boundary object' that forces participants to vocalize tacit assumptions and perceptions about an issue. They further emphasize that whereas most people have strong visual literacies with respect to data visualizations such as a pie charts, these skills are not easily transferred to more complex and less-known visualizations (Jensen et al., 2021). This is productive for forcing participants to 'slow down reasoning' and qualify interpretations.

I leverage this in my work across all three empirical projects and explore how data visualization "beyond the pie chart" can open visual materials up to interpretation. Data visualization was moreover used in the Urban Belonging Project to engage a wider public in experiencing the stories created by participants about Copenhagen. As shown in Figure 3.6, the project used visualizations of maps and photos to create an Instagram profile and two public exhibitions (more on this in Chapter 6).

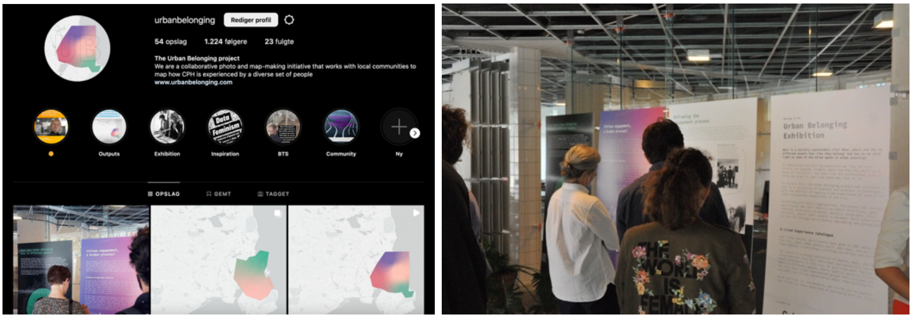

Figure 3.6: Instagram profile (left) and public exhibition (right) of the Urban Belonging Project. Instagram at https://www.instagram.com/urbanbelonging/. Credit: Author photos.

The centrality of design and data visualization to the PhD is hereby linked to the participatory approach to visual analysis already described. It is moreover guided by – and is a part of – the data feminist approach I take to visual research. In Chapter 5, for instance, I explore how data feminist principles such as intersectionality can be used to rethink mapping and the way identities of are represented in urban research (Bravo et al., 2022; D'Ignazio & Bhargava, 2020).

Coming up next

Next, the dissertation dives into Part II, which contains four articles: The article in Chapter 4 documents my Instagram study of COVIC-19 place attachments. Chapter 5 presents the use of participatory GIS in the Urban Belonging project, while the article in Chapter 6 describes use of photovoice in the same project. Finally, an article in Chapter 7 reports on the design of the photovoice app, UB App. Geographically, these cases are all situated in Denmark, while on a methodological level they show different potentials for using visuals digital methods to study cities.


TIVOLI
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PART II

Experiments with visual data

PART II
PART II
PART II
PART II

Chapter 04

Publication

Cities journal
Status: In second review.

Authors

Sofie Burgos-Thorsen, Anders Kristian Munk

Studying COVID place attachments

in Denmark with Instagram photos and computational visual methods

Studying COVID place attachments

Abstract

Planners, policy makers, and scholars are increasingly using social media data to study public life in cities. Yet, such projects tend to be limited by three commitments that shape the imaginaries of such data-driven urbanism, namely 1) bias towards textual social media; 2) fixation on geotag-ontologies; and 3) seeing the subjective nature of data as a bias. The consequence is that the potential of digital traces for renewing the empirical ground of digital urban studies is not fully realized. To open alternative imaginaries around data-driven urbanism, we provide a bibliometric review of these trends and suggest that social media images could be used to study place attachments and explore how people experience cities, bridging ethnographic research questions with the computational agenda. Second, to exemplify what can be gained from such a re-orientation of urban projects, we deliver a digital methods study of 39K Instagram posts from 2020 and explore how people in Denmark attached to different environments during the first nine months of COVID-19. The case demonstrates that we might open new empirical routes in urban studies by centering image data, moving beyond geotag-ontologies, and foregrounding the subjectivity of data as an analytical opportunity, rather than a problem.

Keywords: visual methodologies; urban studies; digital methods; place attachment; image analysis; computer vision

Introduction

With the proliferation of online media, critical voices in the humanities and social sciences have argued that digital technologies alienate people from cities and places, producing an abstracted, distracted, and spatially disembodied relationship to the urban environment (Luke, 2005; Shaw, 2015). In this view, technology produces a postmodern subject, or 'cyberflaneur', who is detached from the city. Others, however, have proposed that the pervasiveness of digital media in cities lead to new contexts for the production of public space (Wilken, 2008). Adding to that, scholars like Halegoua (2020) and Gatti et al. (2022) pose that digital media do not only constitute an integral part of how we experience urban life, but is central to how we re-embed ourselves in urban environments and create a sense of place and community.

This became more visible than ever in 2020 when the COVID-19 pandemic put urban populations under quarantines and lockdowns, changing life in cities across the globe. Navigating these new urban realities and everchanging restrictions, people took to social media to share their experiences of life during the pandemic (Hussain, 2020; Venegas-Vera et al., 2020). Gatti et al. for instance argue that when COVID-19 restrictions "(…) partially or totally hindered the opportunities for individuals to attend common places in their community and, more specifically, to keep in touch with their social meanings, these social media have represented reliable alternative strategies to do so" (2021, p. 41). In Italy, as an example, people started meeting on balconies and singing together in events orchestrated via social media (Antchak et al., 2022). Such events would not only change spatial practices in Italian cities: They went viral on social media and spread to other countries. The digital media's capacity for connecting people and embedding us in the city makes social media platforms an important arena to study when seeking to understand people's place attachment during COVID-19, and how such attachments were enacted and unfolding via social media.

Increased dependency on social media platforms for embedding ourselves in the urban environment in other words presents researchers with an opportunity to rethink how we study place attachments with and through digital media. This has not gone unnoticed in research. Following the rise of Web 2.0 (O'Reilly, 2009), a growing number of scholars in fields like human geography, digital humanities, and urban studies have become interested in utilizing user-generated traces from online platforms to study urban public life. Especially influential has been the proposition that we can think of 'citizens as sensors' and the geo-tagged traces they leave behind as 'volunteered geographic information' (Goodchild, 2007). Leveraging such traces, the past decade has seen more and more scholarship exploring how social media data can be used to study cities (Moore & Rodgers, 2020; Schwartz & Hochman, 2014). Yet, as we will show, the visual data shared on such platforms remains at the margins of digital urban research. This is striking, since the proliferation of image-based platforms is creating increasingly visual cultures where citizens produce and share photos to negotiate their urban experiences (Manovich, 2020). Scholar likes Gatti & Procentese (2021) have for instance shown that platforms like Instagram can enhance people's ties to the community and its places. Photos, moreover, have certain characteristics that make them a unique source of insight, compared to textual and numerical data, when tackling urban issues. Photos are always taken somewhere, making them geographically and temporally anchored. As a consequence, user-generated images offer a chance to investigate the city from a 'situated' and partial citizen perspective (Haraway, 1988). Images open for phenomenological inquiry that ties urban issues directly to the physical environment and grasps aspects of lived experience that may not be understood by words alone (Plunkett et al., 2013). Meanwhile, images shape the cultural politics of place-making, generating visibilities and (in)visibilities that frame how we are able, or made to see (Rose, 2016). In 2020, images of doughnuts from a particular shop in Copenhagen for instance started trending on Instagram. For six months this led to a never-ending line outside the shop. What places and moments are shared online thus do not only reflect those people's experiences, but also influence how others use the city. In this light, social media images provide a chance to ask questions about how cities are experienced, and how people attach to and make sense of places (Stedman et al., 2013). But, as we show next, digital projects have not fully leveraged this.

Visual studies between data science and ethnography

To review the literature at the intersection of urban studies, social media, and visual methods, we take a structured bibliometric. We searched the Scopus database for scientific contributions that mention 'city', 'cities' or 'urban' in the title, abstract or keywords, combined with mentioning 'social media' and either 'visual', or 'photo' or 'image'. Executed in May 2021, this search string returned 738 results in total. Out of these, 311 papers are from the social sciences or humanities, published between 2011 and 2021. To get an overview of the content, we mapped the author keywords of the papers as a co-word network (Callon et al., 1991) connecting keywords (nodes) in a network graph whenever they co-appear in an article. After filtering out generic keywords, we spatialized the network with a force-directed algorithm in Gephi (Bastian et al., 2009), which positions author keywords closer together, the more often they appear together in articles. Next, we sized nodes representing author keywords according to their frequency in articles. Using techniques from Visual Network Analysis (Jacomy, 2021) we identified clusters of keywords that often co-appear in the 311 articles, coloring nodes according to a modularity-based classification (Blondel et al., 2008). Finally, we produced the graph in Figure 1 using customized scripts (Jacomy & Thorsen, 2018) for Graph Recipes.

There are two thematic regions to be observed in Figure 1, indicated with a white line down the middle (authors' annotation). On the right side, the green, dark green, blue, light-blue, and yellow clusters constitute themes around 'big data', 'spatial analysis', 'GIS science' and keywords centered on geo-tagging and computational tools like ‘machine learning’, ‘text mining’ and ‘computer vision’. Keywords like ‘volunteered geographic information’, ‘smart city’, ‘smart cities’ and ‘urban planning’ are also found here, along with two larger nodes, ‘remote sensing’ and ‘social sensing’, which frequently occur as keywords in articles.On the left side of the network, the red, pink, and purple clusters represent a different theme around ‘ethnography’ and keywords like ‘community’, ‘perception’, ‘public space’, ‘social interaction’, ‘visibility’, ‘gender’, ‘women’, and ‘urban culture’.

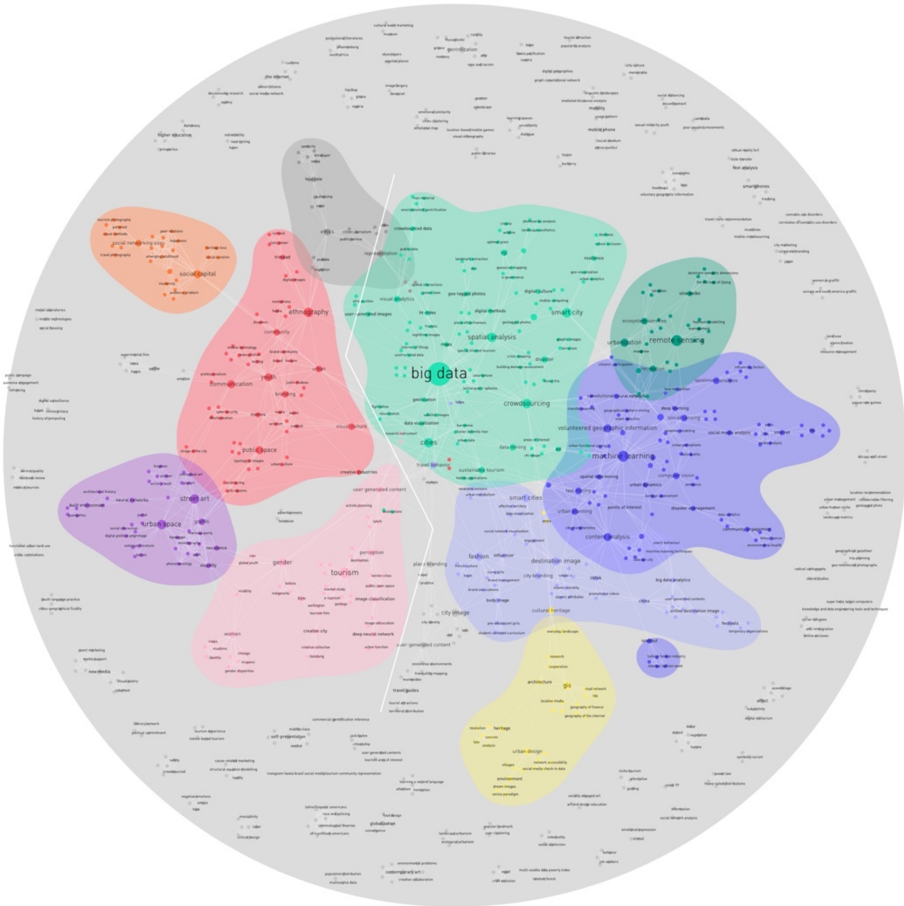


Figure 1: Network graph visualizing co-occurrence of author keywords in the 311 Scopus articles. Spatialized with ForceAtlas2, sized according to occurrence of keywords in articles, colored with Modularity Class algorithm. Illustrated with Graph Recipes. White line is an annotation by the authors.

The lack of connections between nodes on the right and left side indicates a split in the literature, showing that author keywords from the two sides are rarely found in the same papers. This suggests that a methodological divide between ethnographic and computational approaches leads to differences in how social media data is used to study the city. On the left side, the ethnographic approach is connected to an interest in social, political, and cultural topics, as well as a subjectivity-oriented agenda, with author keywords like 'perception', 'phenomenology', 'motivation', and 'culture' being frequently used. On the right side, papers centering on computational methods tie social media data to author keywords about 'land use classification', 'event detection', 'destination image', 'city branding' and 'disaster management'. It is also noticeable that 'urban planning' is positioned in the computational cluster to the right, close to 'machine learning' and 'smart cities'. This indicates that most articles on urban planning also construe social media data as an opportunity for managing the city within the frame of a computational, big data paradigm, without including more ethnographic topics.

Such an epistemological split might seem like a logical consequence of the methods found on each side, one being inherently more qualitative and interpretative, and the other more quantitative. Meanwhile, we argue that there is no reason why the use of computational tools should exclusively lead to framing the city as a problem that can be quantified and measured in a remote sensing way. Instead, it is imperative to bridge the gap between the capacities of computational methods and ethnographic questions about urban culture, subjective experience, perception of urban issues, and so on. A similar point has been made recently by Madsen et al. (2022), who call for untangling data-driven urbanism from a dominating 'hard city sensing' paradigm, often subsumed under Smart City politics. The article argues that an alternative 'soft city sensing' approach is possible if scholars reframe digital data and computational techniques as a potential to study humanities-led research interests. Similar calls have been made from the emerging sub-field of computational anthropology (Munk et al., 2022).

So, what prevents us from advancing in that direction? In discussing the 'making and governing' of digital data technologies, Markham (2021) uses the concept of 'discursive closure' to describe how in established knowledge cultures "particular values and (infra)structures are naturalized, neutralized, and legitimated, closing off discussion of alternatives that might counter current hegemonic power" (p. 382). Learning from the network in Figure 1, we can only wonder if the split into two observable islands, means that digital urban studies have already produced a kind of discursive closure around how social media data is envisioned to be of use. We can at least observe that the author keyword 'urban planning' is positioned in the computational side with little to no links to ethnographic-centered keywords on the other side. To unpack this, the next section provides a review of empirical urban projects that use social media data as research materials. We identify three trends in this literature that shape the 'data imaginaries' of the field and prevent us from taking advantage of social media images to study lived experience.

THREE COMMITMENTS THAT SHAPE IMAGINARIES IN DIGITAL URBANISM

Zooming out a bit, it has been problematized that urban social media projects are biased towards textual platforms like Twitter, Foursquare and Facebook, leaving visual platforms critically understudied. This has for instance been emphasized by scholars like Highfield & Leaver (2016), Zasina (2018), and Davies et al. (2019), among others, who emphasize the need to include visual materials in digital urban studies. Such bias is also seen in Figure 2, which shows the frequency of results from a bibliometric search on Scopus from May 2021 for social science and humanities projects that use data from any of the listed platforms to study cities. Figure 3 compares this to numbers of active users in 2021 (Tankovska, 2021).

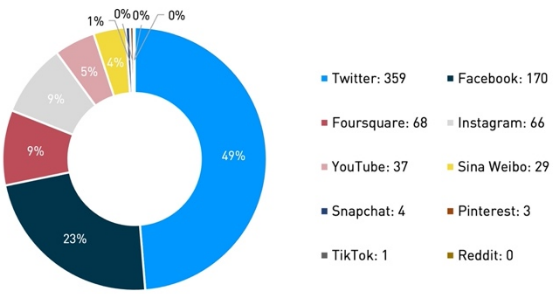


Figure 2: Number of results on Scopus by May 2021 within social science and humanities when querying for 'cities' and 'data' in combination with one of the listed platforms in title, abstract or author keywords.

In Figure 2, we see that few articles study visual platforms like Instagram, Flickr and YouTube, while almost no projects study TikTok, Pinterest and Snapchat. The graph in Figure 3 further reveals that the high number of Twitter studies is disproportionate to the number of active Twitter users. There can be multiple explanations for this preference for textual data, including easy APIs access, or more developed computational tools for processing text compared to images.

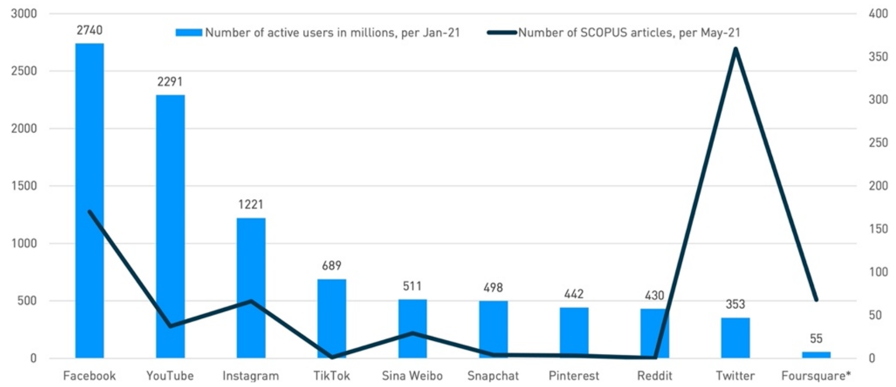


Figure 3: Number of active users per platform (in millions) per Jan-2021 compared with May-2021 Scopus results in social science and humanities that mention cities, data, and each platform.

No matter the reason, this over-commitment to textual data leaves visual platforms vastly understudied in the context of cities, even though visual data offers a rich source for exploring how citizens experience urban issues.

In response to this, an emerging body of literature is starting to use social media images for studying cities. In this research, however, a second over-commitment can be observed, namely the tendency to focus on the metadata of images as the main analytical unit. The literature is saturated with projects that use social media images to capture the whereabouts of users, relying on geotag and timestamp metadata to map spatial-temporal dynamics of city life, without looking into the visual content of the images. Examples range from studies of Flickr (Becker et al., 2015; Haider & Ali, 2018; Hollenstein & Purves, 2010; L. Li et al., 2013), Panoramio (García-Palomares et al., 2015), and Instagram (Boy & Uitermark, 2016, 2020; Domínguez et al., 2017; Mukhina et al., 2017), Weibo (Cai et al., 2017), to Getty Images (Currid & Williams, 2010). Such projects typically use image data to map the pulse of the city, identify urban hot spots, or detect urban events and clusters. An example is seen in Schwartz & Hochman (2014), who collect around 48 K Instagram photos from Union Square, Bryant Park, and Madison Square Park in New York. While the image data could offer rich insight into how users experience these three parks and capture certain aspects of life in them, the authors do not look at the images themselves, but mainly use the geolocation and timestamp metadata to study spatial and temporal patterns of how the parks are used. Another example is a project by Quercia et al. (2015) who uses Flickr and Foursquare data to identify safe and walkable streets in London. The authors map safety of streets from the logic that where there are higher numbers of photos posted at night, a street is safer to walk. This operationalization reduces the issue of safety to a quantifiable question about posting frequencies. While such projects are valuable in mapping geo-temporal dynamics of city life, they do not utilize the phenomenological richness of the images to qualify the issues being mapped. It for instance seems like a missed opportunity that images are not used in the Quercia et al. (2015) study to examine how people experience safety and examine how the urban space affects that experience. The commitment to the geotag is effectively limiting the research to where and when questions, leaving little space for how, what, and why inquiries. A similar critique is advanced by Campton et al. (2013), and refined by Shelton (2017) who has argued that; "analysis of geotagged social media data over-privileges the single latitude/longitude coordinate pair attached to each individual data point, often leading to the kind of simplistic mappings and interpretations" (2017, p. 721). Since this review has shown that geotag-fixation continues to characterize many urban projects today, it is only appropriate to echo their call to go 'beyond the geotag', by centering image content as the analytical unit.

Some urban projects are already doing this, as exemplified in for instance Li & Ratti (2018), Zasina (2018), and Zhang et al. (2019). Meanwhile, a third epistemic commitment can be identified in many of these projects, namely the tendency to use the images for 'remote sensing' and 'city forensic' purposes. Many of these visual analytics projects construe the subjectivity behind the production of the images as a bug, not a feature. As an example, Cervone et al. (2017) uses Flickr and Twitter along with satellite images to do remote-sensing damage assessment of a flood in Boulder. Contrary to the geotag-projects this project actually uses the content of images analytically but interpret them as a form of objective sensor-like record of the city during the flood. They use social media images as a replacement where satellite footage is missing. A similar disinterest in the subjective nature of the data is also found in Doersch et al. (2012), who writes: "The difficulty with Flickr and other consumer photo-sharing websites for geographical tasks is that there is a strong data bias towards famous landmarks. To correct for this bias and provide a more uniform sampling of the geographical space, we turn to GOOGLE STREET VIEW (…). This enables extraction of roughly fronto-parallel views of building facades and, to some extent, avoids dealing with large variations of camera viewpoint" [authors' emphasis]. Here differences in 'viewpoint', is seen as a weakness of the social media data, instead of an analytical opportunity to understand what citizen focus on, relate to, or emphasize as important. These projects are in other words interested in the geographic, rather than experiential topography of cities. They construe the user-generated photos as a form of sensor-like, objective, scanning of the streetscapes, as also seen in Arietta et al. (2014) and Zhang et al. (2019) who use social media images and computer vision AI to compare the visual distinctiveness of cities.

This leaves unexplored what we argue is a key quality of social media images; namely that they are semantically rich data inscribed with individuals' subjective needs, preferences, and perceptions of the urban experience.

As demonstrated, most of the existing work has only to a limited extent taken advantage of visual social media, because of 1) bias towards textual data (even when working with visual platforms), 2) over-committing to the ontology of geotags, and 3) interpreting subjective nature of social media as a bug, not a feature. A handful of projects, however, do not bind themselves to these commitments, but use social media images and their content to do Kevin Lynch-inspired cognitive mappings (Huang et al., 2021; Liu et al., 2016), understand what attracts people to certain places (Crandall et al., 2009; Gomez et al., 2019; Hu et al., 2015; Jayarajah & Misra, 2016; Rossi et al., 2018; Song et al., 2020), or map visual rhythms in the city (Hochman & Manovich, 2013). Graham & Gosling (2011) even use profile picture of people who visit bars and cafes to determine the ambience of these places. Such projects take steps to push data-driven urbanism in a different direction, producing alternative 'modes of knowing' cities (Kurgan & Brawley, 2019). In the following we advance this work through a case study that exemplifies how it is possible to reorient the digital agenda in urban studies in a way that; 1) centers visual data, 2) moves beyond geotag-ontologies to look at content of images, and 3) frames social media as analytical opportunity to study subjective, lived experience.

Materials and methods

CASE STUDY: #BAREDAMARK CAMPAIGN ON INSTAGRAM

In 2020, when the COVID-19 pandemic hit the world, the closing of national borders forced people in Denmark, as in many other places, to stay within the country for holidays and leisure time and explore places and experiences closer to home. To encourage an active public life and make visible what you can do within the country, tourist organization Dansk Kyst- og Naturturisme (DKNT) launched an Instagram campaign called #BareDanmark (in English: "just Denmark"), inviting people to share local experiences. The campaign launched May 28th when 100 influencers shared posts from around the country using the hashtag, inviting people to do the same.

At the end of 2020, we entered a research collaboration funded by the Danish Board of Business Development to analyze the #BareDanmark campaign. We report here the part of our analysis which explored the around 39,000 images that were shared in the first nine months of 2020, and use it to study how people in Denmark related to their environment during COVID-19 from the first lockdown, through different phases of re-opening, and until the second wave and lockdown. In doing so, we build on Halegoua's 'Digital City' framework, as previously mentioned, which conceptualizes everyday digital interactions as placemaking activities that people employ to produce a sense of place. She argues that people today use digital media to "(…) shape emotional attachments with(in) urban environments by re-placeing the city as unique, desirable, familiar, or knowable through assorted digital media forms" (Halegoua, 2020, p. 5). Further, she proposes that locatable digital media offer people a sort of geospatial empowerment that aid their interpretation and experience of urban spaces, which is something a growing number of urban studies have begun showing interest to (Martí et al., 2017; Schwartz & Hochman, 2014). In the pandemic, this seems more true than ever with media like Instagram becoming a crucial way for people to produce a sense of place and negotiate attachments to their environment, while isolated (see also Gatti et al. (2021).

Hashtag campaigns, like #BareDanmark, where users respond to a call for participation by a company or an organization, have been studied on Instagram before (Oh et al., 2016). Likewise, a shift from ad-hoc to calculated publics organized around a hashtag campaign has been theorized in media studies (Bruns & Burgess, 2015). On Twitter, for example, it is now well-documented that use practices around hashtags have developed and changed over time resulting in a need to distinguish between different types of hashtag events with different characteristics (Bruns et al., 2016). In relation to COVID-19, more specifically, the use of hashtag campaigns has also been prominent. An example is the #Stayhome hashtag, as documented by Umar (2020), which was used as a social campaign in Makassar City to prevent spread of the pandemic. The #BareDanmark campaign studied here was organized by DKNT as a COVID-19 specific campaign and was not widely used as a hashtag prior to the campaign (although some usage can be observed, see Figure 4). The choice to study this hashtag hereby provides both an analytical limitation and advantage, which shapes our results: Since the hashtag campaign is COVID-19 specific, there is no way to compare the #BareDanmark campaign during the pandemic with anything that came before it. This could have been possible if we had scraped Instagram data using a place-specific hashtag that was in use before the pandemic, as we have for instance done in a related project where we studied photos of Rømø on Instagram, comparing the summer of 2020 with photos from five preceding summers. Here it was the place-specific hashtag, #Rømø, that enabled collection of historic data. While use of place-specific hashtags is a data collection strategy taken in many Instagram studies, such strategies impose a different limitation, making the geographical location a constraint on the analysis by pre-determining where data is collected from. This closes down opportunity to discover that there might places beyond our a priori assumptions that matter to people. The #BareDanmark campaign, in contrast, opens possibility to explore what sort of environments people found valuable and meaningful to visit during 2020, which is the analytical interest in this study.

DATA COLLECTION

Data was collected on October 20th 2020 and contains posts from January 1st 2020 to October 19th 2020. We used Instaloader (2020) to scrape 39.575 posts that tag #BareDanmark in their caption. While some would argue that we should not collect data from platforms where APIs have been closed, this project subscribes to discussions about post-API research (Freelon, 2018; Perriam et al., 2019) and calls made by Ben-David (2020) to challenge the data colonialist powers of media platforms that increasingly privatize inherently public debates. Meanwhile, we made the distinction that only public posts were collected, meaning posts that were made publicly visible by both the user and the platform to anyone with an internet connection, without requiring login to Instagram. By design, no private data is thus collected. Even so, and guided by ethical standards in the field (Franzke et al., 2020) concerning personal identifiable information, data is anonymized in two steps; first by removing user-specific metadata, and second by blurring faces in pictures with 'deface' (Drawitsch, 2021). Data is stored on protected servers and registered under GDPR at our university.

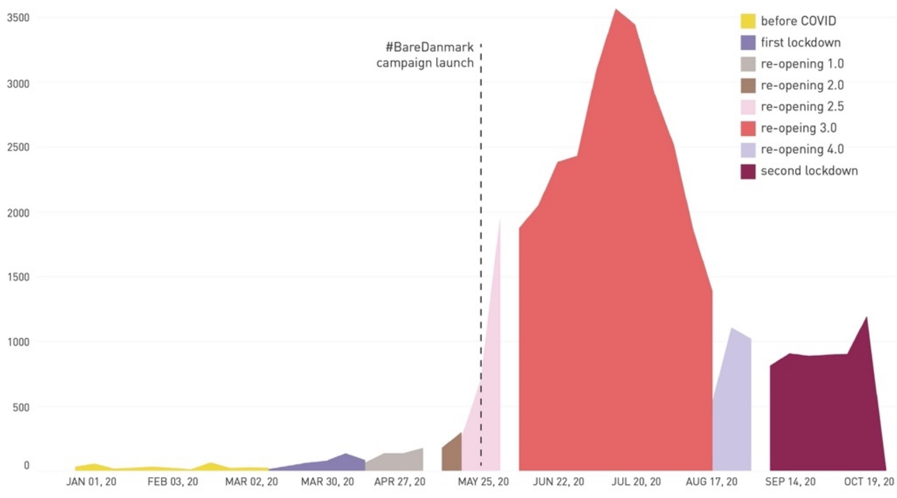


Figure 4: Distribution of posts collected from #BareDanmark campaign.

The dataset is produced by 5.807 unique users and contains images from; before the pandemic; the first lockdown; different phases of re-opening; and on to the second COVID wave and re-closing of society.These periods and the distribution of image data collected is seen in Figure 4. It should be noticed that 95% of the posts are from after the campaign launch, while 5% were posted before. Qualitative examination, however, reveals that content of earlier posts equally relate to experience in Denmark before and during COVID-19, suggesting that the hashtag #BareDanmark was not invented but rather appropriated by the campaign. Since these pre-launch posts are a part of what others see when looking at the hashtag, we keep them in the dataset.

PRE-PROCESSING

Geotags were not retrievable when scraping data from Instagram, due to restrictions on scraping. As such, a three-fold geocoding process was carried out which allowed us to geolocate 28.336 posts (about 75% of the dataset). First, a script was used to open each post in a browser and pull post location name, if found. Using a geo-gazetteer from Geonames.org, the scraped location names were then translated into geolocation with latitude and longitude. Second, Google AI Landmark Detection was run on images that were yet unidentified, annotating locations for 772 additional posts. Third, a manual geocoding was carried out for the 10 most frequent location names pulled from Instagram which the geo-gazetteer could not translate into latitude and longitude. These are posted from 458 times and geocoding them manually thus ensured that locations often visited by users did indeed get geolocated. These elaborate steps taken to geocode the posts, however, provide another, more pragmatic, argument for pushing digital urban research beyond geotag-fixation, since it gets harder and harder to get data with good geographical metadata due to social platforms closing and restricting APIs (Perriam et al., 2019). While Instagram makes it difficult to scrape data with location, a platform like Twitter offers a relatively open API, but in our experience only has geolocation for around 8% of results. A singular focus on geotags will thus often leave out majority of data, limiting results and increasing risk of misrepresenting the studied phenomenon. To annotate images according to their visual content, the 39.575 images were also processed with Google Vision AI, which was used to assign labels to each image that describe objects in the image. Each label comes with a confidence score from 0 to 1, which we used to remove labels with a confidence less then 70%.

Results

To explore the question of what environments were important during COVID-19, we first test what we might call the 'naive geotag-approach' by plotting the image metadata onto a map, as seen in Figure 5, with a bar chart that shows a list of the most frequently posted-from locations. Figure 5 shows that cities like Copenhagen, Aarhus, Odense, and Aalborg are among the most posted-from locations during COVID-19. This could indicate that these are most visited or important during the pandemic. But this is a case where overly focusing on the geotag could lead to a mis-conclusion. If we deploy a computer vision strategy instead and study the content of images as annotated by image recognition, we can interrogate what types of environments are depicted and shift the attention from 'place' to 'space' in what we tentatively dub a 'space typology' analysis.

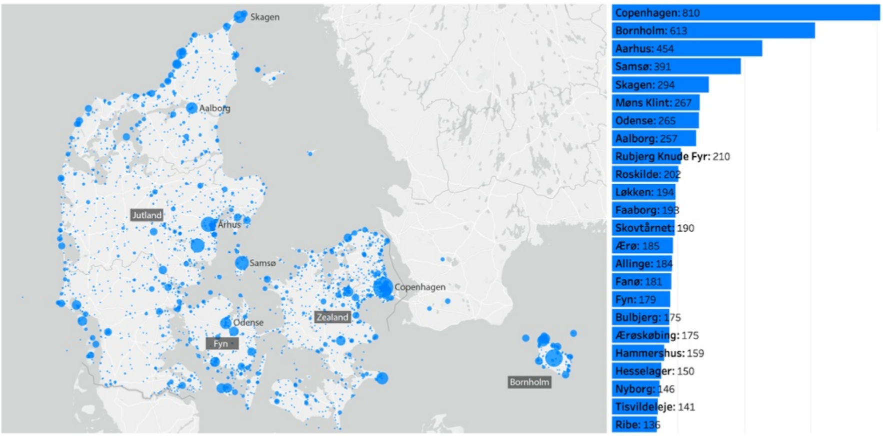


Figure 5: Locations sized by post frequency (left) with bar chart of top locations (right).

Qualitatively investigating all labels detected across the dataset more than 90 times by Google Vision AI, we source a list of labels, such as 'forest' or 'city' that describe the physical environment in the image. If 'beach' has for instance been identified by Google Vision Ai in an image, we assume that it depicts a beach as a type of space. Although we only examine labels with more than 70% confidence score, this will not be accurate in all cases as there is always inaccuracies when depending on supervised image recognition (we return to this in 'Discussion'). But if combined with qualitative exploration, such space typology-annotation is a useful strategy for getting an overview of image content based on how certain space types re-occur within photos. Building a source-list that matches image labels to a space typology (see Appendix A1), we annotated the data in a non-exclusive exercise: If an image depicts both 'beach' and 'forest', it is annotated with both typologies. We identify one or more space typologies in 78,64% of posts, and classify a space typology in 9.401 of the 12.766 posts without geotags.

Figure 6: Tree map showing distribution of space typologies within #BareDanmark image posts. Size according to how frequent each space type is detected in the dataset.

In Figure 6, a tree map shows the frequency of space typologies identified in posts. Square sizes indicate frequency, and one of the most liked images of each typology exemplifies what it looks like. Figure 6 shows that 'green' nature such as natural landscapes, cliffs, hills & highlands, meadow, forest, and grasslands is often depicted in image posts. When we center visual content, we can thus unsettle premature conclusions about place stemming from simplified geotag ontologies and use visual strategies to open for interrogating place attachments in alternative ways. And contrary to what the map in Figure 5 might suggest, we discover that during COVID-19 people form strong attachments to natural environments, more than urban spaces.

This ties into other COVID-19 studies, which have shown that recreational use of green spaces increased during the pandemic, which has caused scholars to argue that nature plays a critical role a source of resilience during such a crisis (Samuelsson et al., 2020; Venter et al., 2020). In contrast to COVID studies from other countries, however, Figure 6 reveals that in Denmark it is especially 'blue' natural environments like beaches, ocean & coast, rivers & lakes, and harbor, which are prominent in images. This indicates that proximity to water plays a big role during COVID-19, and taking a closer look we even discover that subsets of the image data depict urban environments in connection to water. We unpack this in Figure 7 and 8 in montages of image examples of 'lighthouses', and 'bridges'. The images in Figure 7 and 8 are from all over the country, and temporally from different phases of the pandemic. Yet, they show consistent ways of visually framing the same types of spaces. This may be a consequence of the aesthetic vernaculars of platforms like Instagram (Manovich, 2019). But refining such simple interpretation, we might also suggest that similarities in framing are more meaningful than just that.

Figure 7: Montage of 75 images of 'lighthouses' space typology.

Exemplified in Figure 7 and 8, contributors to #BareDanmark capture photos of harbors and lighthouses as built structures that connect them nature: While the boardwalks and bridges in the 'bridges' photos are pointing visually out towards an endless horizon, the lighthouses point our gaze up towards the endless sky, framing nature as expansive and boundless.

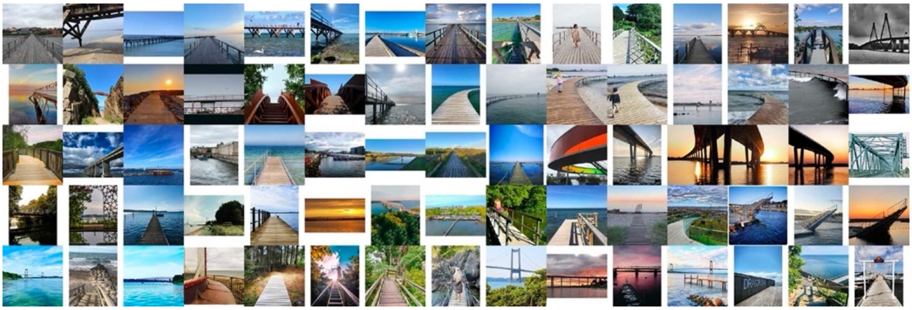


Figure 8: Montage of 75 images of 'bridges' space typology.

It is remarkable that people emphasize this sort of attachment to nature in a time where cities did the opposite and offered confinement and isolation. What this points to is perhaps a reflection of what Brenner & Scmid in their conceptualization of planetary urbanism has termed the 'end of wilderness', describing how the kind of urbanism we live in has become so expansive "that even spaces that lie well beyond the traditional city cores and suburban peripheries (…) have become integral parts of the worldwide urban fabric" (Brenner & Schmid, 2011, p. 12).

Opposed to seeing this through a city-nature divide, which has been argued to be an artificial construct anyway (Latour, 1993), a planetary urbanism lens invites us to interpret the nature in these images as an extension of life in urban centers. This is also supported by literature on COVID-19, which has emphasized that the pandemic highlighted the importance of nature as an essential quality-of-life element in sustainable cities (Kleinschroth & Kowarik, 2020). While COVID research has shown that that the pandemic has had a negative impact on public mental health, increasing loneliness and social disconnection (Bil et al., 2021; Holaday et al., 2022), access to nature on the other hand has been documented to have a positive impact on mental health during this crisis and been proposed as a source of resilience (Samuelsson et al., 2020; Soga et al., 2021). If access to nature is a key to creating resilient cities during a crisis like COVID-19, the next question from a planning perspective becomes: Where are these spaces found?

GEOSPATIAL MAPPING OF SPACE TYPOLOGIES

The previous section exemplified that we might discover a cohesiveness in photos that are temporally and geographically scattered by using image recognition to identify re-occurring space types, and qualitatively studying them to unpack how people frame these spaces. Relating this to the review, this is a concrete example of how it is possible to use computational methods in ethnographic explorations, when studying cities with visual social media data. We might also relate it to discussions by Massey (2005), who has proposed a relational ontology of 'place'. Extending this perspective, we can use the space typology approach to map photo locations as connected geographies based on visual similarities in the photo content. This is exemplified in Figure 9.

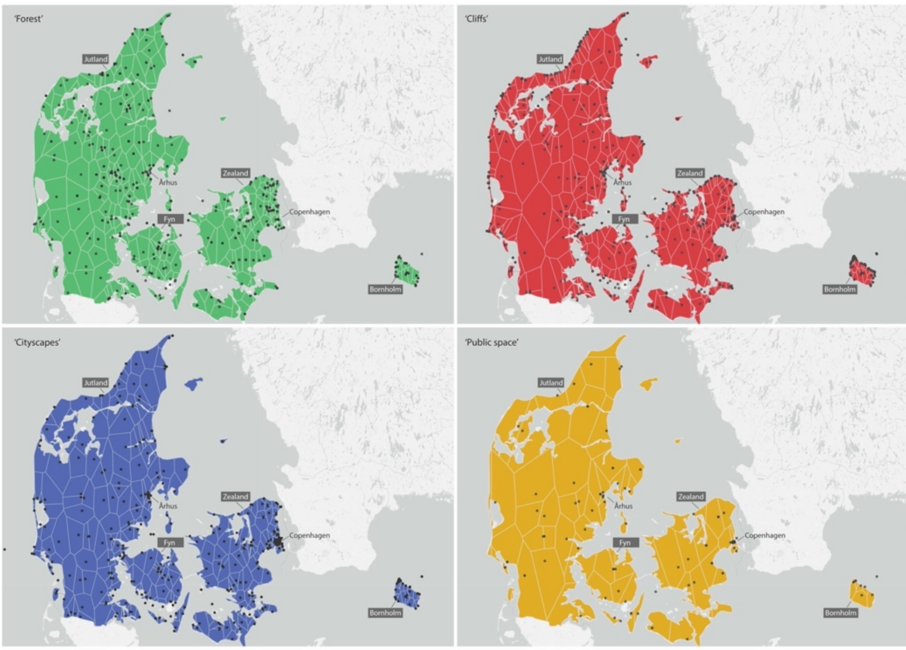


Figure 9: Voronoi plots made in QGIS showing spatial denisty of photos across Denmark depicting particular space typologies. Top left: Forest. Top right: Cliffs. Bottom left: Cityscape. Bottom right: Public space.

In figure 9, Voronoi plots are used to indicate spatial density by creating web-like structure that visualizes proximity between photos of a particular space type, showing where people have shared photos of forests (top left), cliffs (top right), cityscapes (bottom left), public spaces (bottom right). In doing so, the maps take inspiration from the 'Soft City Sensing' approach (Madsen et al., 2022) and use geospatial granularity of data to draw bottom-up topologies. Instead of aggregating data within pre-defined spatial ontologies such as zip codes or municipalities, the plots suggest new borders and layouts based on what types of spaces are highlighted in the #BareDanmark campaign. This exemplifies that it is possible to leverage social media images to break with the trend identified in the review of using data in 'remote-sensing' and 'city forensic' ways. Photos are not used here as a proxy for objectively registering where there are beaches or forests in the country. Rather, the subjectivity of the data, being produced by citizens who highlight certain places they value, is used to unlock insights about their preferences and attachments to certain spaces. The green map for instance makes it clear that people find valuable forest-related experiences in higher proximity in central Jutland and North of Copenhagen. In contrast, the red map shows a different spatial pattern for cliff-related environments, which people find along the coast, especially around Northern and Western parts of Jutland and the island Bornholm. Further, the blue map in Figure 9 shows that cityscape-images do not surprisingly have high proximity in the two biggest cities; Copenhagen and Århus. Yet, there are cityscape-images all around the country. Meanwhile, the yellow map shows that there is very far between Instagram users capturing images of public space outside of Copenhagen. In especially West and Mid Jutland, there are seemingly far in between any public spaces of value to people in the campaign. This suggest that the smaller Danish cities did not provide the same access to quality public spaces during COVID as the capitol. For planners, this could warrant further research into how public spaces in smaller cities were used during COVID. This is a pressing issue in planning, where studies outside Denmark have emphasized that COVID-19 revealed inequalities in access to good public spaces (Apostolopoulou & Liodaki, 2021; Kordshakeri & Fazeli, 2021).

To examine this qualitatively, Figure 10 compares a handful of images annotated with 'public space' from Copenhagen and smaller towns, unpacking our idea of what sort of 'public space' is of value to the Instagram users, and why these are more often found in the capital: In Copenhagen, we see people in the photos, gathered in plazas, parks, or along the waterfront, where bike lanes or swimming decks invite for activity and coffee stands and street food attracts people to spend time. In contrast, the images from smaller towns like Grenå, Ebeltoft, and Næstved show empty public spaces with no benches, shops, or bike lanes. People are mainly visible in spaces designed for play, where kids and families are using the space actively. This sort of digital analysis could help planners and policy makers identify cities where interventions are needed to increase quality of public space and can help qualify how different design and programming of the environment attracts people and activates a space, which is a recurring question in planning. This demonstrates how we can problematize the city in new ways, when we move beyond the geotag and use image content to see cities through the eyes of its users, as opposed to just mapping where photos are captured.

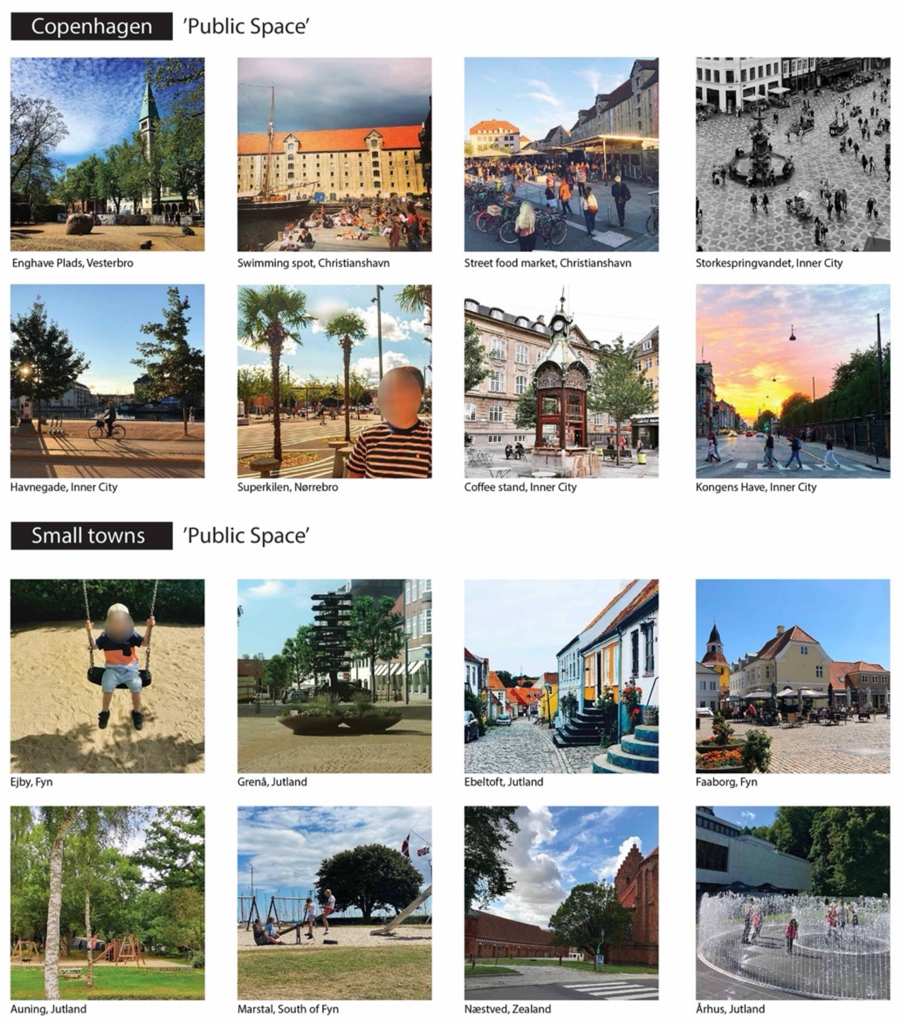


Figure 10: Images from Copenhagen and small towns of the 'public space' typology.

PERCEPTIONS OF NATURE IN CITIES

To examine representations of urban spaces further, we zoom in on images from the two most posted-from cities; Copenhagen (2243 images) and Århus (851). Producing an overview of the content of images, we map them as a network graph, based on visual similarity detected in images.

To do so, we combined the image labelling done with Google Vision AI with Visual Network Analysis and built an image-network for each city in which images are connected if they have three or more image labels in common (see also Thorsen & Astrupgaard (2021), Ren & Munk (2019), and Omena et al. (2021). The more labels are shared between two images, meaning the same visual motifs are depicted in both, the stronger the connection and the closer images are positioned in the network when spatialized with ForceAtlas2. This creates a network that positions images based on visual similarity. Images are sized according to number of likes, and we use custom Graph Recipes scripts to draw clusters identified with Gephi's Modularity Class algorithm (Blondel et al., 2008). Figure 12 shows a network graph of all 851 photos from Århus, plotted in clusters of visual similarity. To increase readability of the graph, Figure 11 shows a network graph of 1233 photos from Copenhagen, filtered so we only see photos with more than 20 likes and at least one comment, indicating that these photos are more interacted with by users.

Looking at Figure 12, we find a medium-sized cluster of images from Århus that depicts the urban environment, with especially several photos of ARoS Aarhus Art Museum, which re-opens in 'phase 2.5' of the pandemic. In comparison, the network of Copenhagen images in Figure 11 shows three big clusters of images depicting the urban environment with photos of buildings, architecture, landmarks, streets, and facades and a lot of aerial drone photos. As a city, Copenhagen thus seems to offer a wider array of architecture and streetscapes that people find interesting enough to share online, supporting the previous exploration that there is more 'public space' imagery from Copenhagen, than other cities in the country. In both networks, however, we also see big clusters of images depicting urban nature, indicating that people find meaningful nature not only outside urban centers, but also within these two cities. While in Århus, Figure 12, we see a mix of forest and ocean photos, the Copenhagen network contains several big clusters of images related to waterfront, harbor, canals, boats, and horizon over the water. This might suggest that in Copenhagen, there is more access to 'blue', than 'green' nature, while in Århus, people highlighting both 'green' and 'blue' nature in photos. This ties into debates among both planners, and policy makers about the role of nature in urban societies, and discussions about how such 'nature' is envisioned. While nature is generally considered "good" (Angelo, 2021) and the reconciliation of nature and urban space is considered among the smart solutions to complex issues created by urban growth, it has also been highlighted in the NATURPRADI project that "(…) there is no agreement on the imaginaries and technical practices that should be included into the new urban nature" (Ricci et al., 2017, p. 2).

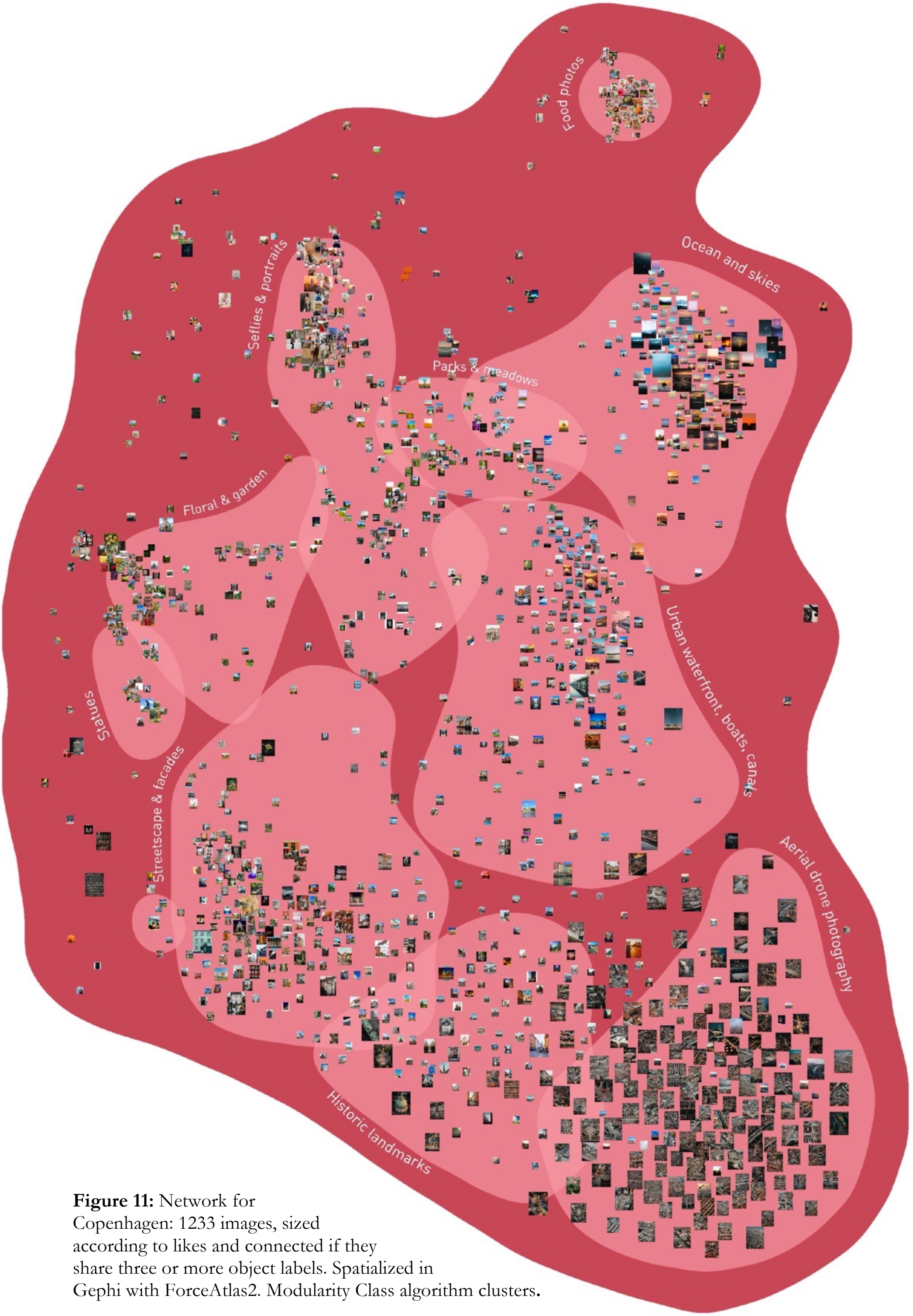


Figure 11: Network for Copenhagen: 1233 images, sized according to likes and connected if they share three or more object labels. Spatialized in Gephi with ForceAtlas2. Modularity Class algorithm clusters.

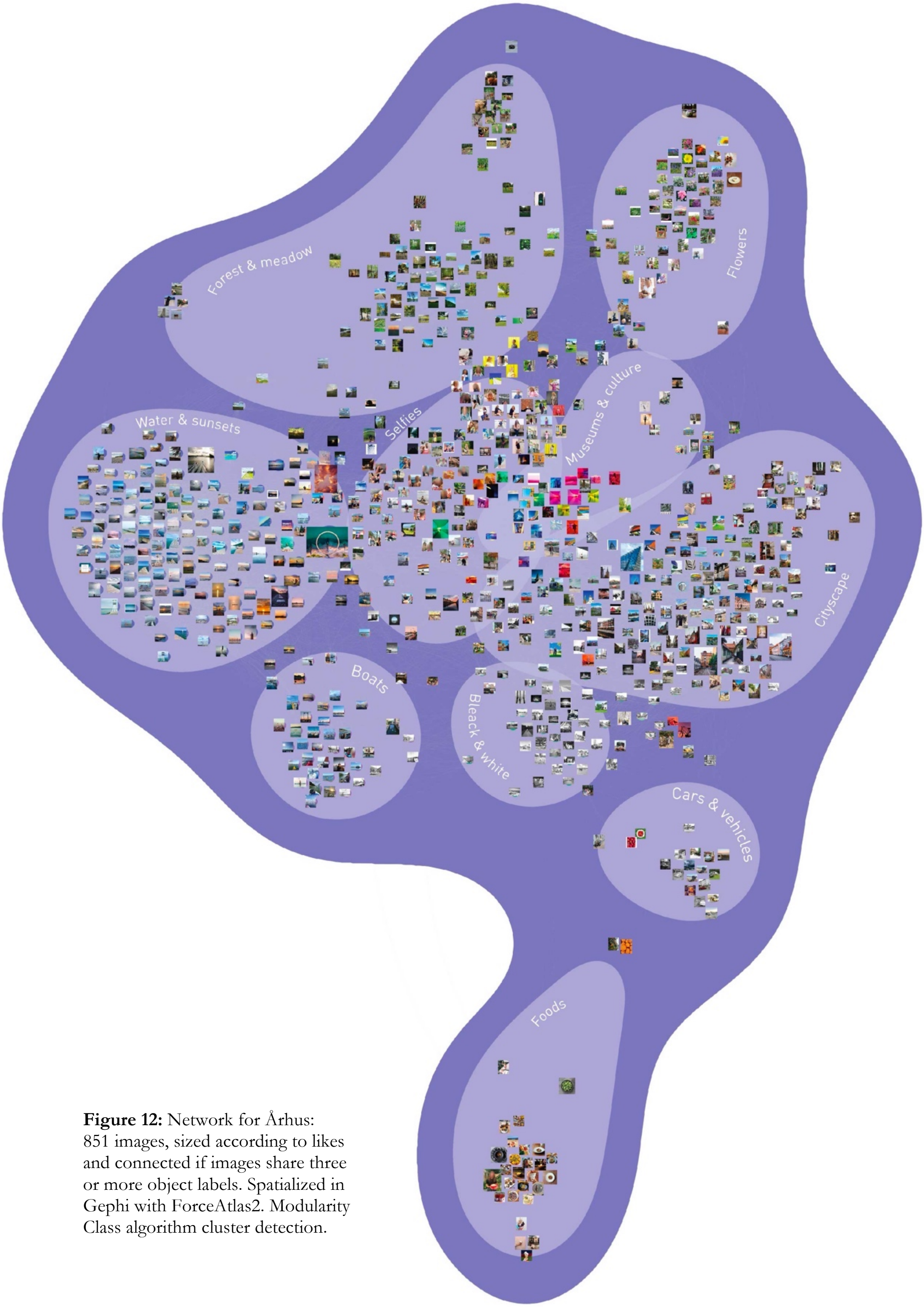


Figure 12: Network for Århus: 851 images, sized according to likes and connected if images share three or more object labels. Spatialized in Gephi with ForceAtlas2. Modularity Class algorithm cluster detection.

Examining what is indeed perceived by people as valuable urban nature, Figure 13 shows a set of images of nature from Copenhagen. These validate previous indications that water is important and qualifies how these environments are framed: We see that waterfront is used for swimming, sitting, walking, and sailing, with harbors, bridges, and boardwalks visible in the photos. While urban nature is often imagined as a green world, against a grey one (Ricci et al., 2017) our analysis thus shows 'blue' nature dominates perceptions of what are valuable natural environments in Copenhagen.

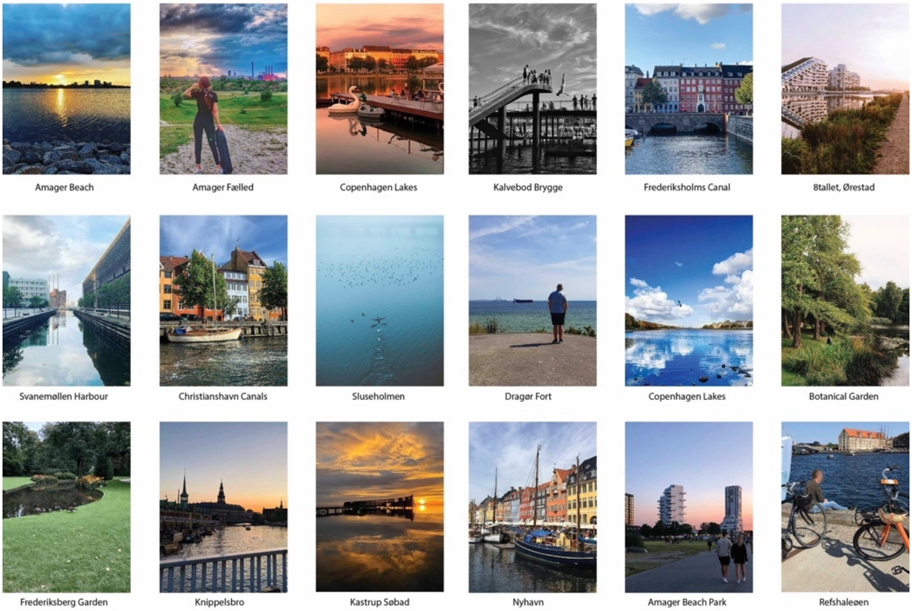


Figure 13: Selection of images from Copenhagen showing urban nature.

Through studying online representations of urban environments during COVID-19, the computational and visual approach hereby opens for detailed exploration of how urban nature is perceived in online debates. But does a city like Copenhagen provide equal access to such nature everywhere? In Figure 14, we filter all images taken within Copenhagen and show only the 911 photos of either blue or green natural environments. The left map renders each of the nature-related photos as a pie chart showing the distribution of space typologies identified within them. Colored thematically, red colors show space types related to built environment, green colors are used for nature-related space typologies, blue shades for water-related, and orange for bridges, harbors, and towers. From this we see that urban natural elements are not only found in the outskirts but that the city center is overflown with images of blue and green nature, often mixed with urban elements as indicated by red color in the pie charts. The map to the right in Figure 14 draws K-means clusters around areas with high density of photographs with green or blue nature in them. It suggests that blue and green spaces are especially documented in 'Indre By' (Inner City) and along the harbor and waterfront running through the city.

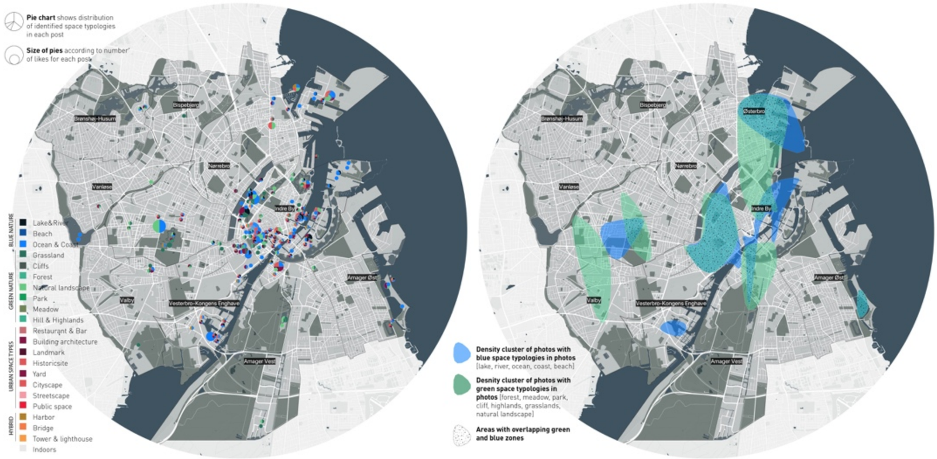


Figure 14: Left: Map of 911 images in Copenhagen that depicts nature, rendered as pie charts that show the distribution of space typologies identified in the images via their visual content. Right: Map showing clusters with a high spatial density of images of depicting parks and other natural spaces (green) or water (blue).

Meanwhile, it also reveals that the neighborhoods labelled Nørrebro, Vestebro-Kongens Enghave, Bispebjerg, Vanløse, Brønshøj-Husum seemingly are 'natureless zones' with neither green nor blue environments that people find valuable enough to share in the #BareDanmark campaign.

Drawing in earlier findings, and considering what implications this analysis can have for post-pandemic urbanism, we suggest that this could help planners and policy makers put (in)equal access to nature and public space on the agenda, inspired by how the NATURPRADI project uses digital methods to inform urban policy (Ricci et al., 2017). Using visual social media data in a computational methodology to investigate how people experience their environment can provide tangible insights into where initiatives or interventions are needed, and qualify what people perceive as good or meaningful spaces and how they interact with those. This can add important nuances to debates about urban nature that often pitch nature as an idealized green world against a concrete one, by empirically unfolding what sort of nature people photograph (Ricci et al., 2017).

Having data-intensive methods to put such topics on the agenda can also make a difference, seeing that few planning studies have focused on inequality in access to public spaces and urban nature in face of the pandemic. In reviews of COVID-19 planning efforts (Martínez & Short, 2021; Sharifi & Khavarian-Garmsir, 2020), planning features either as a component of pandemic control (e.g. how to design transport systems for social distancing) or as a practice that could learn from the pandemic in relation to environmental issues (e.g. what cities with clean air and green mobility could look like). As discussed by for instance Acuto et al. (2020), few planning responses addressed the pandemic as "a window of urban opportunity" (p. 978) for attending to the urban inequalities that underpin the pandemic specifically, and urban societies in general. By rethinking the empirical ground of data-driven urbanism, the digital-visual methodology used here, and similar to the NATURPRADI project, could inform future efforts to plan resilient and equitable sustainable cities, by giving hands-on tools to understand how people experience different spaces in a crisis like the pandemic.

Discussion

As a methodological contribution, this project's use of social media images raises at least two questions that demand further reflection. One regards the kind of participation we make possible for the people we are studying when we collect social media data. Another regards the way visual computational technologies frame what we see (and do not see) in image dataset.

When we collect digital traces left by people as a biproduct of online activity (so-called exhaust data (Kitchin, 2014)), we put several limitations on what sort of participation is possible. For one, we are only able to study the parts of the urban population that are indeed using social media, and there are consequently many people that we leave out when using social media data as a stand-alone source to study cities. Social media data is "pre-filtered to a very specific group of users", as Schwartz & Hochman (2014) write, limiting participation to people who own mobile phones, possess a certain digital and visual literacy, and general ability to use a camera. This has data ableist consequences for who are able to render themselves visible through this sort of data (Charitsis & Lehtiniemi, 2022). Adding to that, the methodology allows for only passive forms of participation, and often produce a distant relationship between researcher and researched. Rather than 'listening in' on what people are debating, the question is if we could involve them further? To do so, we would need to reframe social media analysis from a one-way extractive endeavor to a two-way relationship where data is being as elicitation devices and fed back to people for continued interpretation. While there have been experiments with this (Madsen & Munk, 2019), GDPR and protection of privacy often makes it difficult to follow up with social media users. Alternatively, more active forms of participation centered around visual data could come from methodologies like photovoice, participatory map-making, and other modes of visual anthropology (Gubrium & Harper, 2016). Advantages of such methods include that visual materials can be sourced directly as primary material from participants in response to a prompt, and that a closer relationship between researcher and participant makes it possible to have workshops with participants to contextualize data. Finally, while social platforms are efficient at revealing what people value in cities, their aesthetic vernaculars and like-economy make them less efficient at inviting people to share the ugly, the problematic, or negative attachments (Gerlitz & Helmond, 2013; Manovich, 2019), which other visual methodologies like photovoice are efficient at unpacking (Wang & Burris, 1997).

The second, but related, point of discussion regards the layers of mediation introduced by computational analysis of images. Supervised machine learning models for computer vision, like the one used to annotate our images, are inherently biased by the datasets they were trained on. While we can perhaps accept random mistakes, it becomes a problem of a different sort when the algorithm has systematic biases around for instance race and gender, as has been documented again and again (Buolamwini & Gebru, 2018; Crawford, 2016; Lambrecht & Tucker, 2017; Mintz & Silva, 2019; Raji et al., 2020). Yet, with the best-performing supervised computer vision available being proprietary (such as Clarifai, Google Vision Ai, and IBM Watson), we often depend on algorithms that are black boxed in engineering and training data, which leaves us in the dark with respect to how they shape our results. While this calls for more research on biases in relation to urban research, the use of computer vision also warrants discussion at the epistemological level: Visual technologies have historically introduced new modes of knowing (Cosgrove & Cosgrove, 2003; Halpern, 2015), and acted as "epistemology engines" in framing ways of seeing the world (Ihde, 2000). To understand what this means for urban studies, we need what Agre (1997) called a "critical technical practice". This could begin by asking: Where does computer vision guide our attention? To explore this empirically, we carried out a small experiment seen in Figure 15, which inverts the object-detection of computer vision image labelling by 'clipping out' the boxes of identified objects in a test image from New York. It shows that when we use supervised models to label photos, we effectively turn images into dissectible objects, and raises the question: What do these objects mean to us as stand-alone analytical entities, when we only focus on them and leave everything else out, as seen in the bottom-right of Figure 15? If we obscure the detected objects and look at what is left (top of figure), it becomes evident how the AI-gaze leads us to overlook what should matter most to urban planners and scholars; namely the environment and landscape in which human and non-human entities are situated.

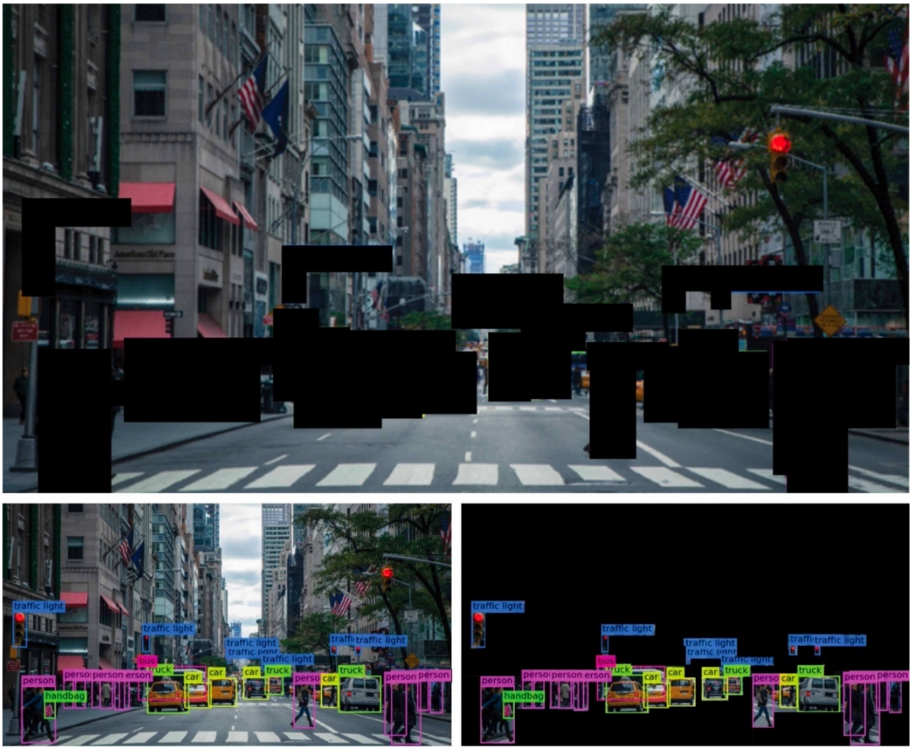


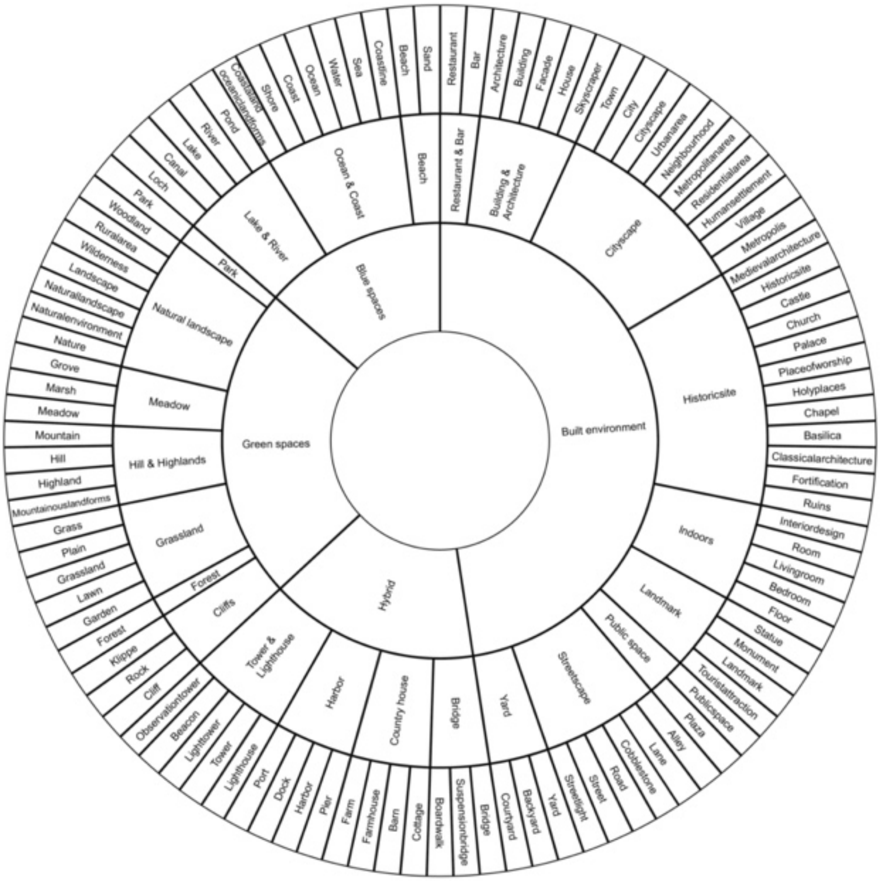
Figure 15: Illustration of an image of New York annotated with AI (bottom left), directing analytical attention towards discrete larger objects (right). If we subvert this (top) we see everything omitted by the AI gaze.

Computer vision thus opens for certain explorations of data, while omitting others. Tools that scale up such experiments by turning computer vision from instrument into object of investigation could encourage more scholars to engage in visual research, rather than stay away out of fear of how algorithms shape the results. A more sophisticated use could also come from training AI models specific to the built environment from datasets like Cityscapes, or from advances in unsupervised vision AI (Gordon, 2022; Hamilton et al., 2022). Models like STEGO or PixPlot's UMAP-model offer a context-specific labelling of images, without depending on human-coded training data. Indeed, this is where one could imagine another set of participatory experiments around visual urban data: Unsupervised image classification does not tell us what is in an image, but only informs how certain images appear similar to, or different from, other images, producing more questions, than answers (e.g. how is this group of images different from that group?). An unsupervised machine learning approach might hereby generate elicitation devices that urban communities could be asked to make sense of in conversations that could unfold their relationships to the city.

Conclusion

With a bibliometric study, this paper has first reviewed projects in humanities and social science that use social media data to study cities, showing that the field is dominated by three 'discursive closures' (Markham, 2021), including: 1) bias towards textual data, 2) fixation on geotag-ontologies as main analytical unit, and 3) frames of the subjective nature of social media data as a bias, not an analytical opportunity. To enable alternative approaches to doing urban research with social media data, we have proposed a way to flip the script on these three methodological commitments by a) focusing digital urban analysis on visual data, b) going beyond the geotag and making use of the content of images in quali-quantitative ways, and c) re-framing the subjective nature of data as an analytical opportunity for studying lived experience and place attachments. Second, we have demonstrated applied strategies for opening such empirical routes in digital urban research through a case study of the #BareDanmark Instagram campaign, where computational analysis of 39K images was used to study place attachments during the first nine months of COVID-19. While a simple geo-tag mapping of the data would suggest that Danish cities are the most important environments during COVID, we have showed how centering visual content enables us to unsettle premature conclusions about place that stem from just looking at the geotag. Instead, our 'space typology' analysis demonstrated how visual social media data affords alternative opportunities for studying place attachments. Through this we learned that most campaign images depict natural environments, with emphasis on the water and coastline with beaches, harbors, lighthouses and so on providing an important refuge for people during COVID. While cities like Århus and Copenhagen are frequently posted-from locations, a visual analysis of images enabled us to discover that within these cities, photos of parks and waterfronts proliferate in the #BareDanmark campaign, revealing that people built strong place attachments to nature both inside and outside urban centers during the pandemic. Mapping spatial distribution of public-space images across the country, and nature-images within Copenhagen, further made clear that Instagram users find little to no quality public spaces in smaller cities around the country. And when zooming in on Copenhagen, images showed that access to valuable nature does not seem equal across the city. Such insights could inform efforts to plan more resilient and equitable cities and identify places in need of planning or policy interventions.

Appendices



Appendix A1: List of Google Vision image labels (outer ring) used to annotate space typologies (middle ring) classified as built environment, or blue, green, or hybrid spaces (inner ring).

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Chapter 05

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Data Feminist Cartography

Five provocations for participatory mapmaking as an engagement method in planning

Data Feminist Cartography

Abstract

In fields like cultural geography, critical cartography, and geographic information system (GIS), the "post-colonial," "post-representational," and "participatory" turns have been productive in critiquing cartographic power at the theoretical level, in parallel with feminist scholarship, which has theorized digital geographies through queer theory, black geographies, postcolonial theory, and more. Such critiques call for the innovation of participatory mapping that involve more diverse groups in mapping urban issues. Meanwhile, empirical cases remain few, and methodological experiments are warranted to determine how to do this in practice. The Urban Belonging project contributes to this by testing data feminist principles such as "embrace pluralism," "rethink binaries," and "challenge power" in action. The project weaves counter-mapping and participatory GIS (PGIS) together with a data feminist project that engages seven marginalized communities in Copenhagen in mapping experiences of belonging. The article delivers novel empirical insights about underrepresented urban experiences and makes five provocations for how to expand the data and spatial justice potentials of mapping as an engagement method in planning. First, it augments the one-group tendency of most counter-mapping projects by bringing a pluralism of communities together around mapping. Second, it reconfigures participation beyond data collection. Third, it reframes what is meaningful to map, mobilizing subjective experiential realities as valid topographies for framing urban problems. Fourth, it experiments with crafting intersectional cartography. Fifth, it turns the empirical eye onto planners, demonstrating that participatory mapping could not only diversify understanding about those who inhabit cities but also create transparency about blind spots among those who design it.

Keywords: participatory GIS; data feminism; counter-mapping; Urban Belonging; citizen science; urban planning

Introduction: No Spatial Justice without Data Justice

> "After examining power, the next step is to challenge it—map by map."
> (D'Ignazio and Klein 2020, 72)

In the planning and governing of cities, historically, mapping has been a dominant "way of knowing" cities, shaping how design and policy decisions are made about urban problems (Kurgan and Brawley 2019, 1). Charles Booth's maps of 1889 London famously changed the perception of the poverty problem from a moral question of churchgoing to a practical issue of unemployment (Vaughan 2018). During the COVID-19 (coronavirus disease) pandemic, mapping was also key to tracking the spread of the virus and informing policies to mitigate it (Rosenkrantz et al. 2021). However, mapmaking is not a neutral endeavor. While urban cartography has conventionally framed maps as objective and apolitical, scholars of critical cartography, such as Harley (1989), have highlighted how mapping is imbued with power, values, and judgments by those who produce them. Seeing maps as social constructions and drawing on notions of knowledge as power found in Michel Foucault and Jacques Derrida, Harley demonstrated that mapmaking involves decisions about what to include, how to scale, style, and project a map, along with other choices that entangle mapping with a politics of visibility. As posed by John Pickles (1995, 146), maps therefore do more than represent territory but indeed co-produce it.

Indigenous and native studies have critiqued how mapping has been used historically by settler-colonial empires to claim territory and subjugate land, resources, and people to imperial control (Schultz 2018). With such problematizations of mapping, it has been proposed that we can think of maps not just as products of formalized knowledge but as knowledge practices that produce power, as put by Bruno Latour (2011): "the social work of mapping depends upon the power of its transcriptions: mapping draws upon the world, but also draws things together" (65). As an example, think of the 1930s redline maps of major American cities that evaluated neighborhoods according to standards for mortgage lending risk, typically deeming Black communities "high risk" and leading to racialized dis-investment, which still has an impact today. This clarifies that spatial justice, outlined by Soja (2013) as the ability to imagine more equitable possibilities for marginalized people's relationships with the city, cannot be untangled from questions of data justice: how people are able to render themselves visible through data shapes, how we understand urban problems, and what solutions we can imagine for them (Charitsis and Lehtiniemi 2022). This prompts the following questions: How is the public engaged in mapping urban issues? What kind of voice do marginalized groups have in negotiating the spatial representation of urban issues?

In fields like cultural geography and critical gartography, problematizations of cartographic power have led to "post-colonial" (King 2003) and "post-representational" (Kitchin and Dodge 2007) turns. Within feminist geography and GIS, there have been significant advances in "theorizing digital geographies through queer theory, black geographies, postcolonial theory, black/queer code studies and more" (Elwood and Leszczynski 2018, 630). While these have been productive in rethinking maps at the theoretical level, methodological responses remain limited in terms of how to practice mapping in ways that include more diverse groups. Post-colonial studies have raised productive questions, as voiced by Jane Jacobs (2003): "For a discipline like geography, whose past has been so closely linked to empires of old, how it might move toward geographies that have alternative assemblages of power and space remains vexed" (346). Examining such questions, efforts to decolonize mapmaking (Rose-Redwood et al. 2020) have emerged, prescribing that researchers move away from universalizing grand narratives of knowledge production and focus on contextualizing diverse and situated experiences. However, Smith et al. (2021) argued that "few contributions actively demonstrate what a shift to decolonizing design means in practice" (1). Similarly, Elwood and Leszczynski (2018) emphasized that "much digital geographies scholarship has yet to heed sustained calls for intersectional and critical race theorizations" (630). They argued that heeding feminist imperatives is about empirically grappling with the interplays of digitality, intersectionality, and marginalization. In other words, there is a need for innovation that turns theoretical critiques into practice and empirical methods. Meanwhile, cartographic power is not fixed but is "a slow construction and it can be corroded, interrupted or destroyed" (Latour 2011, 70). The article builds on this ethos and insists that mapping is a nonprescriptive, fuzzy knowledge practice that can be reconfigured to produce alternative power relations and elevate citizen-led mapping. Specifically, it explores what data feminism, introduced by D'Ignazio and Klein (2020) as intersectional feminist thinking in data science, can offer to a reorientation of cartographic practice. Data feminism, taking feminism in its most expansive definition, is a critique of all forms of oppression built into and reinforced through unjust and biased data-driven practices. However, more than adding another theoretical position from which to problematize mapping, data feminism encourages us to intervene and make alternative modes of knowing possible. It is a call to action for reworking power asymmetries of data processes, as D'Ignazio and Klein (2020) write:

"Data is a double-edged sword. In a very real sense, data have been used as a weapon by those in power to consolidate their control – over places and things, as well as people. (…) Data are part of the problem, to be sure. But they are also part of the solution." (14–17)

With principles such as "rethink binaries," "embrace pluralism," and "challenge power," I propose that data feminism offers a useful lens through which to reconfigure participatory mapmaking in ways that foreground marginalized voices and connect spatial and data justice in planning by giving more people agency in rendering visible their relationship to the city through mapping. This is demonstrated in the article through the Urban Belonging project, which was carried out from 2020 to 2022 to study how seven marginalized groups experience belonging in Copenhagen. Through this case, the article puts forward five strategies for data feminist cartography. Before diving into this, let us revisit how counter-mapping and participatory GIS have leveraged collaborative mapping so far.

Revisiting Participatory Methods for Mapping

Retracing the history of GIS, STS (science and technology studies) scholar Olascoaga (2021) documents how geospatial computing systems were originally envisioned in the 1960s within universities as a tool to make map drawing widely accessible and enable citizens to collaborate on mapping urban issues. The software he introduced was later moved to a private enterprise, ESRI, which has made ArcGIS the industry standard for governments, businesses, and universities, increasing technical and financial barriers to mapping and creating a culture of expertise that excludes citizens (Olascoaga 2021). The result is that citizens are rarely involved in negotiating spatial representations of urban problems. In response to this, participatory GIS has emerged as an ambition to let citizens inform planning through mapping. While GIS has often been criticized for widening the digital divide (Gubrium and Harper 2016), participatory GIS tries to "ameliorate uneven access to GIS and digital spatial data and diversify the forms of spatial knowledge" (Elwood 2006). Especially promising is the attention paid to developing tools that enable collaborative mapmaking. Examples include Olascoaga (2021) developing the tools Painting with Data and Drawing Participation, and researchers from Aalto University developing a PGIS tool called Maptionnaire, which is used in this project. In planning, scholars have especially used such tools to enable community members to report problems in their physical environment, such as trash and broken street furniture (Cila et al. 2016; Groen and Meys 2015). An example is FixMyStreet! in the United Kingdom, which uses PGIS to report on neighborhood issues (Matthews et al. 2018).

While such projects demonstrate the digital and participatory capabilities of PGIS, they mainly engage communities in monitoring immediate problems in the physical environment. They do little to involve people in mapping values, sentiments, and experiences to inform complex urban problems, as problematized by Kahila-Tani et al. (2016): "In public participation practices, the knowledge received from the laypeople is often considered to be opinions or beliefs, and is therefore dismissed" (196–97). According to the authors, experience-based topographies are discarded in favor of "hard facts" about the city. Although there have been initiatives toward developing a qualitative (Cope and Elwood 2009) or feminist GIS (Elwood and Leszczynski 2018), such applications are still rare. Projects on feminist geographies and a review by Kahila-Tani, Kytta, and Geertman (2019) show that PGIS processes tend to include citizens mainly in data collection rather than in the whole process and that PGIS projects often foreground elitist-based participation and struggle with engaging diverse and marginalized groups.

Meanwhile, research in counter-mapping has a powerful history of upsetting cartographic power and centering marginalized perspectives. As an empirical version of critical cartography, counter-mapping involves those outside or at the margins of established, powerful institutions in mapping, making visible those who otherwise go unseen (Kindynis 2014, 236). An early example can be seen in Peluso (1995), who used mapping to reinforce the territorial claims of indigenous populations. Since then, counter-mapping has been used to contest hegemonic narratives in disputes over land (Barbosa and Burns 2021; Rose-Redwood et al. 2020). In the setting of cities, initiatives such as the Anti-Eviction Mapping Project (Maharawal and McElroy 2018) have used counter-mapping to reveal the injustices of the housing crisis in the Bay area, while others have addressed issues of police violence and street harassment (Dalton and Mason-Deese 2012; Fileborn 2021). The "Useless Map" project by D'Ignazio and Day (2017) even engages locals in replacing imperialist street names in Boston with names based on everyday lived experiences, cultivating civic imagination. Though different in terms of what issue is mapped, these projects demonstrate the spatial and data justice capabilities of counter-mapping as a "grassroots data science" (Dalton and Stallmann 2018).

These projects also have limitations, one of which is that projects tend to engage a single community, whether it be homeless people (York 2014), drug users (Germes and Klaus 2021), indigenous peoples (Hunt and Stevenson 2017), youth (Taylor and Hall 2013), or others. This potentially pigeonholes and tokenizes marginalized groups and limits the potential for contrasting different viewpoints and stimulating understanding between minorities. Furthermore, many counter-mapping projects do little to challenge the ontological security of cartographic categorizations of, for instance, identity and have yet to take a more intersectional approach to spatial visualization.

As this article demonstrates, data feminism can be an engine to reimagine a cartography that augments these limitations. This is exemplified through the case of the Urban Belonging project, which put forward five provocations at the methodological level for how to extend spatial and data justice potentials of mapmaking as a participatory method. I call these "provocations" because they trouble conventions in hegemonic cartography, as discussed in the Introduction, and the shortcomings of PGIS and counter-mapping just reviewed. The following sections present these provocations in parallel with introducing the case: two provocations relate to sampling and organizing participation, while three relate to how collaborative mapping can be used to reframe urban issues that upset cartographic power.

Materials and Methods

PROVOCATION 1: SAMPLE A PLURALISM OF COMMUNITIES

The project's first provocation regards the way citizens are sampled in public participation projects. Referencing black feminist Jennifer Nash (2018), D'Ignazio and Klein argued that marginalized people offer a valuable perspective that should be included when scholars or planners craft normative visions of a just society. However, more than engaging a single marginalized group, the data feminist principle of "embrace pluralism" proposes that nuanced insights come from synthesizing multiple perspectives, with priority to local, marginalized, and experiential ways of knowing (D'Ignazio and Klein 2020, 125). Informed by this, the Urban Belonging project invited seven marginalized groups to be a part of the project, including those with physical disabilities, those with mental vulnerabilities, LGBT+, those who were deaf, ethnic minorities, international expats, and homeless people. We partnered with local organizations that represent the interests of these groups, involving them in framing the project's questions and designing an inclusive process, while building on established trust with their members to invite participants. The project enrolled 32 participants who lived in Copenhagen and self-identified with one or more of the seven groups. While the project invited them to use both photovoice and participatory GIS to document their experiences of belonging, this article focuses solely on the use of participatory mapmaking.

To contribute spatial data, the participants were asked to fill out a spatial questionnaire using Maptionnaire, a digital web-based tool that researchers can use to create spatial questions that participants respond to by drawing points, lines, and polygons. To mitigate data ableism (Charitsis and Lehtiniemi 2022) and digital literacy issues (D'Ignazio and Bhargava 2020), the Maptionnaire survey was introduced in small groups, where researchers brought computers, instructed on how to fill it out, and assisted people with disabilities or other barriers in drawing maps. As drawing and reading maps are socially learned skills (Gubrium and Harper 2016, 155), we also gave the participants options to individually choose a base map in the spatial survey that they were familiar with. To protect their privacies, the participants were instructed not to map the locations of where they live, sleep, or work to avoid creating visibilities that could lead to potential harm (what is discussed as the "paradox of exposure" in data feminism).

The effect of sampling for pluralism, as we shall see, is the contrasting and layering of different perspectives on what makes an inclusive city, producing more diverse and nuanced insights. However, it also contributes to coalition building, as expressed by one participant: "When I am invited to citizen engagement, I rarely meet others like me. I don't get anything out of that! In this project, it was cool to meet other disabled people and people who are minoritized in ways other than me. Working together has built new community and alliances between us." While the participants together produced 200+ digital maps in the spatial survey, their involvement, as the quote hints, extended far beyond data collection. This leads to the second provocation.

PROVOCATION 2: RECONFIGURE PARTICIPATION

With reference to Gayatri Spivak, D'Ignazio and Klein (2020) argued that data projects carry a high risk of "epistemic violence" when "the people doing the work are strangers in the dataset, when they are one or more steps removed from the local context of the data, and whey they view themselves (or are viewed by society) as unicorns, rock stars, and wizards" (147). In response, they emphasized that feminist projects should involve participants in all stages, including data analysis and communication. Moreover, D'Ignazio and Klein (2020) encouraged a shift from "doing good with data" to "data for co-liberation" (140), which entails a process design that gives leadership to members of minority groups, ensures data ownership by community members, and ground-truths data in a participatory, community-led analysis. Co-liberation also entails incorporating education and knowledge transfer as parts of the project design and building social infrastructure, as already mentioned, by contributing to coalition building. Thus, what can that look like in practice? Demonstrating this, the Urban Belonging project involved communities from beginning to end, inviting community organizations to input on the design of the process itself before engaging members in collecting, interpreting, and telling stories with data. After collecting data, we brought spatial data to workshops, where it was used as elicitation devices (Pink 2013) to prompt the participants to unfold experiences of belonging. In this process, the participants selected what to highlight and crafted stories (exemplified in Figure 1) while the researchers worked as facilitators and GIS support, with the built-in educational outcome that mapping exercises train the participants' spatial and data literacies.

Figure 1: Photos from the workshop (left) and exhibition (right).

Furthermore, the process was designed to grow shared understanding within and across the seven minorities by bringing people together in different constellations. The participants were invited to two rounds of workshops to interpret data. In the first round, we grouped participants based on the community association they had signed up with to ensure that they were in groups with others who shared a particular identity. In the second round of workshops, we regrouped the participants according to geospatial overlaps between the participants who had captured photos in the same areas during photovoice and asked them to unpack their relationships to those areas with analogue mapping exercises. The project culminated with a public exhibition in winter 2022 and again in summer 2022 at the Copenhagen Architecture Festival, where two participants and two researchers took the stage to present the project together. To contribute to community ownership, we also had professional portraits taken of the participants and included them in the exhibition (see Figure 1), which ensured that the participants receive credit and visibility for their work, unless they wanted anonymity, in which case people were represented with black squares instead of portraits to still signify their contribution. In evaluating the process, the participants expressed that this created a sense of pride in the project, as voiced by Alexandra: "The exhibition gave me the feeling that something tangible came out of all these hours we spent together. It made me so proud to see my portrait and my stories up there that I invited all my family and friends to come and see it."

Reconfiguring participation and embracing pluralism can thus shift the outcome of mapping projects from "data for good" to "data for co-liberation." However, involving participants in interpreting data was also crucial because it empowered an analytical practice that resituates urban issues in lived experience. This is the next provocation.

Results

PROVOCATION 3: SITUATE SPATIAL FRAMES IN LIVED EXPERIENCES

Exploring what it means to belong in the city, the project takes inspiration in the data feminist principle of "elevate emotion and embodiment," which invites us to "value multiple forms of knowledge, including the knowledge that comes from people as living, feelings bodies in the world" (D'Ignazio and Klein 2020, 73). Extending Donna Haraway's notion of situated knowledges and problematization of the "God's eye trick" as an illusion of neutral and objective data, D'Ignazio and Klein (2020) invite us to embrace the subjective, partial perspective and to leverage rather than resist emotional experiences. A first attempt to do so in our project came from asking participants in Maptionnaire to rank from 1 to 5 how inclusive each neighborhood in Copenhagen is to them on the basis of their perceptions. This produced the outputs in Figure 2.

Figure 2: Participants' individual maps ranking the perceived inclusivity of Copenhagen neighborhoods.

The maps suggest that the city's neighborhoods are perceived very differently by different people. In fact, there are no two maps that look the same. We can also see that the Inner City seems particularly contested, as this area is ranked by some as most inclusive and by others as least inclusive. In the workshops, the participants were asked to unpack this, describing Inner City as follows:

> "Inner City belongs to nobody. It lacks the specificity that makes certain groups belong there. When a space is for 'everyone,' it becomes unpredictable. You can't know why others are there."

> "I feel uneasy about the spaces of Inner City without identity. Spaces for everyone essentially are for no one. There are no rules or intentions for how the space should be used or who it is for."

These stories bust the myth of "all-inclusive" spaces by suggesting that no place can be universally inviting to all. By contrast, most participants articulated, as in the following examples, that they feel like they belong in spaces with a clear ownership that invites them in, while excluding others, even if this ownership is not permanent:

> "Nørrebro is the only place I feel home because here I will never be the only person of color or woman with brown hair. There is a community of people like me."

> "I normally don't feel at home in the Inner City. But when there is Pride, this part of the city changes ownership and becomes for me."

When designing for diversity, planners typically aim to create spaces that are inclusive of everyone, but is that even possible? What these stories demonstrate is that belonging emerges in a complex inclusion/exclusion dynamics. This prompts the question, "What role can universal design principles play in creating a socially sustainable city?" According to these stories, belonging does not come from generic all-inclusive spaces but from designing for community and ownership. However, while the maps in Figure 2 helped unfold this, they also raised another issue: most participants commented that it was arbitrary to rate the inclusivity of neighborhoods because the boundaries separating them do not resonate with how they experience the city, as exemplified by a participant: "Inner City feels different than Christianshavn to me, although they are in the same polygon." Thus, the participants challenged the borders dividing the map in Figure 2, indicating that it is not meaningful to report experiences according to these geospatial categories.

Taking seriously the data feminist credo of elevating subjective realities and embodied forms of knowledge leads us to the project's third provocation: let lived experiences of an issue define how it is framed spatially. This provocation insists that an objective-presenting ontology of maps be replaced with one that considers subjective experiential realities as valid frames. To exemplify this, the participants were asked to plot negative (red dots) and positive (green) experiences of belonging in Copenhagen in Maptionnaire. The results are seen in Figure 3. With QGIS, a K-means clustering algorithm was run to identify spatial clusters with a high density of positive and negative experiences. A concave hull (Moreira and Santos 2007) algorithm is used to draw these as zones of belonging (green polygons) and zones of exclusion (red polygons), while still displaying the individual experiences from which clusters are calculated to create transparency.

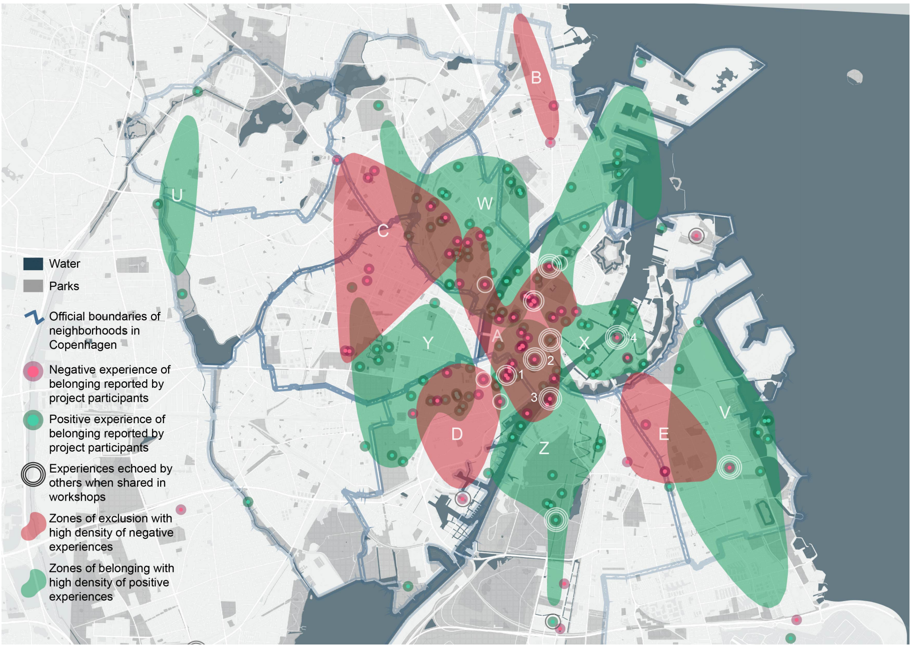

Figure 3: Zones of exclusion (red polygons) and belonging (green) in Copenhagen, calculated with K-means clustering from the spatial density of positive and negative experiences (green and red dots).

The map exemplifies how PGIS can be used in a counter-mapping ethos to draw bottom-up maps that ground spatial divisions of the city in problem-specific and situated local experiences. It produces a new topography and shows that zones of belonging and exclusion cut across administrative divisions of neighborhoods (blue lines). Doing so, it becomes noticeable that zones of belonging often overlap areas with parks or waterfronts. Investigating this closer, 59 (50.4%) of 117 positive experiences fall inside or close to a park or waterfront, while only 9 (14%) of 64 negative experiences do. This could indicate that experiences of belonging are connected to nature, especially since the exclusion zones B, C, D, and E constitute areas with little to no parks and waterfront. The map also reveals that Inner City is the most contested area, with green zone A overlapping the red zones X, W, and Z. Compared with how Figure 2 forced participants to report within neighborhood borders, the bottom-up map making in Figure 3 hereby captures more nuance in the participants' ambivalent relationships to Inner City and allows us to break this area up into different zones. This could inform where planners make interventions and add nuance to design and policy initiatives. Meanwhile, the high density of red dots in zone A indicates that this area is not just made up of a few but many negative experiences. To unpack this, the participants were asked to select one of their experiences from the map in the workshops and present it to others in their group. Noticeably, the experiences shared in all groups revolved around discrimination in the nightlife around zone A, as exemplified here in the following quotes:

> "For deaf people, there are many negative experiences in the nightlife: You are kicked out because the doorman thinks you are making trouble when you don't hear them. Or someone is physically violent to you." [*1 in the map]

> "A group of young men rolled up in a car when I was walking and threw trash at me, yelling "faggot". When you have an episode like this, you don't forget. I feel unsafe as an LGBT person in these spaces with lots of random, drunk people pass through." [*2]

Other stories revolved around accessibility and feelings of exclusion:

> "As a homeless person, I feel like I am not wanted or allowed to be. It is difficult to find a place to just sit and rest or eat food. The parks are my refuge, but most of the city is not for me." [*3]

In the deaf group, a participant shared a related yet different experience in the workshop:

> "This bridge is too crowded. As a deaf person, I cannot hear when people on bikes ring their bell and want to pass me. It is stressful. I feel unsafe and like I am getting in the way all the time." [*4]

These stories produce layered narratives about how the city works to exclude marginalized groups and exemplify that by redrawing the map from lived experiences, it is possible to unpack embodiment and emotion. The map and the stories that go with it introduce a subjective ontology of map making that unpacks the problem of belonging from the different viewpoints of the involved groups. This can help discover new relationships between an issue, such as belonging, the physical environment, and urban cultures, and ground-truth the spatial framing of the issue in light of how it is experienced.

PROVOCATION 4: CRAFT INTERSECTIONAL VISUALIZATIONS

To create more diversified insights into cities, it is not enough to redraw spatial divisions. It is also crucial that we innovate visualizations that break with the dynamics of "othering" (D'Ignazio et al. 2021). Think about how many times you have seen a map with dots on it colored red and blue, representing "men" and "women." Such maps not only produce a binary standard of how gender is represented, excluding people who do not identify within this binary, but also propose an isolated view of gendered issues, encouraging planners to address social problems as standalone issues, without sensitivity to how gender intersects with other identities in shaping people's experiences.

With the data feminist emphasis on intersectional thinking and the principle of rethink binaries and hierarchies, D'Ignazio and Klein (2020, 7) encouraged the project's next provocation: craft as an intersectional mapping language. *Intersectionality*, a term coined by Kimberlé Crenshaw, describes the ways in which systems of oppression based on gender, race, sexual identity, class, ethnicity, or other forms of marginalization can intertwine within a single identity to form experiences. Unpacking this, Crenshaw (1991) writes, "The problem with identity politics is not that it fails to transcend difference, as some critics charge, but rather the opposite—that it frequently conflates or ignores intragroup differences" (1242). In the context of planning, this was experienced as a real problem by our participants, as expressed here:

"Sitting in a wheelchair and being queer means that there is no place for me in Copenhagen. If I go to gay bars, I cannot get in, and if I go to places with good accessibility, I don't feel at home as a gay man. I don't belong anywhere."

As an experiment with capturing intersectionality, we might use alluvial diagrams to show identities as connected, as exemplified in Figure 4, which plots the participants' identities as waves connecting different aspects of identities across a horizontal axis.

In the figure, all participants are plotted with light grey. As examples, two lines highlight a participant in the homeless and deaf groups, showing how interwoven their identities are and inviting a more holistic reading of these individuals. This opens for discovering that although the two participants might seem very different, one being a homeless non-white able-bodied person and the other being a white deaf cis woman, both of them experienced mental vulnerabilities, had sexual identities outside the heteronormative, and were in the lowest income bracket, according to how they have self-identified.

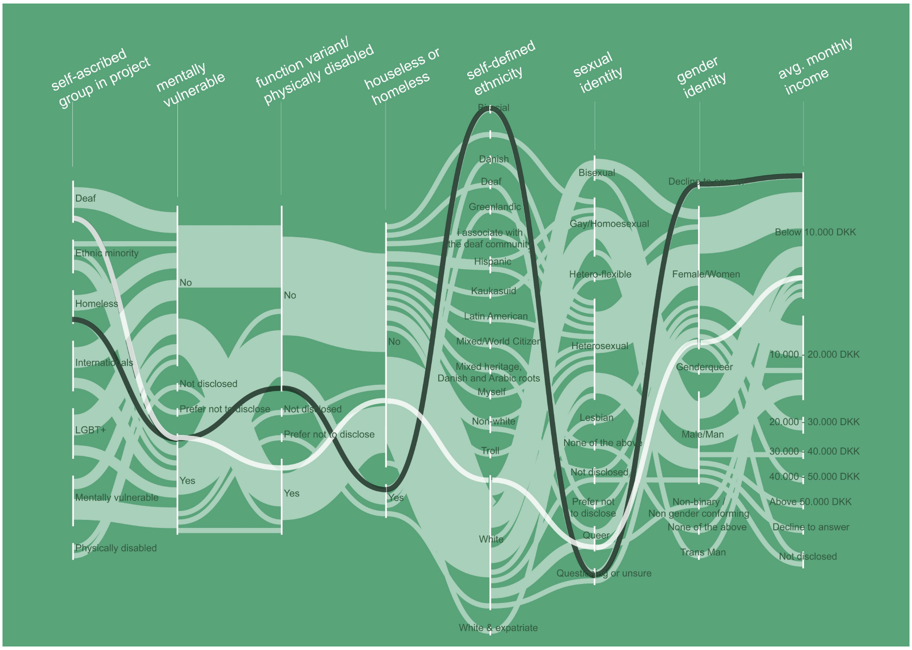

Figure 4: Alluvial diagram showing the participants' identities across eight parameters.

The intersectional approach hereby allows for seeing differences and similarities across and within groups with greater nuance. One proposition for translating this into cartography is to combine mapping with self-reported information about how people self-identify. Retooling a mental mapping tradition (Lynch 1960) with digital participatory GIS, we asked the participants to draw a shape on an empty base map that indicates what Copenhagen is to them. We then added a color to the shapes to indicate where the participants had self-defined as marginalized in certain ways. The result is shown in Figure 5. More colors mean that a person holds multiple marginalized identities, creating gradients that flow together to show how uniquely assembled every identity is and how impossible it is to separate various aspects of an identity.

The shapes show that for some, the city boundaries spread wider, while for others, their idea of Copenhagen is a lot smaller. This may reflect differences not only in perceptions of the city but also in access to the city. Moreover, the figure invites readers to compare color gradients within and across groups. What is first made clear is that few participants were comprised of an identity that is marginalized in only one respect. Looking across, we find participants in all groups with multi-marginalized identities (an exception is the group with physical disabilities, but because a participant in the LGBT group self-identified as having a physical disability, intersectionality was also found in this group).

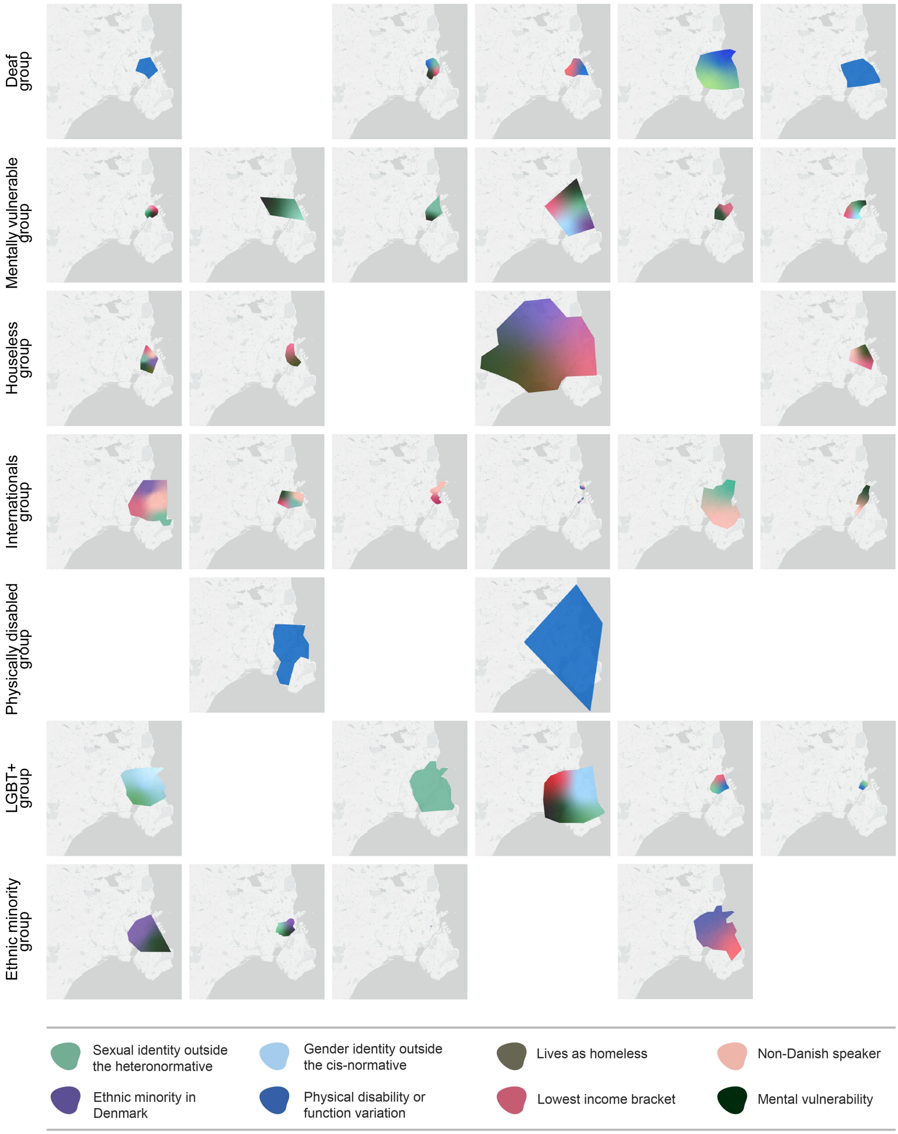

Figure 5: The participants' intersectional data portraits. The polygons show mental maps of Copenhagen, filled with one or more colors to indicate how the participants self-identify.

If we compare mental maps within groups, we further see that identities do not look the same. Studying the homeless group, we see that for several participants, being homeless correlates with having mental vulnerabilities. However, this is not the case for all homeless participants. From this, we can conclude two things: First, the problem of intersectionality is relevant to all groups in the project. Second, there is no combination of intersectionality that is primary, and we cannot define which aspects of marginalization matter more in shaping experiences of belonging. Instead, this is a contextual and empirical question. This is why we need intersectional strategies for mapping if we want to improve data and spatial justice for marginalized communities. These mental maps propose just one way to do this: the gradients use bright colors to celebrate diversity and difference, inspired by Crenshaw (1991), who writes that "the social power in delineating difference need not be the power of domination; it can instead be the source of social empowerment and reconstruction" (1242). Whatever strategy is deployed, the provocation here is that participatory map-making can be used to craft an intersectional gaze on the city and unsettle binary and hierarchical classifications of people.

To challenge how planners understand the city, we can do more than subvert the mapping techniques. In fact, we might use map making to illuminate blind spots among urban professionals. This is the fifth provocation.

PROVOCATION 5: MAKE BLIND SPOTS LEGIBLE

A starting point for data feminism revolves around acknowledging that power is not distributed equally in the world, as "those who wield power are disproportionately elite, straight, white, able-bodied, cisgender men from the Global North" (D'Ignazio and Klein 2020, 8). Design justice, outlined by Costanza-Chock (2020), extends a similar critique: "Professional design jobs in nearly all fields are disproportionately allocated to people who occupy highly privileged locations within the matrix of domination" (73). Consequently, it is often recognized that designers unconsciously default on imagined users whose experiences are similar to their own and have blind spots when imagining the needs of more diverse groups. However, these blind spots continue to be theoretical and are rarely examined. The data feminist principles of "examine power" and "challenge power" (D'Ignazio and Klein 2020, 17) encourage us to upset this attitude. To do so, I propose that participatory GIS can be used for more than simply reconfiguring who is doing the mapping and can equally be used to subvert who is being mapped. As an experiment, a local planning company in Copenhagen who was a partner in the Urban Belonging project agreed to fill out the same Maptionnaire survey that the project participants did, opening an opportunity for comparing the two groups. Figure 6 compares how frequently the two collectives of planners and participants experienced various negative experiences.

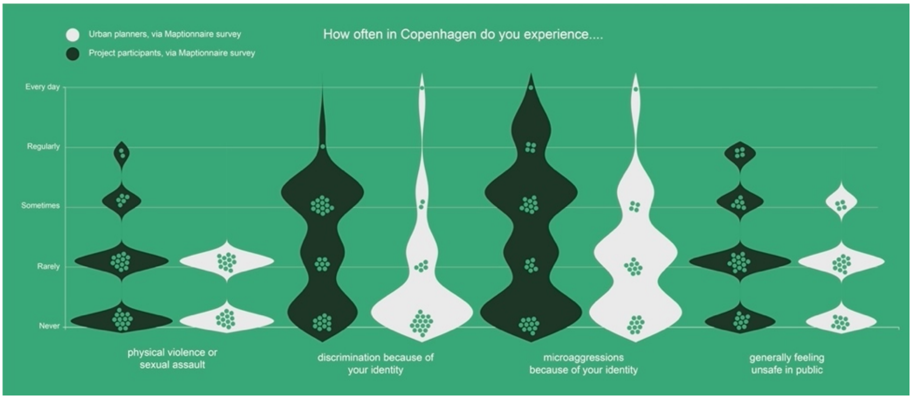

Figure 6: Violin diagrams comparing group-level trends of how often planners (white) and participants (green) experience physical violence, discrimination, microaggressions, and feeling unsafe in the city.

The figure shows that a higher number of project participants than planners often experience physical violence, discrimination, micro-aggressions, and feeling unsafe in public spaces. This relates to insights from other studies that have shown that transgender and gender non-conforming people have negative experiences with harassment, discrimination, and generally feeling unsafe in public, which are shaped by "a broader cultural system that normalizes violence and harassment towards gender minorities" (Lubitow et al. 2017). When asked how inclusive they think the city is for all people on a scale of 1 to 5, the planners ranked Copenhagen higher on average (3,4) than the participants (3,0), making clear that planners' position in the social hierarchy affects an underestimation of the issue of inclusivity compared with how it is perceived by the project participants. To unpack this in a spatial way, Figure 7 shows a comparison of frequently visited areas drawn by the planners (blue) and participants (dark blue) on the map to the top. The map at the bottom of Figure 7 juxtaposes these layers by using QGIS algorithms to cut out overlaps and show only areas often visited by the project participants, where none of the planners have reported that they visit frequently, creating what we might call the "blind spot map". The map shows that the planners were very particular about what areas of Inner City, Vesterbro, Nørrebro, Christianshavn, and Amager they visit, which often overlap with the more central and gentrified parts of these neighborhoods and areas with proximity to green parks and waterfront areas.

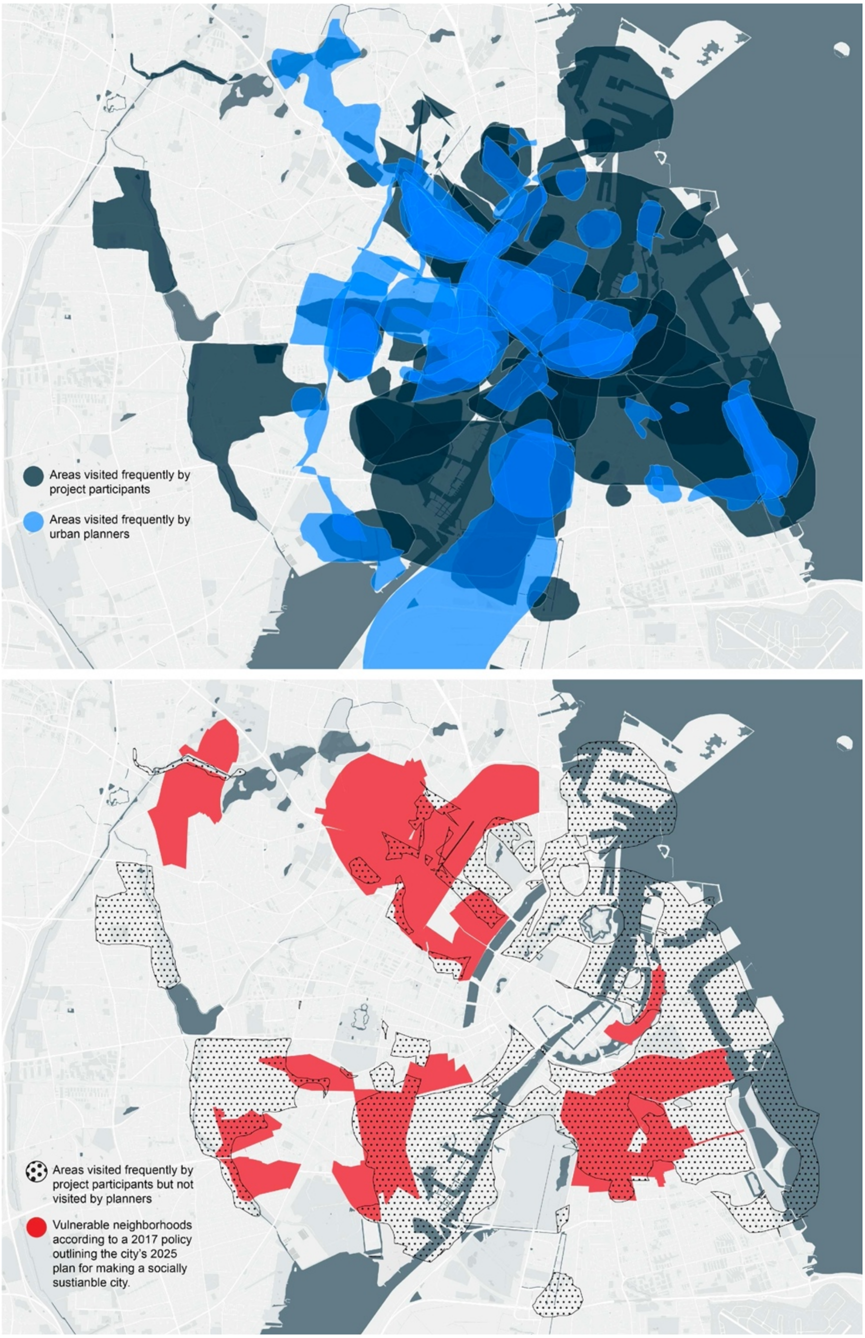

Figure 7: Top: Map of areas frequently visited by the planners (blue) and participants (dark blue). Bottom: Map of areas frequently used by participants but not the planners (scratched), layered with "vulnerable areas" (red) from the official municipal policy.

Meanwhile, the project participants frequently used areas of the city that are more peripheral and further away from the center, which the planners do not. Most interesting is that the red parts of the map to the right show that the planners' blind spots (areas they do not visit that matter to the participants) often correlated with the areas deemed as "vulnerable neighborhoods" by the municipality and established as sites of intervention in a policy for making the city more socially sustainable toward 2025 (Teknik- og Miljøforvaltningen 2017). If these areas are subject to urban renewal, it appears crucial that the planners involved (it might indeed be planners other than the ones examined here) get to know these areas and involve the affected communities in the design process. Blind spot mapping can thus be used to select places in the city that warrant site visits by planners or additional engagement of local communities, fostering a culture of accountability and transparency among designers.

Conclusion

This article investigated the potential for using participatory GIS to open spatial and data justice potentials within citizen engagement and involve more diverse groups of citizens in negotiating and framing urban issues through mapping. In the case of the Urban Belonging project, the article used a data feminist framework to rethink a set of conventions that limit planners and scholars from using map-making to engage marginalized communities.

Specifically, the article proposes five provocations. First, it urges planners and scholars to reconfigure who is doing the mapping, insisting that to design inclusive cities and practice data for co-liberation, we need to engage a pluralism of marginalized groups beyond the single-group focus of most counter-mapping projects. The second provocation insists that data justice comes from involving communities in not just collecting but also interpreting and analyzing data. The third provocation suggests grounding maps in problem-specific topographies and situating the spatial framing of urban issues in lived experiences. The fourth provocation insists that we craft an intersectional mapping vernacular to diversify our understanding of social issues in the city. Finally, a fifth provocation demonstrated that PGIS can be used to make blind spots among legible planners.

Together, these strategies advance data feminist participatory map-making as an engagement method in urban planning that promotes spatial and data justice.

Discussion

The project raises at least two dilemmas. First, it is pertinent to ask: what is the effect of these mapping strategies for giving marginalized groups a stronger voice in planning? It could be critiqued that the use of a base map forces participants to conform to a Cartesian representation of space that carries in it inherently colonial, exploitative legacies. A radically deontologized cartography would perhaps replace "scale mapping" exercises, where participants are asked to locate experiences on maps with geographic accuracy, with sketch or ephemeral mapping. However, participatory GIS proposes, as follows, that there can be empowerment in using standardized base maps and mapping techniques because it ensures commensurability: "Project teams turn to GIS because it allows them to speak to policymakers using the authoritative voice of maps" (Gubrium and Harper 2016, 167). The cartographic strategies proposed here adhere to this and use scale mapping to let communities document experiences in spatial terms that planners and policymakers will recognize and that can be compared with other maps.

Meanwhile, it is still possible to upset cartographic conventions by refusing to aggregate data within predefined units such as official neighborhoods and instead offer alternative spatial frames of the issue at hand. However, what happens when we introduce intersectionality? Are we potentially making it more difficult for a minority to have a shared voice? Contributions on anti-oppressive data visualization would insist otherwise and emphasize that an intersectional language is key to liberate marginalized groups from tokenized representation, introducing greater nuance and sensitivity to intergroup differences (Bravo, Rufs, and Moyano 2022). On the quest for intersectionality, however, there is no straightforward approach, and every design choice warrants reflection. The mental maps in Figure 5 plot identities against the norm, including an able-bodied, Danish-speaking, white hetero-cis person not living with mental illness, homelessness, or low income. By doing so, do we risk further "othering" people? It could be argued that we should stop categorizing people altogether. Meanwhile, D'Ignazio and Klein argued that there is no untangling of data from some sort of classification: "the flaw in that plan is that data must be classified in some way to be used. In fact, by the time that information becomes data, it's already been classified in some way" (2020, 103). Bowker and Star (2000) similarly emphasized that the problem is not classification itself but rather when classification systems become naturalized to the degree that we stop questioning who is made (in)visible as a consequence. Therefore, the intention of the provocations put forward in this article is not to dissolve cartographic representation but rather to advance it in a data-feminist direction.

Second, does map making change planning outcomes? It has been questioned whether public participation projects actually enhance planning outcomes or change decision-making (Brown, Weber, and de Bie 2015). To increase impact, I believe participatory GIS is faced by at least two challenges. On the one hand, there is a problem of accountability: whenever marginalized communities submit their time, data, and stories to a planning process, there is no community control over what agenda data are used to serve and no accountability for how planners use insights to inform decisions. For that reason, PGIS has been shown to continue a top-down planning tradition and lead to "cherry picking," in which data are misused to validate a priori assumptions and already made decisions (Kahila-Tani et al. 2019). Building accountability into citizen science is a design challenge we must take seriously if we expect citizens to continue contributing time and data. This relates to a second problem, which has been termed "the problem with solutions" (Holmes 2020), characterized by the trend to plan cities through the prism of known solutions, letting solutions define the problem. Most PGIS projects invite citizens to validate already made decisions, not taking seriously the potential for letting citizens negotiate and reframe urban problems. If participatory processes are to have greater impacts, we need to move toward non-solutionist planning that allows the framing of a problem to precede efforts of solving it. In pursing that, data feminist cartography has a lot to offer, as demonstrated here.

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Chapter 06

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What is an inclusive city?

Reconfiguring public participation with digital photovoice to unpack experiences of belonging among marginalized communities

What is an inclusive city?

Abstract

Visual research has historically been productive in foregrounding marginalized voices through photovoice as an alternative to the written and oral forms of participation that dominate public participation. However, photovoice projects have been slow to leverage digital and spatial technologies to rework the method in ways that enable geospatial analysis and collect structured metadata that can be used in workshops to bring different groups together around unpacking urban problems. The Urban Belonging (UB) project contributes to this by testing a new application, the UB App, in an empirical study of how participants from seven marginalized communities in Copenhagen experience the city. From a dataset of 1459 annotated and geolocated photos interpreted by participants in workshops, the project delivers a two-fold analysis: First, it unpacks community-specific patterns in how the city creates experiences of belonging for different groups. Second, it examines how participants experience certain places and situations differently, producing multilayered representations of conflicting viewpoints between different participants and groups. Thereby, the project brings GIS and digital methods capabilities into photovoice and opens new epistemological flexibilities in the method, making it possible to move between qualitative and quantitative analyses, bottom-up and top-down lenses on data, and demographic and post-demographic ways of organizing participation.

Keywords: photovoice; participatory method, urban planning; GIS, digital methods

Introduction

In the context of how cities are designed and governed, the arrangement of public participation has become foundational to urban planning in most democratic societies (Healey 2020). From notions of procedural justice and equal “rights to the city” (Harvey 2008), contemporary planning demands that citizens have a voice in decisions about urban futures and that the public is invited to contribute local knowledge that can inform planning and policy making (Friedmann 1998). But what is an urban public? This depends on how the public is assembled and what participation is made possible.

An idealized notion of "the public" in political discourse typically construes the public as a stable entity that exists "out there," having a priori status, and can be sampled and consulted in rational discussions about pressing issues. However, the Science and Technology Studies (STS) literature troubles such a notion of "the public" in two important ways that we build upon. First, Marres (2005) offers a notion of "issue publics" that builds on Deweyan pragmatism (Dewey and Rogers 2012) and challenges the idea that a single public exists prior to the issues it forms opinions about. On the contrary, publics in the plural emerge around the issues that matter to them. For instance, one public can exist around the problem of affordable housing and another around the issue of urban nature. The consequence is that many publics can exist at the same time, and people can occupy different positions within them. This also means that the composition of—and fault lines between—different publics is constantly developing. On this account, the nation state or administrative city is not necessarily the relevant container from which to sample the public and gauge its concerns. Second, STS scholars have emphasized the role of materiality in constructing the "democratic situations" (Birkbak and Papazu 2022) that make up our society. The act of making a public tangible to decision makers is such a situation. No matter how this is done, it involves material technologies for inscribing the public. What counts as the public thus becomes a consequence of the design of the sociotechnical infrastructures through which it is manifested (Osborne and Rose 1999). In other words, publics are the result of situated data practices that can be unpacked, criticized, and redesigned (Ruppert and Scheel 2021). This is what this article contributes to. It documents the Urban Belonging (UB) project as a digital photovoice experiment that reconfigures public participation methods to make the empirical foundation of planning and policy making more inclusive.

While intended to give everyone a voice in planning, public engagement in its conventional formats has been shown to have a problem attracting a diverse group of participants and often foregrounds those who occupy the top of the social hierarchy (Lowndes, Pratchett, and Stoker 2001; Witkowski, Reyes, and Padilla 2021). Among the identified reasons are inadequate and inconvenient methods such as public hearings and written statements (Kahila-Tani, Kytta, and Geertman 2019) and what Boomgard and Brom (2017, 10) observe as a tendency to judge publics by a purely quantitative logic. As put by Kahila-Tani et al. (2019), "Although many techniques exist to arrange the participation of large groups of citizens, (…) the kind of pluralistic thinking that introduces a diversity of interests to support the creation of more innovative planning proposals remains rare" (46).

Popular engagement methods such as sample surveys and citizen assemblies (Flanigan et al. 2021) sample citizens to be representative of the population (corresponding to a notion of an a priori "public"). The consequence is that minorities are likely to be represented by just one or two people, if at all, which can further tokenize and marginalize them. To many, this makes citizen engagement feel broken and non-inclusive. Irvin and Stansbury (2004) further indicated that although public participation has become a common practice in most urban and regional planning, conventional processes lead to sparse influence on decision making and planning outcomes, which are for the most part already decided. In other words, engagement methods need rethinking to empower a diversity of people to participate and frame urban issues.

Even though the rise of the digital city (Halegoua 2020) carries the potential for rethinking engagement practices, this has not happened in practice. As the digital city has to a large extent been envisioned within the paradigm of the smart city, urban planning has largely missed the opportunity to innovate digital methodologies for assembling the public around urban issues. In fact, Halegoua (2020) suggests that the data-driven urbanism subsumed under the "smart city" umbrella has an "engagement deficit" that must be addressed. Within urban studies and planning, we have recently seen attempts to address this by making publics tangible through alternative data infrastructures (see, e.g., Madsen and Munk 2019). However, most cities continue to emphasize written and oral participation, which also dominates the Action Catalog by the European Commission (http://actioncatalogue.eu/). With continued innovation in visual methods, we are offered the opportunity to imagine engagement methods that better include marginalized groups. Visual materials such as photos offer people a chance to show how they experience the city, foregrounding local, situated knowledge (Haraway 1988). As emphasized by Gillian Rose (2016), "Visual images can be a powerful tool in this process" (135). This is especially true since advances in mobile technology have made geolocated photo data accessible. However, visual methods continue to be underexplored within public participation. This is what the UB project c: The project reconfigures the methodological toolbox of citizen engagement in urban planning, using a geolocated and digital photovoice method to deliver an empirical study of how seven marginalized communities in Copenhagen experience belonging.

Reviewing and Reimagining the Photovoice Method

Photovoice was introduced as a framework during the nineties by Wang and Burris (1997) as a participatory method where participants are given cameras and asked to take photos that represent their experiences or perspectives on a particular issue. Photovoice is often used as a Participatory Action Research method (Rose 2016) in community-based research to give voice to marginalized groups. More than photo capture, it is typically followed by a process where participants select photos and use them to elicit group discussions that aim to inform planning, policies, or collective actions that address the problems documented in the photos (Gubrium and Harper 2016; Wang and Burris 1997). Thus, photovoice sits somewhere between "photo documentation" and "photo elicitation" (Harper 2002).

However, in contrast to photo elicitation, where photos might be researcher-generated or sourced from archives, photovoice sources photos directly from participants who are empowered to frame an issue from their perspective (Budig et al. 2018). Thereby, citizens are positioned as co-researchers in a participatory ethos mirrored in the credo, "Nothing for us without us" (Wang, Burris, and Ping 1996). In the context of urban studies, photovoice has especially been used to engage disadvantaged groups who are otherwise overlooked, excluded, or invisible in the governing and planning of cities. Some projects study how low-income, racialized, and disinvested communities navigate the local food environment (Soma, Li, and Shulman 2022; Valera et al. 2009), while others explore how minorities such as homeless people or black women perceive safety in the urban environment (Davis et al. 2020; Gaboardi et al. 2018). Specifically regarding questions of belonging, as is the topic of this article, photovoice has been used to engage underrepresented groups in documenting the experiences of what makes people feel at home in a place (see, e.g., Bennet 2014; Duran 2019; Magee 2007; Miled 2020). Relating back to the introduction, photovoice in these instances productively reconfigures who has a voice in public participation, challenging the "statistically representative" approach by giving voice to marginalized communities. They also rework engagement methods that depend on oral and textual means by enabling a visual form of participation that is accessible to more people and foregrounds experience-based local knowledge.

Most urban projects are characterized by methodological tendencies that we argue limit the potentials of photovoice for redesigning public participation in a more inclusive direction. First, most photovoice projects collect a small number of photos and have a sample size between 10 and 15 participants (Budig et al. 2018; Duran 2019; Holtby et al. 2015; Macdonald et al. 2022; Magee 2007; Meenar and Mandarano 2021; Plane and Klodawsky 2013), limiting the scope of results. Second, these projects tend to focus on one marginalized group, exemplified in studies of LGBTQ+ youth (Holtby et al. 2015), homeless people (Plane and Klodawsky 2013), indigenous youth (Goodman et al. 2019), or people with physical disabilities (Macdonald et al. 2022). Rarely do studies involve multiple groups at a time, thus missing out on the opportunity of putting communities in conversation with each other and potentially isolating and "othering" minorities. This correlates with a third trend of failing to take an intersectional lens on the participants, who are rarely construed as more than the minority they are invited to represent. This potentially extends a tokenized view of marginalized groups, instead of producing nuanced stories about people's experiences and empowering participants to voice when and how an identity shapes their experiences.

Finally, a characteristic of photovoice projects is that they typically ask participants to document a predefined area. Plane and Klodawsky (2013) investigated a local park, while Holtby et al. (2015) studied a small urban center in Ontario. Similar to conventional engagement methods, photovoice projects sometimes impose a top-down, expert-led "framing" of an issue by predetermining what environments it is relevant for participants to do photovoice in rather than letting participants show what places matter to them.

Taking stock of these shortcomings, it is also noticeable that photovoice projects typically self-position as qualitative research with little to no involvement of digital methods or GIS science. In addition, scholars such as Foster et al. (2022) have emphasized that the method has evolved little over the past two decades. This is a shame, as mobile and geocomputational technologies offer a chance to reimagine photovoice in ways that connect photovoice to GIS and "quali-quantitative" analyses (Venturini and Latour 2010). This raises the question: How has digital technology been leveraged so far?

Innovation of photovoice with digital technology

In photovoice research, the uptake of digital and mobile technologies has allowed for new applications of the method in recent years. Smartphone cameras have made it easier and more affordable to do photovoice, replacing digital, analogue, and single-use cameras in many projects, as observed by Volpe (2019). This has made the method more accessible to a wider range of communities and has allowed for a more immediate and interactive process. In addition, online photo-sharing platforms such as Instagram or Flickr can be used to collect and share photos, with projects such as those of Cai and Marks (2021), Foster et al. (2022), and Greene et al. (2018) connecting photovoice to digital online storytelling.

However, a set of challenges arise when photovoice studies depend on reusing smartphone apps and social media platforms that are proprietarily owned and developed for purposes other than research. First, photovoices must be attentive to issues of privacy and the "blurry lines between research, informed consent, ethics, data protection, data ownership" (Aboulkacem, Aboulkacem, and Haas 2021, 877). With exceptions such as that of Petteway (2019), many projects commit themselves to the conditions of commercial sites and platforms and ask participants to send photos to them via email, WhatsApp, Instagram, and the like (see, e.g., Plowman and Stevenson 2012). This means that the researcher cannot guarantee privacy protection or data deletion if requested by the participants because data lives in environments outside the researcher's control. Informed by data feminism (D'Ignazio and Klein 2020) and an "ethics of care" (de la Bellacasa 2017), we argue that it is necessary to ensure participants' privacies and rights to delete data. A second challenge is that most projects collect no structured annotations and little to no metadata (Budig et al. 2018; Duran 2019; Holtby et al. 2015; Macdonald et al. 2022; Magee 2007; Meenar and Mandarano 2021; Plane and Klodawsky 2013). Whether using smartphones or other cameras, most projects ask participants to annotate images after photovoice, involving problems with recall and poor contextualization of data.

Although increasingly looking to digital technology as a source of innovation, photovoice scholars have been slow to rework the method beyond making photo capture easier or enabling wider photo sharing on social platforms. García et al. (2016) similarly argued that in contrast to quantitative research, the use of smartphones for qualitative research is "yet to be fully explored" (6). To the best of our knowledge, only a few projects have designed digital photovoice tools, such as that of García et al. (2016), who tailored an existing mobile app, and Cila et al. (2016), who prototyped a web app for data collection. Although neither offer well-documented open-sourced apps, they show that the design of smartphone apps holds potential for "retooling" photovoice in ways that geo-track locations of photos or builds tagging functions into the data collection. In the UB project, we took inspiration in this and designed a photovoice application, the UB App, which is available for Android and iPhone and open-source on GitHub (Kettles 2022).

RETOOLING PHOTOVOICE: THE UB APP

The development of the app is documented by Madsen et al. (forthcoming) and can be found on GitHub[6], who described how local communities, planners, and other stakeholders helped shape the app in a collaborative design process. Some functionalities are worth mentioning here because they have shaped our results. The UB app has the following capabilities:

[6] https://github.com/Urban-Belonging/UrbanBelonging

- data collection with no limit to number of participants or photos;
- standardizes photo collection across phones in a square format;
- collects timestamp and geolocation for photos and routes with consent;
- asks participants to annotate their own photos;
- invites participants to react to others' photos while keeping anonymity;
- gives participants option to see and delete their own data in the app.

The app not only protects privacy but also produces photos that are enriched with three layers of information: geolocation and timestamp metadata, annotations by the author of the image, and reactions by other participants. This encourages an analytical process in which geolocation, annotations, and reactions can be used as inputs to exercises in workshops, to filter and analyze image data, and to group participants in different constellations. This, as we shall demonstrate, opens various opportunities for studying cities with photovoice and subverts tendencies in conventional engagement, as discussed in the Introduction section.

Materials and Methods

The UB project was initiated in 2021 by a collective of researchers and planners with the goal of contributing new insights about underrepresented communities in Copenhagen. To engage a diversity of perspectives, the project invited participants who self-identified as ethnic minorities, deaf, homeless, physically disabled, mentally vulnerable, international expats in Denmark, and/or LGBT+. Building on the principles of design justice (Costanza-Chock 2020), we designed a process that involved communities from beginning to end, as illustrated in Figure 1. First, we partnered with local organizations that represent each group's interests, and let their insights about each group inform the design of our process through onboarding interviews. Representatives highlighted that their members were often invited to document how the city excludes them, without the possibility of sharing positive attachments. This influenced the design of an open-ended photovoice prompt that asked participants to capture negative and positive experiences. Collaborating with organizations, we engaged two to six participants from each community. The requirement for signing up was only that participants self-identify with one or more of the invited communities and live in Copenhagen. However, to cultivate sensitivity to intergroup differences, we encouraged community organizations to sample with variation among their members. In total, 32 participants signed up (presented in Figure 2).

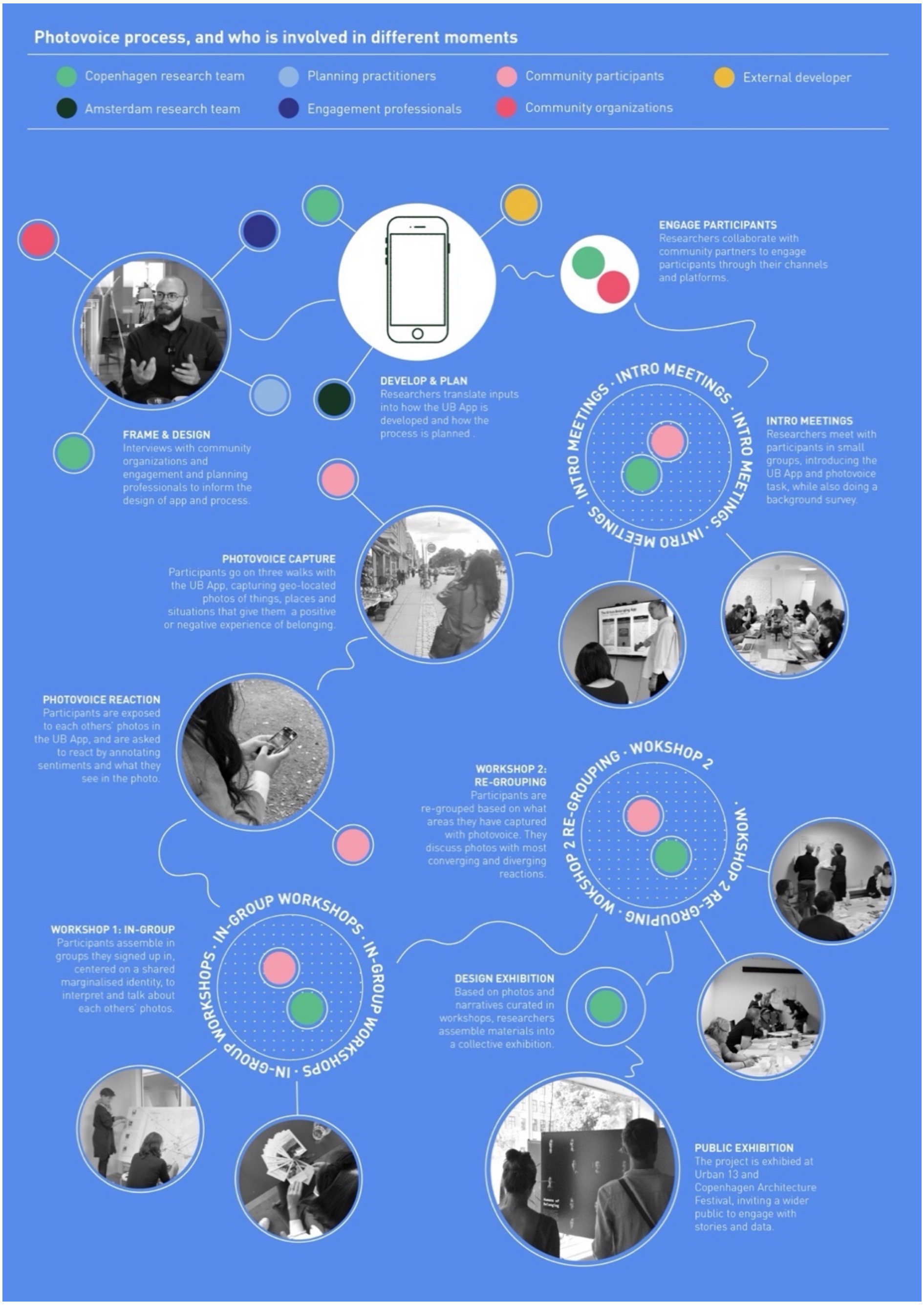


Figure 1: Process and how different actors were involved at different moments.

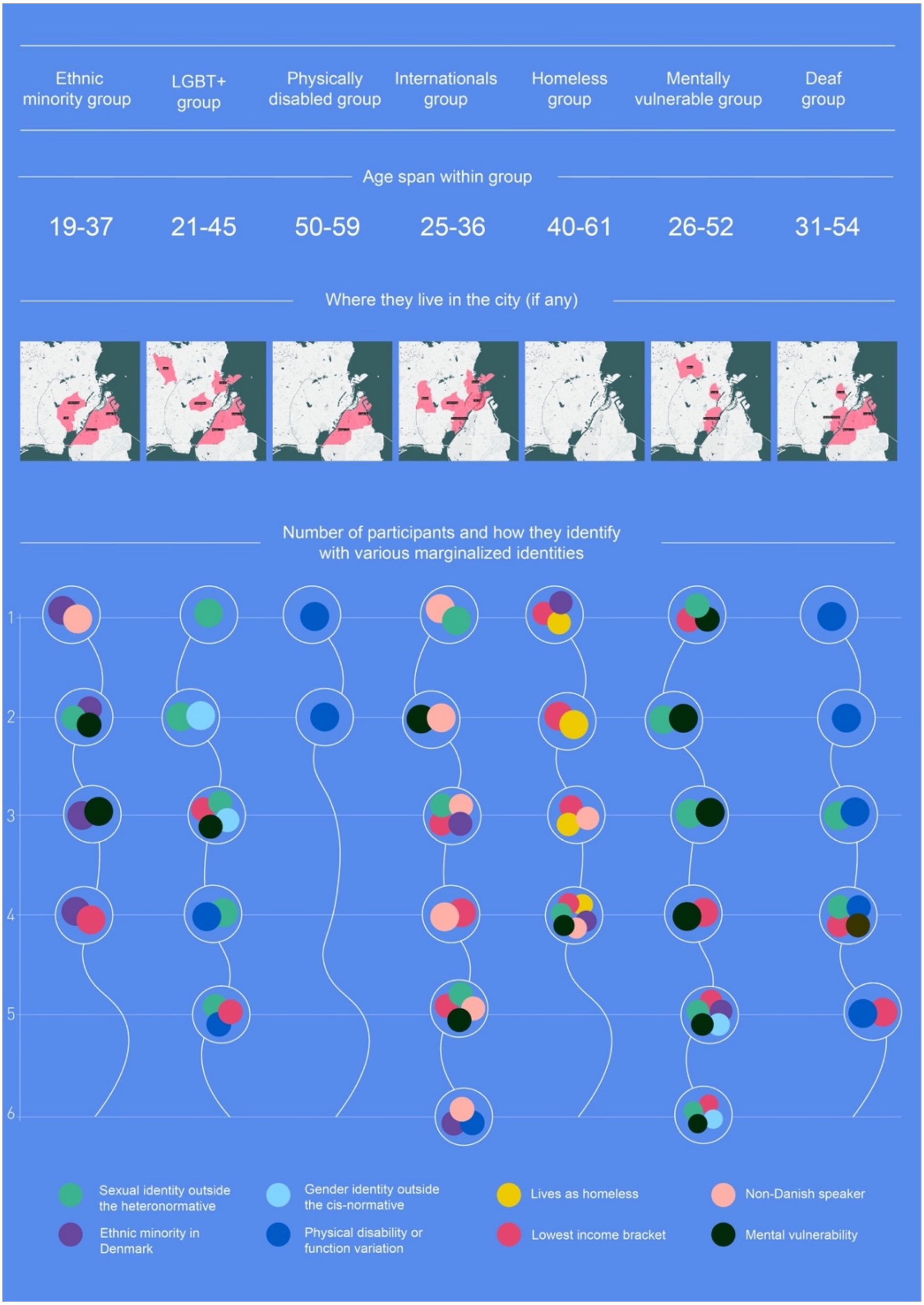


Figure 2: Overview of the participants in each group.

After onboarding the participants, we held introductory meetings with each community group. To mitigate digital divides, we handed out smartphones to participants who did not own one and introduced the app to the participants in small groups so we could help each person install and log into the app and conduct tests with it in the room. In this setting, the participants also filled out a questionnaire about how they self-identify. Following this, the participants had 10 days to go on three walks whenever they wanted and take at least 10 photos of “things, places or situations that negatively or positively affect your sense of belonging.” We did not define where people should go, but we invited them to go on walks in different areas and asked them to avoid places that are risky, dangerous, or triggering for them (Pichon, Teti, and Brown 2022). On these walks, photos and routes were geo-tracked in the app, and the participants were asked to tag photos in the app with a 5-scale sentiment from negative to positive and with one or multiple annotation categories such as “architecture,” “object,” and “nature” to indicate the content of the photos. After photovoice, a reaction task opened in the app, showing people other participants' photos and asking them to react to them with a sentiment from negative to positive.

Over 3 months, the participants went on 100+ walks in the city and took 1459 photos. To protect the privacy of the people captured in the photos, we used the machine learning model “deface” to blur faces in the images. All participants were given pseudonyms in this article and remained anonymous to each other in the app, giving them the choice to decide what they wished to share with others in workshops. This was informed by discussions on the “paradox of exposure” (D'Ignazio and Klein 2020), recognizing that visibility is not always desirable and should be in the participant's control. Following this, we facilitated two workshop rounds in which the participants were grouped according to the communities they signed up with and later regrouped with a post-demographic strategy (more on this in the Results section). The participants worked together in different constellations on interpreting, contextualizing, and narrativizing data. The result is a collection of photos, maps, and visualizations that tell individual and collective stories about Copenhagen. In 2022, these materials were displayed as exhibitions at Urban 13 and the Copenhagen Architecture Festival.

Results

The photovoice carried out in this process opens up different analytical approaches that we demonstrate here. The first approach explored community-specific experiences of belonging. A second strategy explored differences in viewpoints around particular places and situations that create mixed reactions.

COMMUNITY-SPECIFIC TOPOGRAPHIES OF BELONGING

To study how participants experience belonging, we first investigated the data with a geospatial analysis using QGIS to plot data. A simple map of photos (dots) and walks (lines) in Copenhagen can be seen in Figure 3. The distribution of the photos illustrates that the open photovoice task productively gives framing power to the participants. Whereas many participation projects ask citizens to report experiences within a predefined, narrow area, the open geo-tracked approach used in this study empowered the participants to show what areas were relevant from their perspective.

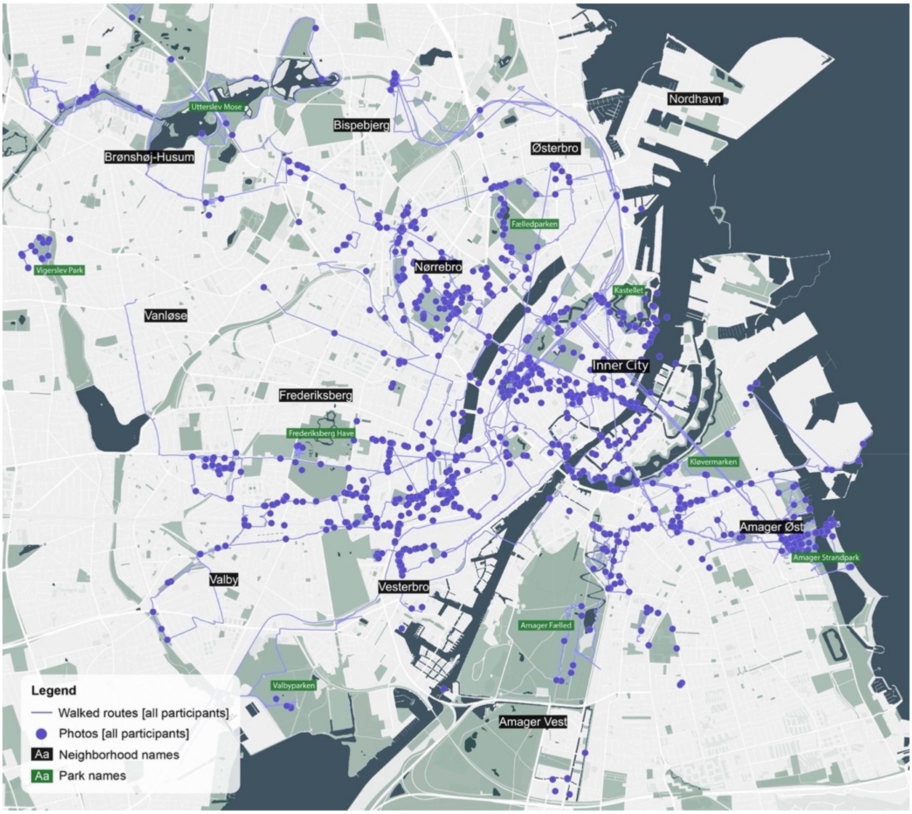


Figure 3: Map of images and walked routes submitted during photovoice.

The map in Figure 3 shows that the most photographed neighborhoods were Vesterbro, Nørrebro, Inner City, and the parts of Amager closest to the Inner City. By contrast, few photos were taken in Frederiksberg, where we mainly found photos around the park "Frederiksberg Have." Similarly, we found little to no photos captured in Østerbro, Nordhavn, Valby, Vanløse, or Amager, with exceptions of the photos from parks (some are labeled in the map). In fact, the map hints that the participants often photographed parks and waterfront areas. Even Utterslev Mose and Vigerslev Park, which are parks outside the city, have been documented in photovoice, indicating that green spaces are important to the participants' experiences of belonging.

To chart community-specific topographies of belonging, the maps in Figures 4 and 5 show where the participants in each group captured photos. Using QGIS, we ran a concave hull algorithm to draw a polygon around the locations of the photos captured by each group. In an ethos of counter-mapping (Dalton and Mason-Deese 2012), the polygons redrew boundaries in Copenhagen according to what areas are associated with experiences of belonging by each community while still showing the locations of the photos captured as white dots. Noticeable is that, first, homeless (Figure 4) and internationals (Figure 5) primarily photographed Inner City, while other groups (see, e.g., LGBT+ and those with physical disabilities) tended to avoid the city center and go to other areas instead.

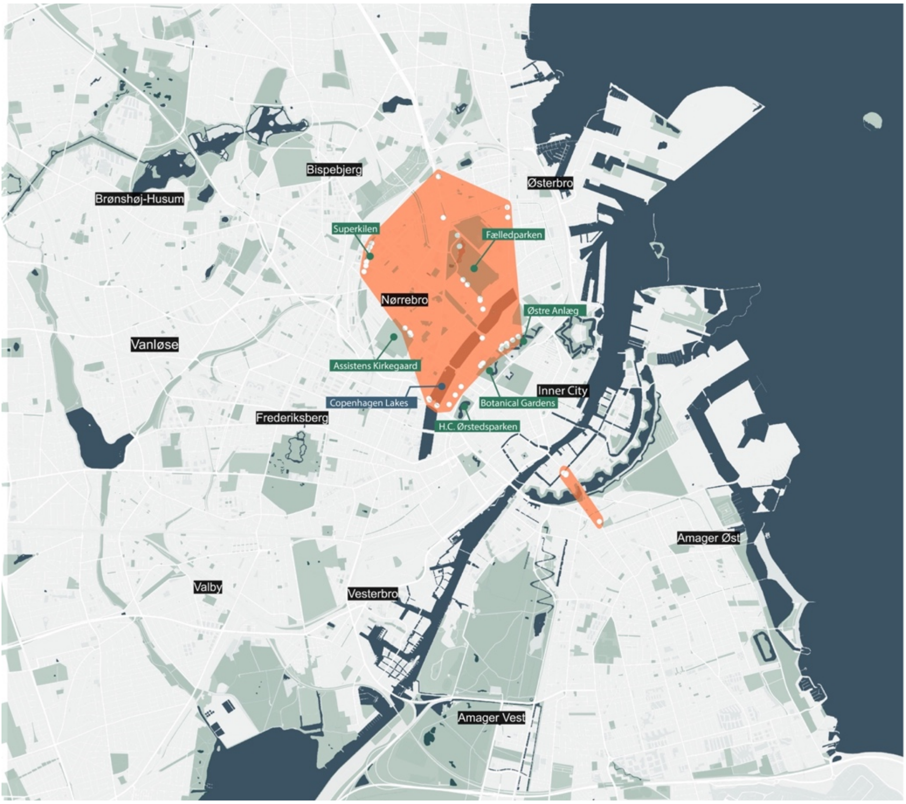


Figure 4: Concave hull (polygon) showing where the homeless participants took the photos (white dots).

Figure 5: Concave hull maps made with QGIS for six groups in the project. Polygons cover the area of the city in which the participants in each group have taken photos (white dots) during photovoices.

Inner City was also discussed with ambivalence by the internationals in the first workshop we held, where some of the participants said:

> "The tourists in Inner City make me feel that there are international people here. The lack of appropriation by locals makes room for others. It feels more open to expats."

> "Nørreport station [in Inner City] is an aggressive place, especially at night, with drunk people who yell, push, and bump into others. Yet, as an expat, your world revolves around the city center, and Nørreport is a focal point for us."

The map in Figure 4 further shows that the participants in the homeless group documented a smaller area than those in the other groups, with a concentration of photos around the Copenhagen Lakes and a few select parks, which are labeled on the map. A participant in the homeless group described this, saying: "People get annoyed, and police might come and ask me to move, if I sit on the streets. In the parks, I feel like I can be allowed to be, as long as I don't bother anyone." According to him, parks provide a home for the homeless, while the rest of the city feels inaccessible, as reflected by the smaller polygon in Figure 4.

To further unfold group-specific experiences, the first workshop round grouped the participants according to the community organization they had chosen to sign up with (though some identified with several).

Figure 6: Images from workshops where participants selected and shared images.

In the workshops, we brought analogue decks of photos captured by each participant. The participants were then asked to select two photos and work in pairs on cowriting photo captions and titles before placing them on a map with pins and strings (see photos in Figure 6). While 854 of the 1459 photos were annotated in the app with a positive sentiment, compared with just 210 with a negative sentiment, the participants overwhelmingly chose to share the photos of when the city excluded them based on their identity.

(A) How the he do I cross?**

"As an immigrant, biking culture is not something I have grown up with, and it can feel alienating. I find this intersection in Vesterbro especially confusing. It is a place I cycle through often, but recently they put the bike lane in the other side of the street and I don't understand how I can cross safely."

(B) A day with the metro.

"I have a difficult relationship to public transport, due to mental vulnerability. I cannot navigate big crowds of people very easily. It can accelerate my stress and anxiety. I am managing now, but I don't feel the metro is designed for people who have "different" mental needs than the majority."

(C) Pussy Boy twice a day

"I pass through this tunnel to and from home, and see this "pussy boy"graffiti. People say, do you even need Pride? But when my sexuality can still be used as an insult, I feel unsafe. When I see this, I am reminded that I still don't truly belong as gay man. That some in this city do not accept me. "

Figure 7: Photos highlighted in workshop 1, with titles and captions by the participants.

In Figure 7, photo A, which was taken by a participant in the ethnic minority group, expresses that the biking culture and infrastructure in Copenhagen can be difficult to decode as an immigrant, which can feel alienating and unsafe. Photo B, which is from a participant in the LGBT+ community, addresses a similar, yet different, negative experience stemming from decoding cultural signs and symbols in a public space that are read as non-inclusive and alienating, while photo C expresses that as a mentally vulnerable person, navigating big crowds in public transport makes them feel that the city is not for them.

For other groups, barriers to belonging revolve more explicitly around accessibility. For instance, a person in the deaf group shared a story (see photo E) about how lack of visual information makes it difficult to navigate public transport. A participant in the internationals group shared a similar, yet different, experience of language barriers about how signs in public spaces in all-Danish (see photo D) feel excluding non-Danish speakers. Thus, we start to unpack a more layered and nuanced understanding of how the urban environment affects people's experiences of belonging differently. Finally, photo F by a person with disability showcases that even when cities are designed according to the "universal design" (Lid 2014) principles such as the barrier-free design, such solutions do not necessarily make people feel like they belong.

(D) Stop and translate

"Something that makes me feel like I do not belong as a foreigner is that all signs are in Danish. So often, I have to use Google Translate to find out if there is vital information that I need to know. Having some signs being translated into English would help shake the feeling of otherness."

(E) Information society

"Information is often only available to the hearing, and access to visual information is always an issue in public transportation. This is a rare example of how digital displays at bus stops can make it easier to navigate public transportation as a deaf person. This makes the city more inclusive".

(F) More wheels than human

"As a wheelchair user, I have been thought of here. But I have been thought of as a vehicle and not a social being. As a technical problem to solve. I must move forward on the bike lane with other 'vehicles'. And I need to split up with my partner or friends. It feels unsafe and somewhat dehumanizing"

Figure 8: Photos highlighted in workshop 1, with titles and captions by the participants.

The photo captures the entry to a park from the viewpoint of the street, with stairs to the left leading up to the park, while to the right, a bike lane with a wheelchair sign runs along the park. As expressed in the caption, this forces the participant to split up from companions, which made him feel "more wheels than human." While well-intended, principles of inclusive design are not enough and can sometimes even alienate. This demonstrates why it matters that planners and policymakers involve local, embodied knowledge in collaborative processes when aiming to design socially sustainable cities. In this effort, photovoice offers an engagement form that, different from the conventional formats, can immerse us in situ in an environment, situation, and emotion and show us the city through the eyes of different people.

VISUAL APPROACH: UNPACKING ENVIRONMENTS OF BELONGING

Taking a visual approach, we can leverage the annotations ascribed to each image by the participants as an indication of what matters in the environment to their experiences of belonging. When taking pictures, the participants were asked to use one or more predefined annotations[7] to indicate why they took a photo and an "Other" option to write their own annotations. A distribution of how often annotations were used is shown in Figure 9, paired with sentiments attributed.

[7] The app provided 12 categories selected by reading literature on "belonging" (Bennett, 2014) and "place attachments" (Scannell & Gifford, 2010), from which we created annotations in three categories: *physical* aspects of the environment ("Architecture," "Objects," "Signs and Symbols," "Urban Nature," "Infrastructure," and "Wind and Weather"), *social* dynamics of a space ("Culture," "Consumption (food, drink, etc.)," "People and Community"), and *personal* history with a place ("Memories and associations").

Figure 9: Distribution of annotations (inner ring) used by the participants, paired with sentiment scores (outer).

The diagram shows that the most frequently used annotations were "urban environment" and "atmosphere." The "urban environment" photos have the highest proportion of negative sentiments, which are exemplified in the photos already discussed in the first section about barriers to belonging. Meanwhile, "urban nature" is the annotation most often associated positively with belonging. The role of urban nature is a highly researched topic in urban studies and planning. Angelo (2021) showed "how green became good," tracing that the desire to bring nature into cities has arisen as a response to social issues from the conviction that green spaces make good cities. In COVID-19 (coronavirus disease) studies, scholars have similarly shown that during the pandemic, people sought refuge in nature, which had a positive effect on their mental health (Lu et al. 2021; Soga et al. 2021). Therefore, urban nature is increasingly associated with the design of resilient cities. However, taking inspiration from the Urban Nature Initiative in Paris (Ricci et al. 2017), we might ask, "What constitutes 'good' urban nature? Ricci et al. (2017) write, "By using the term nature, often, a green world is imagined against a grey one, the wild depicted against the built and organized environment. Indeed, the term 'urban nature', for a long time, has been an oxymoron" (2). Unpacking this oxymoron, we investigated what urban nature means for the participants by zooming in on the photos shown in Figure 10, which were discussed in the workshops.

Figure 10: Photos annotated with "urban nature" shared in workshop 1, with titles and captions by the participants.

While different, these stories emphasize how nature acts as a kind of sanctuary, refuge, or safe space for participants and creates a "pocket" that protects from the noise of the city and the invasive eyes of other people. Photo G shows that nature is experienced as a more democratic place where you can feel free and where everyone is equal. From the stories, it becomes clear that urban nature plays a positive role in making participants feel belonging, and these experiences are echoed across all groups. However, the images, some from parks and others from the streetscape, also raise the question, "What counts as 'nature,' and where is it located?" To explore this, we used QGIS to filter the data and only show images annotated with "urban nature." This is seen in Figure 11, where dots display image locations on a base map with water and park areas registered by the municipality. The photos are then divided, with red dots showing "urban nature" photos *outside*, while purple dots show photos *within* or on the edge of official park and waterfront areas in the city.

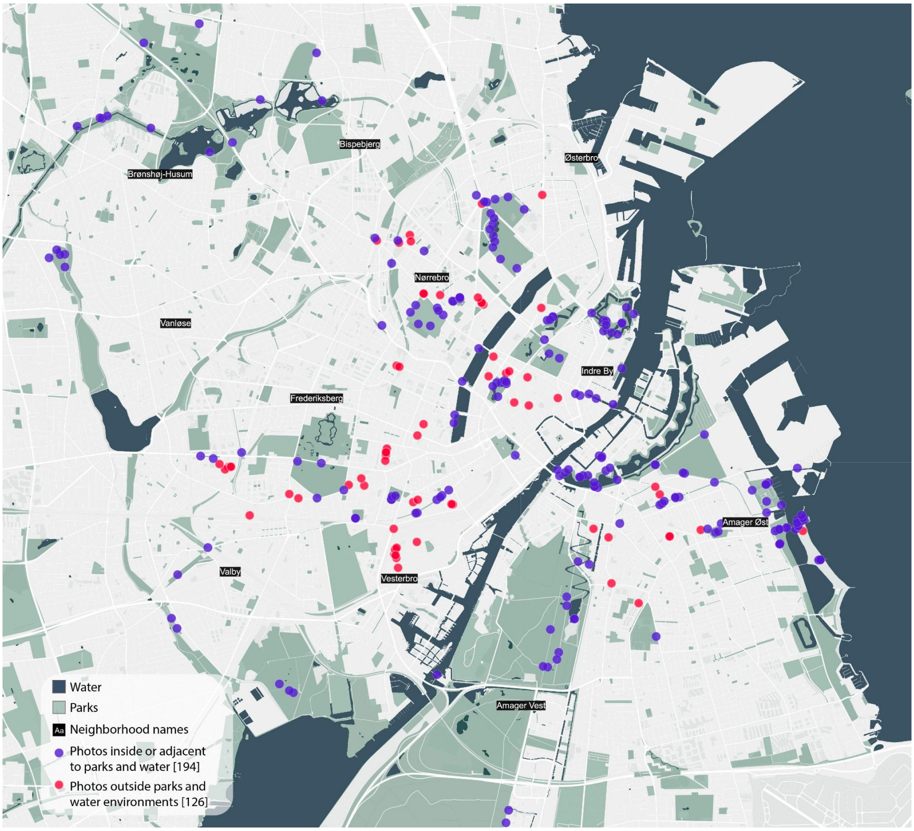


Figure 11: Map of "urban nature" photos located outside (red) or within (purple) official parks and waterfront areas.

While more than half of the nature photos (194) fell within "official" natural space, a high number (126) of nature photos were outside such spaces. The montages in Figure 12 compare the two categories of nature photos. Noticeable on the left side is that what counts as "nature," according to participants, is not only green but also blue environments, evidenced by the many images of water. We also see examples of dunes, marshlands, and wild meadows. The photos on the right unpack what "nature" is captured "outside" official parks, with flowers and plants growing on urban infrastructures such as signs, electricity poles, and facades. We also see in several photos that the presence of just *one* tree is positively associated with belonging by the participants.

Figure 12: Photos of "nature" inside (left) or outside (right) official park areas.

This can be related to projects such as "Treepedia" (Li et al. 2015) and the increasing attention in cities on the implementation of re-naturalization strategies (Ricci et al. 2017) using trees to produce comfortable microclimates and mitigate air pollution. This photovoice study suggests that street tree canopy is also positively associated with experiences of belonging, thereby inserting nature in a different frame of valuation. The photos of overgrown urban infrastructures also indicate that the participants responded positively to what Gandy (2016) calls "unintentional landscapes." Photo K in Figure 13 is an example of that and explicates that there is great value found in nature that is not "planned" but has been planted by the local community. Meanwhile, we see different attention to the community or culture of nature expressed by an ethnic minority participant who expressed surprise with how Danes use the cemetery captured in Photo L as a space for leisure. While nature is considered a common "good" by all participants, this shows that there can be cultural differences in how such environments are used and perceived.

(K) Nature by locals

"I like these planters, because they have been put here by locals. It is nice that it is civil society, not the government, who is behind this. It makes me feel that there is space for me in the city, because it signals that you don't have to be polished to fit in here. You can be different."

(L) Cemetery culture

"This is Assistent Kirkegaard. It is a cemtery park in Nørrebro. Now, I go hwere with my dog, but in the begininng it was a big cultural shock for me to see how Danes use this place to run, hang out, and go on dates. For me that is a radical use of a place mean for dead people."

(M) Artificial nature

(N) Pathway in the wood

"This is a really nice park in Frederiksberg with trees and greenery which creates a place of 'wilderness' in the city. I would love to come here. But unfortunately there are stairs with steps instead of a ramp here, meaning that I cannot really access it in a wheelchair."

Figure 13: Photos annotated with "urban nature" shared in workshop 1, with titles and captions by the participants.

We might equally ask, "When is nature considered negative?" Among the 320 photos annotated with "nature" in the project, only 9 photos have a negative sentiment. Photos M and N are examples of this, with photo N presenting a story about lack of accessibility in nature for wheelchair users. While photo M was not discussed and given a caption in workshops, the author of the image used the "Other" annotation to write the keywords "artificial nature," and gave this image a negative sentiment. It is thus an example of how the "Other" option can empower participants to unsettle predefined categories. By making up the new category "artificial nature," the participant adds the important nuance that nature is *not* just a neutral or unambiguous "good," but can also equally alienate. The "Other" annotation, in fact, has been used on 340 of the 1459 photos (see Figure 9), showing that the researcher-defined categories often did not cover all that the participants felt mattered in their photos. This clarifies that the opportunity given to the participants for taking photos wherever they wanted and writing their own annotations productively allowed them to work outside the categories and frames defined by the researchers or other "experts." If we had limited photovoice strictly to a particular park (e.g., Amager Fælled, which has been the center of debate in Copenhagen (Friis 2020)), a strong framing would restrict how the participants captured their relationship with nature in the city. By capturing photos freely, the participants could instead renegotiate what "nature" is and where it is found, as seen in photos K–N, and produce nuanced, multivocal representations of such environments.

SITE-SPECIFIC APPROACH: CONFLICTING VIEWPOINTS

In contrast to the open-ended approach taken so far, we propose that photovoice can also be used in more targeted ways to explore how people experience particular places differently. To showcase this, we regrouped the participants for workshop 2. Plotting all photos in QGIS, we used a K-means clustering algorithm to divide the photos into five spatial clusters (see Appendix). The participants were then grouped according to which of these areas they had mostly taken photos within. This shifted the organization of participation from community-specific in workshop 1 to post-demographic (Rogers 2013) in workshop 2, enabling us to zoom in on areas that everyone in a group had a relationship to. To open conversations about this, we used the twofold sentiment scores attributed to the photos and created the "double sentiment" map seen in Figure 9. The map plots images as dots with an inner and outer ring. The inner ring indicates the sentiment ascribed to a photo by its author as follows: green for positive, red for negative, and gray for ambiguous. The outer ring uses the same colors to show the distribution of sentiments attributed by the participants when reacting to the photos. As we can see, there are photos where the participants responded with the same sentiment, where the inner ring matched the color of the outer ring. However, some photos were also associated with diverging sentiments and had a green inner dot and a red outer ring or vice versa. The participants reacting to a photo might also disagree, as exemplified when the outer ring was both green and red. Using the statistical capabilities of QGIS, we identified 127 photos with the highest variance on sentiment and reactions by a minimum of two people. These are displayed as bigger dots in Figure 9.

To elicit conversation about how people experience situations and places differently, we brought the most contested photos to workshop 2. Here, we asked the participants to work in pairs (see Figure 10) on selecting a photo, discuss how they see it, and write notes. Examples are seen in Figures 11 and 12.

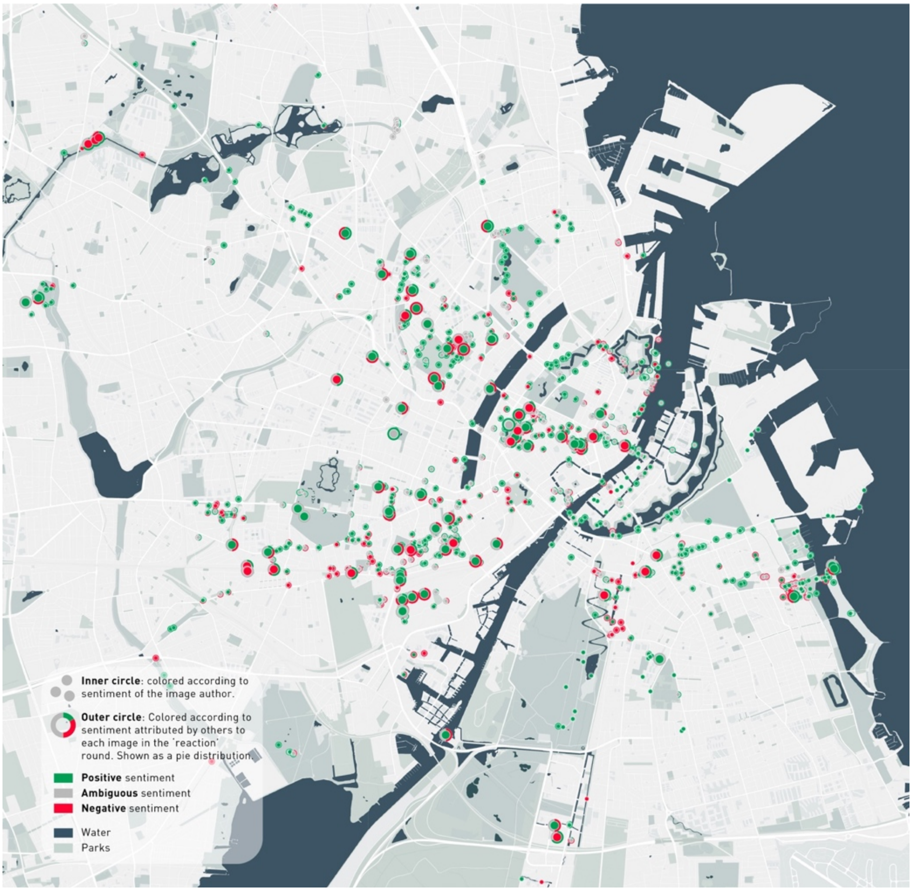


Figure 9: Double-sentiment map showing the sentiment ascribed to each photo (inner dot) compared with the distribution of sentiments by participants reacting to it (outer ring).

Figure 10: Images from the workshop where participants discuss contested photos.

(O) Bike culture Vs. Mayhem

Bo: This feels very unstructred and messy, and like there's no consideration of other people's needs, when people are just dumping bikes everywhere like this. I get stressed and anxious navigating streets and public spaces with this sort of bike mayhem.

Nathalie: I understand. I somewhat agree. Bike parking is an issue. But I associate this to a positive sentiment of belonging because biking culture is so central to Copenhagen - both the city's landscape and the culture and way of life here. It's a part of the identity of the city!

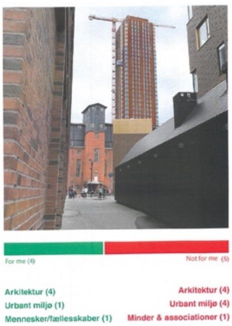
(P) Cozy or dangerous?

Jeppe: This is a street with a lot of colors on the sidewalks, which gives an artsy, creative vibe, and gives the concrete city some much needed color. As a queer person, I also associate the colors to the rainbow, which gives LGBT-inclusive associations. And the bikes make the scene feel very 'Copenhagen'. It is refrehsing, and the street feels cozy and inviting.

Hans: You're right. But the street is too narrow. And see how the bikes are taking up all the space on the sidewalk? They make it impossible for me or others in wheelchairs to move forward here. It is something able-bodied people don't think about when parking their bikes, but it feels exclusive to me.

Figure 11: Contested photos discussed in workshop 2, with captions by the participants.

Photos O and P tell conflicting stories about biking culture in the city. While Nathalie sees the bikes in photo O as a characteristic part of the streetscape and a positive part of the identity and way of life in Copenhagen, Bo experienced the parked bikes as a "mayhem" that is stressful to navigate as a mentally vulnerable person. Similar to Nathalie, Johan sees the bikes in photo P as adding positively to the identity and atmosphere of the street. However, from Hans's perspective, being in a wheelchair, the bikes in photo P block his movement on the sidewalk and exclude him from the space. This exemplifies how photovoice can unfold conflicting views and needs around, for instance, bike parking.



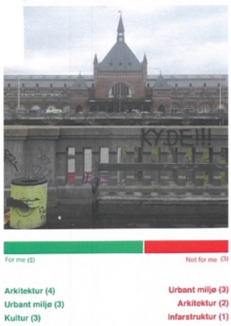
(Q) New Vs. Old

Henrik: This is Carlsbergbyen, an old industrial area, undergoing development. I like it because it is a rare example where the city protects the cultural history, while updating it with modern buildings and streets that are accessible for me as a wheelchair user.

Torsten: I disagree. I don't like this new development. It has no soul. It lacks the charm of old Copenhagen with cobblestoned streets and so on. I like that more than this pavement and building.

Henrik: But I dont feel at home in places with cobblestones as a disabled person.

Torsten: I understand. But it is also just an annoyonce with the constant construction work in the city. It is stressful. And as a deaf person, its visually noisy!



(R) Landmark, or dirty place?

Joel: I like this because it shows a historical building, a landmark in Copenhagen which is the central station. It is a bit ambiguous though: The urban furniture invites me to sit down, but the graffiti and lack of people here also makes it feel a little un-inviting.

Iva: I dont understand what the graffiti says, but is feel agressive. Also, this area around the central station is noisy and dirty. And it can feel unsafe at night. So while it is a landmark in the city, that feels very "Copenhagen" and positive, the state of the environment feels unpleasant. Like you dont want to spend time here.

Figure 12: Contested photos discussed in workshop 2, with caption by the participants.

In Figure 12, we see other examples of conflicting viewpoints. In photo Q, Torben feels negatively about the new urban development in Carlsbergbyen, which he feels lacks the charm of "old" cobblestoned Copenhagen. Meanwhile, Lars, who is a wheelchair user, feels positive about this area, where the smooth pavement makes the space accessible for him. By contrast, he feels excluded by the cobblestone streets mentioned by Torben. While both Torben and Lars identify themselves as LGBT+, it is here that other parts of their identities, one being deaf and the other having a physical disability, that shape why they react to this photo differently. This shows why it matters to take an intersectional lens and not assume that people who share one identity have the same needs. Meanwhile, photo R discusses with ambivalence how the Central Station is at the same time seen as a positive landmark and a dirty, unsafe transit area. Here, the participants agree but feel positive and negative about this space. To design inclusive cities, it matters that planners develop data-driven practices that can capture such complexity and ambiguousness beyond oversimplistic ideas of "good" and "bad" spaces. Photovoice, as demonstrated here, can help produce multilayered representations of particular sites that contrast different viewpoints.

Differences in experiences can also be studied by zooming in on locations where participants photograph the same place and examine how they frame it. Figure 13 shows the area in and around "Ørstedsparken" in Inner City, which as we see by the colored dots has been photographed by many different participants.

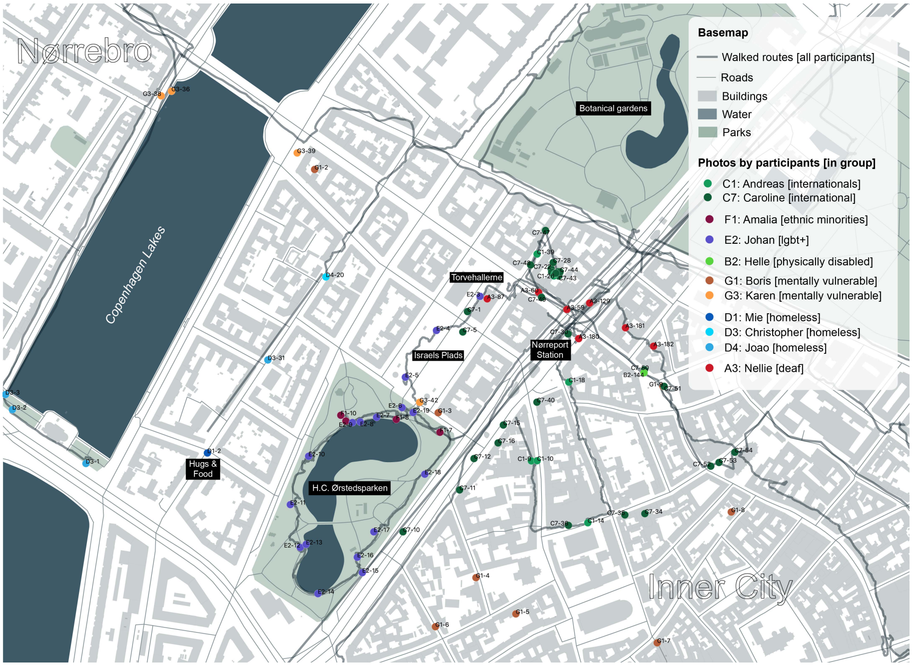


Figure 13: Map of photovoice data in and around Ørstedsparken (Inner City).

Ørstedsparken is a public park in central Copenhagen, which for decades has been a popular cruising site for gay men. In the 2010s, the municipality, however, cut down vegetation to regulate and/or prevent cruising (Bengtsen 2013). The park is located next to the square of Israel's Plads, a food market called Torvehallerne, and Nørreport train and metro station. What is noticeable is that neither the internationals nor homeless participants captured photos of the park, although they are frequent users of Inner City, as we learned earlier that the homeless participants depend a lot on parks. The fact that the homeless participants were not using this park, could indicate that the city's interventions to "clean" the park of cruising gays by cutting away vegetation also had a negative effect on homeless people's chances of finding protective pockets in nature. Noticeable is also that most participants arrive from around Nørreport. In fact, no one enters the park from the south, west, or east. Such insights can inform planning interventions to open the park more to other sides. Walking to the park from the north, participants instead created a connection between the park and the square, food market, and station, as exemplified by the photos in Figure 14.

Figure 14: Photos of Israel's Plads and Torvehallerne.

Only a participant from the ethnic minority group, Amalia, who identified herself as bisexual, and a participant from the LGBT+ group, Johan, went into the park. Figure 15 compares their photos to make legible how the two participants noticed different things. While Johan walked all the way around the park, Amalia stayed in the part adjacent to Israel's Plads. Whereas Johan mainly captured the park itself (statues, flowers, lake, and so on), Amalia's photos portrayed people lying on grass, dog walking, visiting a café, and so on. Thus, she seemed to connect mostly with the public life in the northern part of the park, while Johan walks away from Israel's Plads and Nørreport, where there are fewer people.

Figure 15: Map of the two participants' photovoice walks in Ørstedsparken.

Here, he takes a photo of a tree (photo T) with a plate in front stating that it has been donated by Copenhagen Pride, thereby connecting actively with the LGBT history of the place. While documenting the park as a space of belonging, Johan and Amalia thus have different uses and viewpoints of it. This exemplifies how we can use geolocated photovoice to trace differences in use and viewpoints. Seeing how participants move in and out of space can also help understand places as networked and connected to other places through the way participants walk between them (de Certeau 2011). Studying photovoice data as a series adds contextual understanding by making legible how people "string" together experiences, not from a snapshot moment but from a sequence of impressions.

Conclusion

The UB project has shown that by retooling photovoice with digital, mobile technology, it is possible to reconfigure public participation in urban planning.

First, a review demonstrated that while photovoice projects are efficient at reimagining who has a voice in planning and making visual alternative to written and oral participation possible, such projects often work with small-N samples and study communities in isolated ways and have been slow to leverage opportunities within 'the digital' to rework the method. The article then introduced the way the UB App enables a digital, geospatial methodology and delivered a three-fold analysis to exemplify what analytical opportunities this creates. In the results, a geospatial analysis mapped community-specific topographies of belonging and unpacked group-specific narratives about barriers to feeling included in the city. Second, the analysis zoomed in on photos annotated with 'urban nature' to examine where participants find valuable natural elements in the city, and what sort of nature they capture as meaningful in relation to their experiences of belonging. Third, the analysis demonstrated how digital photovoice can be used to regroup participants and study how differences in viewpoints between people, with bike parking and Ørstedsparken explored as two examples of how participants see the same situations differently.

Discussion

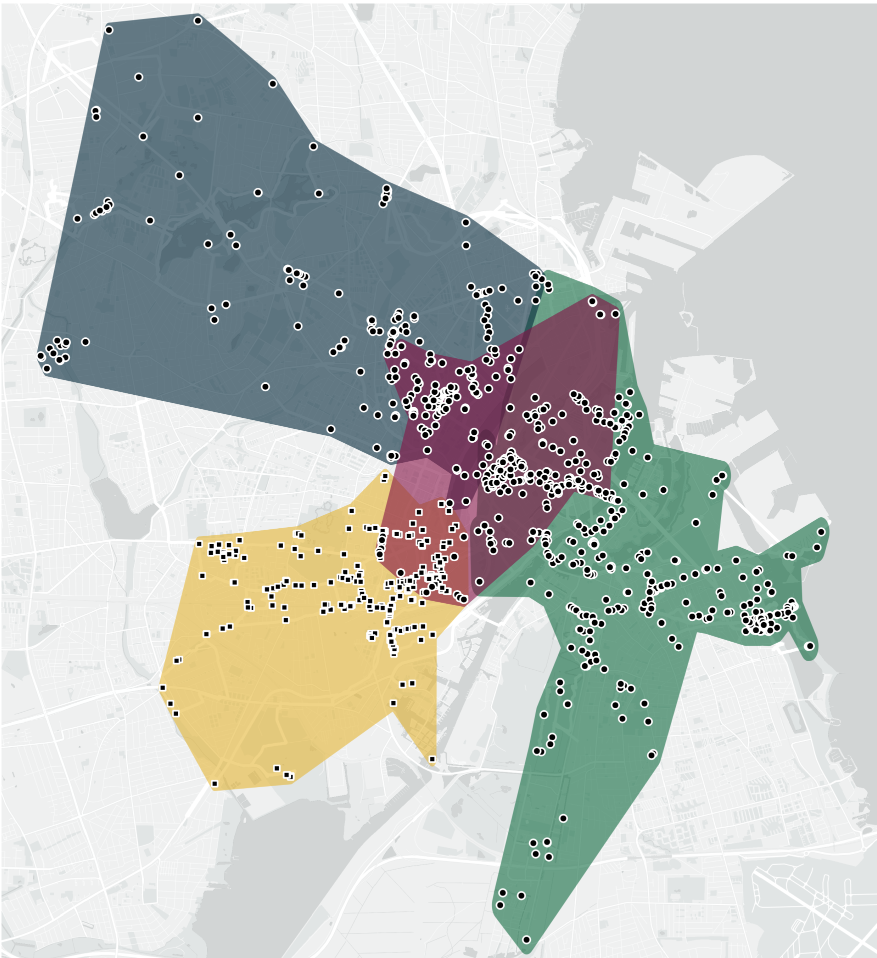
The empirical case demonstrates that a digital photovoice method can open several epistemological flexibilities with analytical potential. For one, the method made it possible to switch between community-specific and post-demographic sampling. This reconfigures conventional engagement by creating opportunities to organize participation in different ways. Second, our methodology allowed the participants to challenge expert-led problem frames exemplified by the spatially open-ended photovoice task. This relates to a third potential of the method, which is that it enables us to move between top-down and bottom-up inquiries. While the first section demonstrated explorative strategies that used data to discover, for instance, where people experience belonging, the analysis also demonstrated that photovoice can also be used in more targeted ways to understand how different people experience a particular site. Finally, the methodology enables qualitative-quantitative visual research, as the image data can be counted, filtered, and used to move between high-level patterns and hyper-local stories.

However, the project also raises dilemmas and questions that demand reflection. One relates to data ableism and visual literacy. As with any tool, the UB app has affordances that can both include and exclude certain groups. In our project, a deaf participant expressed that the visual method gave their community a new voice in planning: "With photovoice, the deaf community is given a chance to influence a city that is also good for us. The visual approach meant that we suddenly have a lot to ‘say’ as well.” However, the photovoice method can exclude the blind and those with visual impairments and poor visual literacy. Unless provided with assistance, participants with disabilities who cannot operate a smartphone, as discussed in the article about the UB app (Madsen et al. forthcoming), may feel alienated by the app-based approach. We might further question the imagined impact of photovoices. Scholars such as Sanon, Evans-Agnew, and Boutain (2014) have critically investigated the social justice outcomes of 30 photovoice projects from 2008 to 2013, showing that impacts tend to be more related to social justice awareness (n = 30) than amelioration (n = 11) or transformation (n = 3). In our project, we also aimed to create increased awareness through public photovoice exhibitions.

Figure 16: Photos from an exhibition at Copenhagen Architecture Festival, 2022.

Talks held at the exhibition at Copenhagen Architecture Festival brought researchers, policymakers, and participants together in panel debates about inclusive cities, demonstrating that photovoice exhibitions can replace a one-way relationship between the public and researchers with a dialogical one (Teti and Myroniuk 2022) and lead to the formation of new 'issue publics’ (Marres 2005). Aside from increased awareness, the project also had other forms of impact. In 2023, we presented the project to Copenhagen Municipality by invitation from the City Architects to expand the city's repertoire of participation methods. The process has also been used in Seattle, where a local NGO, DVSA, recently used the app and method with the youth in South Park and put data into action in workshops with the city to create new neighborhood policies. The digital photovoice documented here can thus both transform the way public participation is carried out in planning and lead to real amelioration in local settings. While the project has not so far resulted in concrete policies or interventions in Copenhagen, the participants in the project expressed that the process itself increased their feeling of belonging, as voiced by a participant: "Through participating in the project, I feel a much greater sense of belonging than before we started." Another participant similarly shared, "Analyzing the data together gave us ownership and increased my sense of agency and community." While engagement processes, as discussed in the Introduction section, can alienate, they can also in themselves produce feelings of belonging and contribute to a processual level in making cities more inclusive.

Appendix



Appendix A: Division of data into five spatial clusters with QGIS' K-means algorithm: one area for English-speaking participants (red) and four areas for the other participants.

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Chapter 07

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The Urban Belonging App

A photovoice toolkit for studying place attachments with digital and participatory methods

The Urban Belonging App

Abstract

This paper introduces the open-source Urban Belonging (UB) toolkit, designed to study place attachments through a combined digital, visual and participatory methodology that foregrounds lived experience. The core of the toolkit is the photovoice UB App, which prompts participants to document urban experiences as digital data by taking pictures of the city, annotating them, and reacting to others' photos. The toolkit also includes an API interface and a set of scripts for converting data into visualizations and elicitation devices. The paper first describes how the app's design specifications were co-created in a process that brought in voices from different research fields, planners from Gehl, six marginalized communities, and citizen engagement professionals. Their inputs shaped decisions about what data collection the app makes possible, and how it mitigates issues of privacy and visual and spatial literacy to make the app as inclusive as possible. We document how design criteria were translated into app features, and we demonstrate how this opens new empirical opportunities for community engagement through examples of its use in the Urban Belonging project in Copenhagen. While the focus on photo capture animates participants to document experiences in a personal and situated way, metadata such as location and sentiment invites for *quali-quantitative analysis* of both macro trends and local contexts of people's experiences. Further, the granularity of data makes both a *demographic and post-demographic* analysis possible, providing empirical ground for exploring what people have in common in what they photograph and where they walk. And, by inviting participants to react to others' photos, the app offers a heterogenous empirical ground, showing us how people see the city *differently*. We end the paper by outlining why we consider the UB toolkit a contribution to photovoice methods, discussing remaining challenges in the tool and provide a short guide for using it.

Keywords: photovoice; digital humanities; participatory design; visual methodologies; urban planning

Introduction: Why engage in digital toolmaking?

When researchers set out to study something empirical, they almost always do so with the help of methods and tools that shape their analytical gaze. Thoughts, associations, and arguments do not run freely - they are guided by the infrastructures through which we inscribe and visualize the aspects of the world that we intend to make claims about. When Latour (1986) once stated that we are 'thinking with eyes and hands' he was exactly calling attention to the fact that the devices we use to inscribe and represent the world simultaneously frame the problems we try to solve. This is not least true when it comes to the creation of knowledge within the field of urban planning. In this context we have historically seen devices such as census tracts (Scott, 2020) and mortgage maps (Kurgan et al., 2019) functioning as vehicles for imagining urban futures and choosing among potential political scenarios. However, the results have often been to the disadvantage of those at the bottom of society. This is why it matters who gets to design the empirical tools through which we make the city legible. No tool or method is neutral. They mediate the interests of their designers and the context in which they were built. They act as "epistemology engines' (Ihde, 2000) that enable particular ways of knowing that may benefit some and disadvantage others.

With that in mind, this article presents a digital toolkit for doing photovoice developed during the Urban Belonging (UB) project which was carried out in Copenhagen in 2022.[8] Initiated by a collective of researchers from different universities and practitioners from Gehl, the project set out to create more diverse insights about how the city works as a space of belonging for marginalized communities. Two of the central tasks for the project team was to a) design an app that could inscribe feelings of urban attachment among the diverse participants through the collection of visual data and b) invent data representations that could simulate relevant conversations among the participants. Whereas the Urban Belonging toolkit was designed in the context of a project, we believe its methodological affordances are of relevance to many empirical disciplines. For instance, it allows the researcher to move between the qualitative and the quantitative in novel ways. The UB App and the scripts in the associated toolkit are thus designed to be used in a myriad of ways, independent of how it was used in the Urban Belonging project. As such, this article focuses on documenting the toolkit as a piece of methodological innovation that hopefully inspires others. It does not aim to report in detail on analytical findings of the Urban Belonging project, which are the topic of other articles.

[8] See more on https://urbanbelonging.com.

This paper documents at the technical level the key capabilities and affordances of the app, and contributes at the methodological level with discussion of the process of how the app was developed and designed in collaboration between various actors. First, we will introduce concepts from STS and participatory design as the theoretical lens through which we unpack the distinctive features of the UB toolkit. Second, we shall dive into the Urban Belonging project mainly to situate the app in the context in which it was developed and use the project as a case to describe the features of the app and exemplify some of what it can be used for. Third, we will argue why we consider the toolkit to be a contribution to photovoice methods and discuss its relevance outside the field of urban studies. Fourth, we touch upon challenges in the tool and provide an overview of the components of the open source tool repository that is published as a practical companion to this paper. The 'UB App' is currently available for Androids and iPhones, in Danish, English, Dutch and Italian and it is published with the 'UB toolkit'; an API-interface and set of scripts for converting raw data into visual outputs and structured, malleable datafiles that open different analytical opportunities.

Participatory Tool Design

The design of tools and methods never happens in a vacuum. The motivation to engage in tool making is often spurred by the realization that existing empirical infrastructure seems unfit to answer specific questions. In such a 'problematic situation' (Dewey, 1910) it is not unusual that people agree on the deficits of existing tools and methods while having different perspectives on how to move forward. A we will explain in more detail below this was the case in the UB project where researchers, architects, professional urban planners, and representatives from marginalized communities agreed on the diagnosis that urban planning currently has an engagement deficit and that there is a need for new (digital) methods for doing public participation. Nonetheless these different groups formulated quite different design specifications when we had to materialize an alternative engagement method. This is not surprising because tools and methods are often materialized and stabilized through negotiations between actors with different interests and sometimes even different disciplinary backgrounds. As most other technologies their design bears the traces of the social groups that were invited into their construction (Pinch & Bijker, 1984). More often than not they are also built on an already installed technical base that sets specific constraints on the design (Star & Ruhleder, 1994).

This paper will frame the design as the UB toolkit as the result of such socio-technical processes where distinct interests and historical trajectories came to matter. Taking inspiration from literature such as 'participatory design' (Brandt et al., 2012; Simonsen & Robertson, 2013) and 'participatory data design' (Jensen et al., 2021) we will describe which actors we invited into formulate design specifications and discuss how this ultimately shaped the technical features of the tool and thus the empirical practices it affords. Drawing on work in 'Design Justice' (Costanza-Chock, 2020), 'Data Action' (Williams, 2020), and 'Data Feminism (D'Ignazio, Klein, 2020), we will pay specific attention to the involvement of communities that are rarely given a say in the design of digital democratic tools. Because we live in a world where decisions about urban futures are increasingly anchored the datafication of publics it is - in the words of D'Ignazio & Kein (2020) - important that we critically interrogate the power dynamics and mechanisms of exclusion built into tools that have implications for who is made (in)visible in cities. As combined frameworks, Design Justice and Data Feminism make clear that we need to involve heterogeneous perspectives in designing tools that are used to datafy urban life and urban problems. Building on such thinking, we designed the process of developing the UB app as a collaborative effort, which centers inputs from local communities, urban planners, as well as policy and citizen engagement experts from the city. In the coming part, we introduce the Urban Belonging Project and pay specific attention to the involvement of various actors in the design process and unpack how they shaped the UB App and toolkit.

Figure 1: Participant in the project taking a picture with the UB App

The Urban Belonging Project

The UB project grew out of a collaboration between researchers at Aalborg University and urban planning practitioners at Gehl Architects. Having previously worked together on developing methods for mapping urban political diversity through large volumes of data on Facebook (Madsen, 2022), the team noticed the need to learn more about people's perception of urban belonging and gain specific insights into the perspectives of social groups that may not be visible in data found on social media. This was coupled with a desire for a more curated form of digital data generation than what is possible when data is harvested from external sources. As mentioned in the literature on digital methods, there is a risk that the use of exhaust data from commercial platforms guide the analytical gaze of researchers in very distinct ways (Ben-David, 2020; Marres, 2012). In response to this tendency, we wanted to build a digital tool that re-locates the agency of orchestrating data collection in the hands of researchers and the people under study. We wanted to build a tool that could translate the perspectives of marginalized groups into the machinery of urban planning.

We decided to do this within the tradition of photovoice this methodological tradition have a history of empowering unheard voices (see e.g. Wang & Burris, 1997). Starting from the ambition to build a photovoice app we scanned for existing open-source tools that we could develop further and found "Snappthis!" (ten Brink et al., 2016) [9], which already contained the ability to take photographs and see and react to images by others with a simple like or dislike. Snappthis! Came to act as our 'installed base' as the UB App directly builds on and redesigns code from Snappthis!, and similarly offers itself up as open-source on GitHub. At the end of the paper we will explain in detail how the UB toolkit contributes to the development of photovoice methods. However, before getting there we will unfold how we invited distinct social groups to formulate the design specifications that ultimately influenced our translation of Snappthis! into what is now published as the open source UB toolkit. Besides the already mentioned Copenhagen-based researchers and planning practitioners these groups include the Visual Methods Collective in Amsterdam, public engagement professionals and participants from relevant community organizations that represent the marginalized voice that we wanted to learn from. How each set of actors shaped the UB App is summarized in Figure 2 and explained in detail below.

[9] The original SnappThis app was created by Marije ten Brink and developed by Iain Kettles, who also developed the UB App. More information about Snappthis can be found here: http://snappthis.com/.

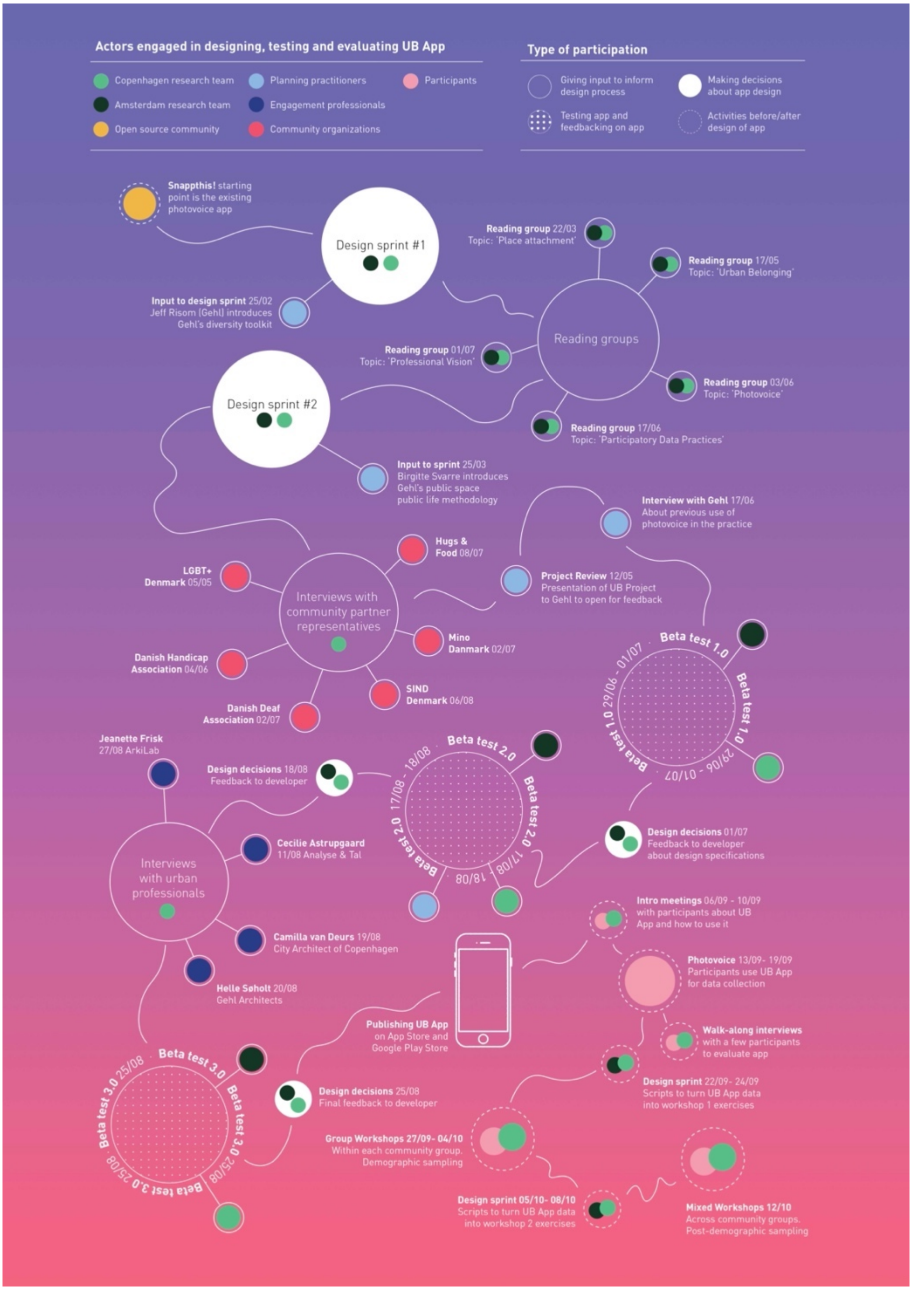

Figure 2: Overview of participatory moments in the UB App design process, indicating who was involved in different stages, as well as what sort of participation the different actors engaged in.

DESIGN SPECIFICATIONS FORM RESEARCHERS

The Copenhagen-based researchers and members of the Visual Methods Collective in Amsterdam - the authors of this paper - assumed a coordinating role in the development of the toolkit. Throughout the process we were doing interviews, collecting feedback, reading relevant literature, and translating inputs from the different groups into design decisions. With another concept drawn from STS, one could thus say that we were the 'obligatory passage point' (Callon, 1984) that every idea or interest had to go through to influence the design of the app and the accompanying scripts. As is evident from figure 2, the initial parts of the process were heavy on our involvement (the green and black dots). To begin with, we met virtually for an initial design sprint with the aim to clarify our respective interests in the affordances of the toolkit. Before the sprint we got an introduction to the existing state of Gehl's tools for studying public space and public life. In the sprint we used this knowledge as a backdrop to identify distinct analytical sensibilities from our own work with digital- and visual methods that would supplement the tools that planning practitioners had already at hand.

From the tradition of digital methods, we took inspiration from the idea that there is no need to reproduce methodological separations between qualitative and quantitative data when working with digital tools. On the contrary, we discussed how separation has prevented urban sociologists from capturing the full complexity of urban issues and we wanted a tool that retained complexity by allowing 'quali-quantitative' movements between overviews and contexts in data (Venturini & Latour, 2010). Another inspiration we took from digital methods is the possibility to use the granularity of digital data to look at urban life through a *post-demographic* lens (Rogers, 2013). Whereas most urban analyses interpret social groups through demographic traits such as gender, age and income, we wanted to design a tool with methodological flexibility to group participants on such demographics as well as post-demographic traits such as shared urban experiences. Recently some of us have introduced the concept of 'soft city sensing' (Madsen et al., 2022) as a headline for empirical projects that aim to bring some of these methodological insights to the field of urban studies. The UB toolkit can thus be understood as contributing to this methodological agenda.

From the tradition of visual methods, we took inspiration from the insistence on putting the practice of photo taking at the center of empirical research. Photo-based methods are known to be productive ways of capturing place attachments from a citizen perspective (Stedman et al., 2014) and opening up phenomenological inquiry into lived experiences beyond what people are able to put in words (Plunkett, Leipert & Ray, 2013). More specifically, we decided to design a toolkit that would afford using the captured photos and their associated metadata as elicitation devices to stimulate qualitative conversations. A choice that was also inspired by Pink et al. (Pink et al., 2016) who show how digital ethnography and 'learning through the hand' is a useful way of empowering people to document their experiences. Our ambition was to make a sort of participation possible that mimics this. One of the design specifications emerging from the first design sprint was thus the need for procedures for feeding the captured photos back to the participants in order to enable them to interpret the data. The choice also fits with more general findings by scholars like Halegoua (2020) and Manovich (2020) who have both shown that digital and visual media are a ubiquitous part of contemporary urban experience and how we build emotional attachments with(in) urban environments.

Between the first and the second design sprint we held dedicated reading groups on ‘place attachment’ and ‘urban belonging’ in order to translate central concepts from these literatures into the design of the app. One design specification that was later developed with references back to these readings was the need to offer the participants a set of predefined tags that in combination captured the various ways ‘belonging’ and ‘attachment’ have been conceptualized in different strands of theory. From Scannell & Gifford (2010) we took inspiration from the idea that people can be attached to urban places for both physical and social reasons. Accordingly, we ended up offering the participants the possibility to tag their photos with social tags such as ‘culture’ and ‘people/community’ alongside physical tags such as ‘architecture’, ‘objects’ and ‘wind/weather’. Reading Bennett’s (2014) thoughts on the role of ‘memories’ in belonging similarly inspired us to dedicate a tag to this specific form of personal experience. However, the final choice on tags was not settled until after we had conducted interviews with the group of urban professionals and the community partners representing the marginalized communities we ultimately wanted to involve and give a voice. Nonetheless, the literature on digital methods, visual methods, place attachment and urban belonging arguably set the scene for the production of the toolkit from the beginning.

DESIGN SPECIFICATIONS FORM URBAN PROFESSIONALS

We sought out inputs from planning practitioners at Gehl Architects at several stages in the design process (the blue dots in figure 2). One motivation for this is that we see a tendency for digital research tools to be developed within a polarized industry/research dichotomy: While many tools within digital humanities - such as TCAT (Borra & Rieder, 2014) - are developed within academia, software like Google Vision AI, Clarifai are developed proprietarily among commercial industry actors. This means that few tools are developed through collaborative efforts in ways that may bridge research with practice. As a partner in the UB project, Gehl gave interviews about past experiences with photovoice, through which we learned that a challenge for using photovoice for them relates to how unstructured the data coming out of it can be. Gehl's planners and anthropologists also took part in beta-testing the app, emphasizing the need for the app to produce geolocated data for photovoice to inform the types of questions they work with. We had designed the app to geolocate photos, but it was development-intensive - and provided new privacy issues - to also track the routes that people walk when taking photos. Because of that, and in prioritizing between other features, we had first suggested not to include route tracking but ended up prioritizing it higher, because Gehl insisted that the tool would be more useful for practitioners if it also captures how participants move in between photo locations. Having different voices involved thus shifted the design priorities in a productive way, making the app useful to more types of urban research.

The design process also involved interviews with the City Architect of Copenhagen Camilla van Deurs, Gehl Architect's CEO Helle Søholt, Jeannette Frisk of ArkiLab, and Cecilie Astrupgaard of Analyse & Tal, who all work professionally with community engagement in Copenhagen. Together, they could tell us about how engagements are carried out in Copenhagen, and answer questions about blind spots in those processes. One of blind spots voiced was the tendency for urban professionals to understand urban problems through a limited set of frames. For instance, in Gehl architects there is a tradition of studying public life with observation methods (Gehl, 1987; Gehl & Svarre, 2013), imposing a particular 'professional vision' (Goodwin, 2015) on the city. An interview with CEO of Gehl Architects informed us how this gaze misses out on knowing lived experiences:

> "We are all limited by our own experience. I cannot see how the city looks from your perspective, and that is why we need new processes and tools that help us step into each others' lived experience." – Helle Søholt, Gehl Architects

The UB project sought to unsettle this by innovating methods that would better equip the practitioners to see the city through the eyes of citizens. This was the motivation for inviting people to document their urban experiences through photography. From the interview with Jeanette Frisk we got the additional insight that the documentation of these experiences should not just flow from the participants to the facilitators of the engagement process, but be shared among the participants:

> ”The important thing is to make people interact. It's not enough to hear the alcoholic say what he wants, and hear an LGBT+ person say what they need. We must expose people in engagement processes to how others see the city so we create understanding of how we have different needs” – Jeanette Frisk, Arkilab.

The resulting design specification was that the UB toolkit should expose participants to each other's photos. The interview motivated us to implement a reaction phase in the UB App where participants could also add metadata to each other's photos. This meant that the user of the app would not exist in his or her own silo but rather have a networked experience with the other participants already within the app. This was something we had already given priority in order to enable the kind of relational and post-demographic analyses suggested in the digital methods literature. The choice to inscribe the relation between participants through these reactions was also a way to materialize a distinction ‘I-narratives’ and ‘we-narratives’ that we encountered in the reading group on place attachment (Duff, 2010) in the beginning of the process. As we will see later, the reaction feature makes it possible for participants to group around shared ‘we’ experiences emerging from their engagement with others' content.

DESIGN SPECIFICATIONS FROM COMMUNITY ORGANIZATIONS AND PROJECT PARTICIPANTS

It has recently been suggested that formats like citizen assemblies and hearings are often inaccessible to people at the margins (Kahila-Tani et al., 2016). This issue was also brought up in the interview with Camilla van Deurs who questioned the diversity of the people attending urban engagement exercises. In the Urban Belonging project we tried to mitigate this problem by inviting seven minority groups in Copenhagen to be a part of the study. In choosing those groups we followed a ‘maximum variation’ (Flyvbjerg, 2006) sampling strategy where we searched broadly for groups who had expressed feelings of being marginalized as part of their life in Copenhagen. We ended up including LGBT+, deaf, ethnic minorities, mentally vulnerable, physically disabled, international expats, and or houseless (in our project this group self-describes as ‘homeless’, which we will refer to them as). To build on existing communities in the city, we decided to approach each group via a local organization that represents the group’s interests. This was important, since our process was designed around the idea of letting local organizations sample participants, building on their existing relationships of trust with the community members, and also having existing knowledge about each group frame the app design.

While this ensured that community partners could inform the app design to make it more inclusive it also had the obvious downside that we did not work with marginalized groups who lack organized political representation. Aside from the seven groups who were enrolled in the project, it should also be noted that we additionally asked local organizations representing elderly, refugees, trans people, specific political youth organizations and the Jewish minority to be community partners in the project. While some did not respond at all, others responded that they did not have the resources at the moment to take part in the project. Sampling was thus also guided by an ethos of pragmatism, and the groups that we ended up working with are groups for which a community organization agreed to sign on as a project partner.

We worked together with each organization on sampling two to six participants among their community, coordinating to use their social media channels and newsletters to send out participant invitations. The requirement for signing up as a participant was that people self-identify with one or more of the invited communities and live in Copenhagen, or spend at least three days in Copenhagen weekly. To our surprise, however, we had a lot of people signing up, who identified with one of the six marginalized groups, but who did not speak Danish. Since enough people signed up to form their own group, we decided to adjust the initial sampling and create a seventh group in the project with 'internationals', who have in common that they have moved to Copenhagen from another country and speak English, but not Danish.

	LGBT+	**Deaf**	**Physically disabled**	**Ment ally vulne rable**	**Homeless group**	**Ethnic minority**	**Internation al group**
Community partner	LGBT+ Denmark	Danish Deaf Association	Danish Handicap Association	SIND Denmark	Hugs & Food	Mino Denmark	No community partner
Number participants	6	5	2	5	4	4	6
Age span	21-45	31-54	50-59	26-52	40-61	19-37	25-36

Table 1: Overview of participants and community partners

These participants would be the only group in the project that we did not mix with other participants in the project, due to the language barriers that made it impossible to get a sign translator to translate between spoken English, spoken Danish and sign language. In total, we had 32 participants sign up for the project. They range in age from 19 to 59 years. Some have just moved to the city, others have lived there their whole lives. Geographically, they live in different parts of the city with zip-codes ranging from central Copenhagen and the big boroughs to neighborhoods further out from the center. To showcase this, an overview of groups is seen in Table 1.

In the onboarding of organizations as partners, we carried out interviews with one or two front-persons from each group. In these interviews we asked questions like: What are barriers for your community to take part in citizen engagement? When and why does your community feel they have a voice? How do we make photovoice the most accessible? Through interviews, we let local insight about each community give input to the app design process- not on the app itself, but on what it should be able to do. It was, for instance, important to hear how difference in visual literacies was highlighted as an important issue to address, as exemplified below.

> "Homeless people are used to using smartphones and taking pictures, but I don't think they use Instagram and are as trained as other people in making photos look a particular way" - Hugs & Food representative

> "The deaf community is a highly visual culture. But if you want people to also document the bad things in the city, you should make sure that people don't feel pressure to take 'good' photos" - Danish Deaf Association representative

An important learning from this was to design the app to 'level the playing field' between participants from these communities by leaving aesthetic-centric features out of it. It therefore does not contain editing or filtering options that people know from social media like Instagram, where they can edit photos before uploading them. Decisions were also made to standardize photo capture to a square format and prevent upload of images from the library, as we shall get back to. Further, through our interview with the Hugs & Food representative we became aware of potential hardware divides:

> "Not all homeless people have phones, or might have old phones. So you might have to lend them phones. Also, most homeless people are scared to even tell us where they sleep out of fear that the police will

> find out and kick them away. If you want to track people, you need to convince them that it is safe".

To mitigate the hardware divide it became a priority that the app works on older phones. We also learned from this that trust is key if we expect participants from these communities to submit data. This informed decisions to make the app as transparent as possible, making it clear for each participant how and when data is being collected, and to give participants control over when tracking of their movement starts and ends.

The issue of trust, however, also relates to how visible participants are within the app itself (something we also discuss at the end of this paper). Thinking about this led to the decision to create an option to sign up in the app anonymously with pre-generated user-IDs as an alternative to signing up with email. Further, it affected a decision to make a collective view of all photos available in the app, without it being possible to see who took what photo. Interviews with community representatives also informed us of differences in spatial literacy, which made it important to design the 'walking mode' to display a map with a blue dot that helps people locate themselves. Finally, we learned that we should design an app that can capture both negative and positive experiences, as expressed by the Danish Disability Association representative:

> "We are used to thinking only in negatives and how the city does not work for people with disabilities. It would be truly new, if we got an invitation to map our positive relationships to the city, and why we like to live in this city. No one shows interest in that."

This informed decisions to create an open prompt and an annotation that asks people to ascribe sentiment to an image from a range of negative to positive.

The UB toolkit & its distinctive features

The participatory process described above resulted in the UB App being designed with the ambition to make participants experts on how they experience the city, while creating a data infrastructure that is *visual*, *quali-quantitative*, *geo-located*, *relational* and *protects privacy*. The chart in Figure 3 shows how the specifications requested by the different actors impacted the design of the concrete features in the app and the toolkit. The figure thus gives an overview of 'core functions', 'data infrastructure', 'interface UX/UI' and 'conversion scripts' in the UB toolkit and how they relate to the specifications described above. Whereas the previous section outlined the design specification sourced from different actors, the next section illustrates how these were translated into features and functionalities.

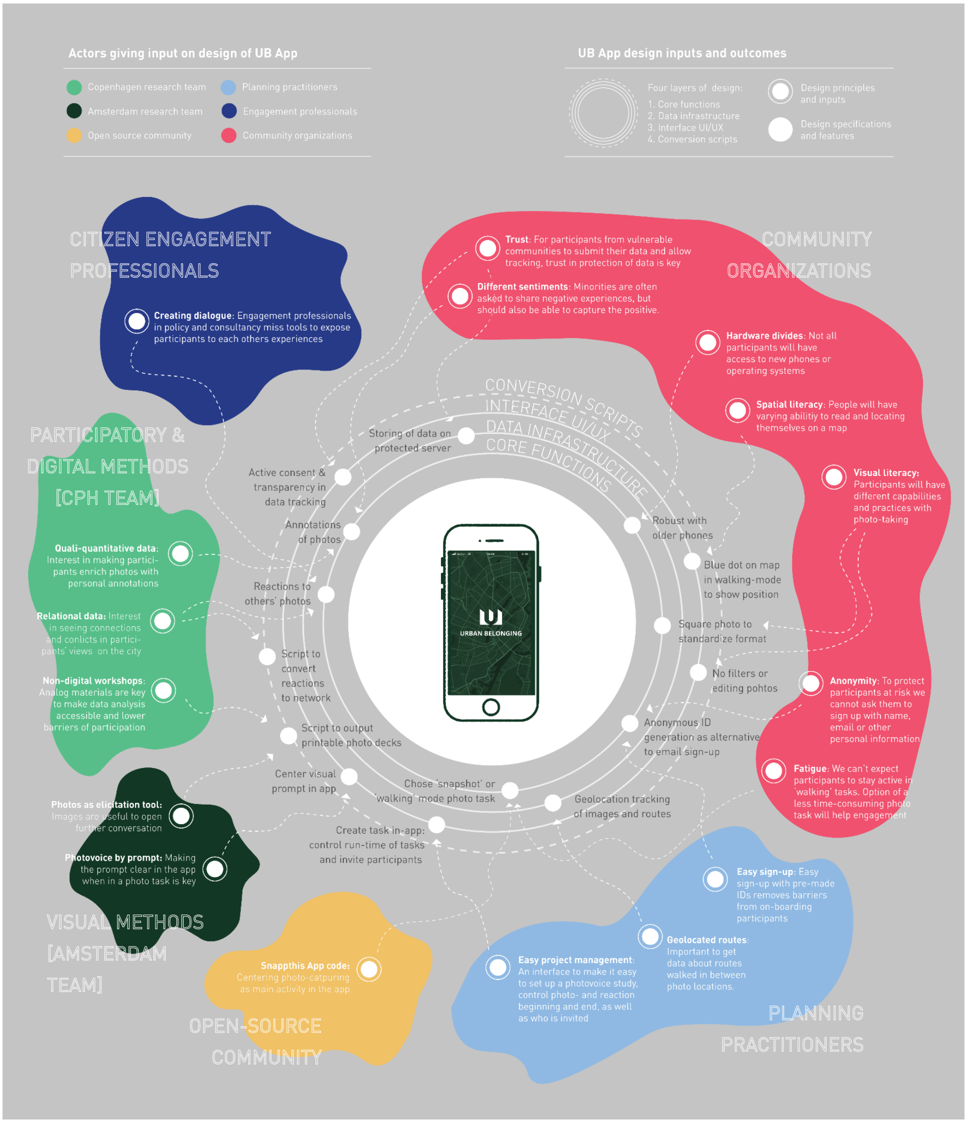

Figure 3: Summary of inputs that have shaped core functions, data infrastructure and interface of the UB App and the conversion scripts accompanying it in the UB toolkit.

IMAGE CAPTURING AND ANNOTATION

The first and most important feature of the UB app is that it invites participants to take and annotate pictures. The images below exemplify this part of the UB-app interface.

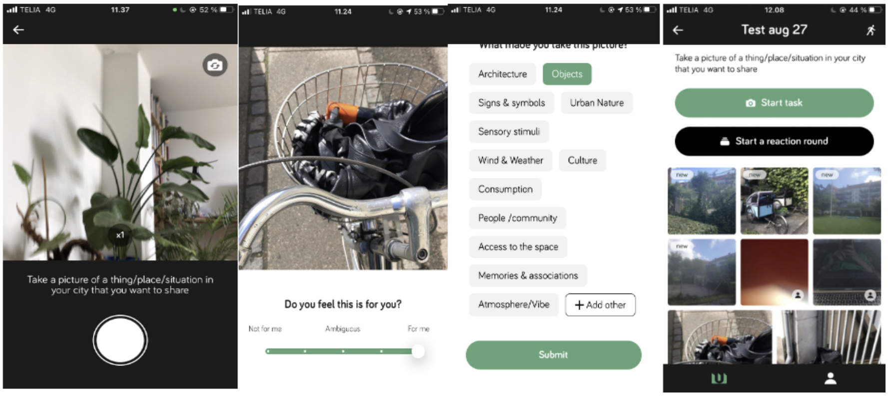

Figure 4-7: The flow of taking and annotating photos

To the left we see the interface for taking pictures (Figure 4). It is quite simply a camera with the prompt "take a picture of a thing/place/situation in the city that you want to share". We designed the prompt to be broad and open in its formulation to not determine a priori what participants should take photos of, but invite them to capture what matters to them. We also deliberately left the prompt neutral to invite participants to share both positive and negative experiences. At the same time, we learned from beta-testing that the prompt should always be visible in the moment of picture taking to help the participants to remember the context of their photo task. Hence, the prompt is displayed above the photo-capture button in the final version of the app, as visible in Figure 4 above. By adding a zoom function and the possibility to flip the camera, we tried to give participants the flexibility to position themselves in space.

To mitigate differences in visual literacy and 'level the playing field' among participants, we put constraints on the activity of picture taking. For instance, it is not possible to put filters on the images or post-process them in any way. The reason for this is to avoid visual hierarchies between participants who are more or less skilled at this, as we see on platforms like Instagram, which is known to be saturated by aesthetic economies (Manovich 2020). Also, the participant can only take images in a square format, which produces an evenly sized and standardized set of images where no one stands out (Figure 7). The app also does not allow upload from image library, which ensures that people have taken pictures only within the timeframe of the study, and encourages a more raw in-situ photo that is off the moment and cannot be staged in the same way as when you take a series of pictures and decide later which to upload.

After submitting an image, the participant is taken through two distinct annotation interfaces that each prompt them to enrich the image with relevant metadata. The first annotation comes in the form of a 5-point slider (Figure 5). In our project we used this to gauge the sentiment behind the image, by asking "do you feel this is for you?". We wanted to give the participants the possibility to portray both positive and negative experiences in the city while also providing the opportunity to be ambivalent about the place, thing or situation captured in an image. This was important because place attachments can just as much be a function of negative experiences as positive ones (Duff, 2010). The second annotation came in the form of a set of pre-defined tags (Figure 6) that the participant can use to answer the question "why did you take this picture?". In our project we chose a collection of tags that covered different theoretical perspectives on what might generate feelings of belonging and place attachment. Some focus on the physical aspects of cities (Scannell, Gifford, 2010), and we therefore included tags like 'objects', 'nature' and 'architecture'. Other theories focus on social relations or individual experiences (Di Masso et al., 2014; Relph, 2006), and we thus included tags like 'humans', 'symbols' and 'memories'. Most importantly we designed a tag named 'other' that gives participants agency to define their own tag when the predefined tags are insufficient. This tag ended up being heavily used in the UB project. Extending the project's participatory ethos, this was an important methodological choice proving that an 'other'-category can encourage co-creation between researchers and participants through bottom-up discovery of what annotations make sense to those using the app to document their experiences. The open source version of the app is flexible in the sense that these prompts and tags can be tailored to the specific project one wants to do.

GRANULAR DATA THROUGH GEO-TRACKING AND TIMESTAMPING

Before the photo-capture moment just described, the participant has to choose between two types of photo tasks. One is 'to take a picture' in snapshot mode, and the other is 'to go for a walk' (Figure 8). A reason for offering both options was that we want participants to decide about the extent to which they are tracked when using the app. When choosing the first option the app will geolocate and timestamp the images captured, whereas the option to go for a walk will start a continued tracking of how the participant moves around the city while taking photos. Guided by the principles of privacy-by-design (Cavoukian, 2009) we decided to make this choice visible as a pop-up dialog (Figure 9) and designed the interface as a recognizable map, where a blue dot tells the participant where they are currently positioned (Figure 10). Finally, before submitting the walk the participant is asked to name their walk and is given the option to see the walk on a map and what pictures have been taken (Figure 11). This dialogue ensures transparency and lets the participant understand what data they are submitting.

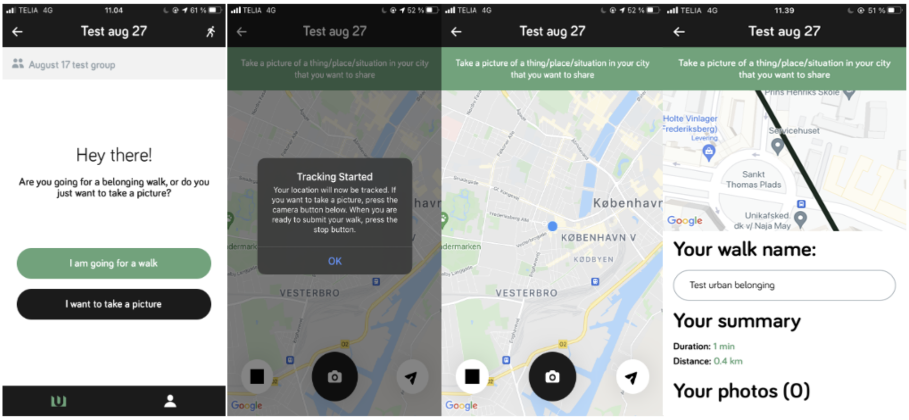

Figure 8-11: From starting a walk, consenting to tracking, to active photo-task, and submission of walk.

While geo-tracking in walking mode only happens if participants consent to it, it is impossible to completely opt out of any form of tracking. In the snapshot-mode the app automatically collects metadata about the time and place an image was taken, which means it is still necessary to inform and make agreements about consent and data ownership outside of the app. The app simply gives participants control over when to start and stop tracking of movement, and prompts them to actively see and think about what data they submit. After ending a walk and seeing the data overview (Figure 11), participants can choose to submit, or delete the data.

RELATIONAL DATA THROUGH REACTION ROUNDS

Aside from the geospatial metadata, we also wanted to be able to study *relations* between the participants. Instead of seeing each participant as an isolated actor, we wanted the app to give them the possibility to interact with each other's pictures. We call this the *reaction round.*

As we will see later the relational traces emerging from this affords studying the participants as a social network, rather than actors in a spatial grid, as it makes possible to study for instance how people who have shared or different sentiments about the same photos. In the app, a participant can 'start a reaction round' (Figure 12) which will expose them to 20 randomly selected photos taken by other participants. They are then asked to annotate them with the same two annotations they used on their own photos. We exposed participants to 20 pictures in each reaction round in order to make it a manageable task to do in 5 minutes. When participants have reacted to the 20 pictures, the task is done (Figure 14). If there are more pictures, it is possible to request a new batch of 20 images and this can continue until the participant has reacted to all photos.

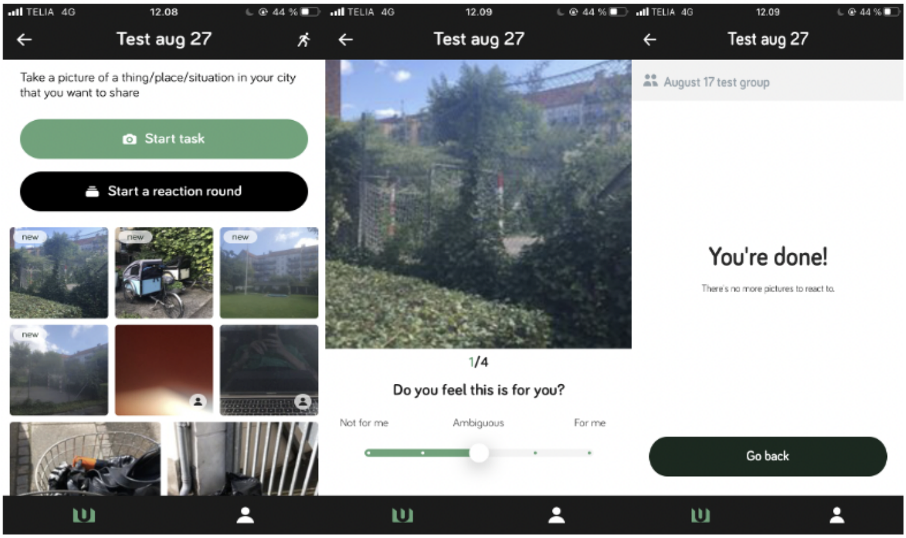

Figure 12-14: The rection round in the UB app

In feedback on using the app, one participant stated that; "It was actually really fun to go through the photos others had taken", and another told us that "seeing other people's pictures made me realize how differently we see the city". The reaction round is in this way more than just data collection. It also creates a collective, reflective moment. A design feature that was explicitly suggested by Jeanette Frisk of Arkilab, who emphasized that "[...] there can be great community building potentials in facilitating that people are exposed to each others' experiences". Using the reaction phase might in itself produce place attachments and feelings of belonging (the thing it sets out to measure), as using the UB App made our participants reflect on their relationship with the city, which became a practice of making sense of place, as also seen in other photovoice projects (Wang, Caroline C., 2006). The integration of the reaction phase in the app comes with an important methodological choice for the researcher about whether one wants the reaction round to run simultaneously with the photo phase, or to open it only after participants are done taking pictures. This brings us to mention how the app affords an 'administrator' role, which enables you to set up a study.

SETTING UP A PHOTOVOICE STUDY

People who are assigned the role of 'administrator' in the app will see an extra option in the bottom panel, which allows them to create a group, decide who is invited to it, and plan a photo task with distinct prompts and tasks. First, the app gives the option to create one or more groups (Figure 15). This might be relevant if a study has different groups, and you do not want participants to see each other's photos across these groups, or if the timeline for photo tasks should look different for different groups in a study.

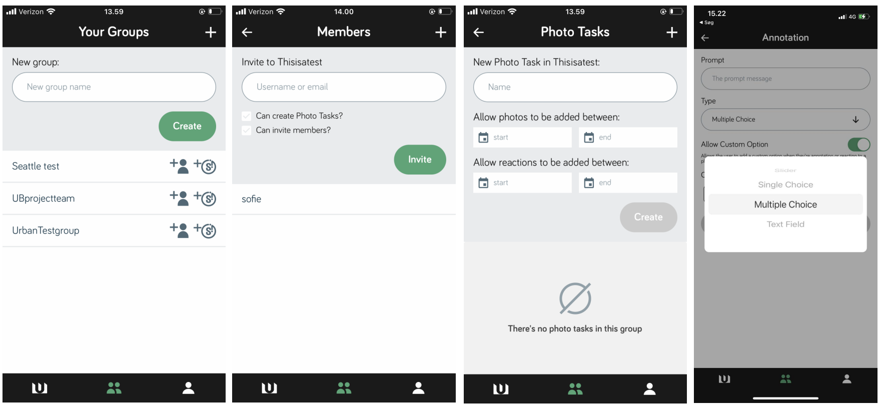

Figure 15-18: Image of UB App interface as administrator, where you can create a group, create a photo task with a specific name and control over when photo and reaction phases start and end, who is invited to the group and which prompts they will get.

Once a group has been created, administrators can invite members via an email address, or by usernames that can be auto generated and handed out to keep participants anonymous in the app. After creating a group, administrators can add a photo task, which will prompt them to decide the start and end time of the photo phase as well as the reaction phase and the specific questions that the participants will answer. As mentioned, it is important to decide if photo-and reaction-phase should be separate or overlap. In our project we chose to keep them separate because we did not want the participants to be affected by seeing each other's pictures, while still documenting their own urban experiences. When the participants are not just exposed to their own images, they begin to take notice of the content of the other images and this will potentially affect their own picture taking. This can be a methodological potential or a problem depending on the research context.

Data outputs and analytical affordances

Developing the UB App, we wanted to create a tool with flexibility in what research questions and processes it can lead to. We have therefore designed it to create empirical traces that can be used to study urban issues from different angles, such as temporal, spatial, relational, demographic, and post-demographic questions. The 'raw' output of the app is a JSON file that opens itself up to many different analytical translations. To enable just some of them, we have created a set of 'conversion scripts' that translate the raw JSON into more accessible data files and visualizations. These scripts are collected in the UB toolkit as open-source Jupyter notebooks in a dedicated GitHub repository which can be found here: https://urban-belonging.github.io/UrbanBelongingToolkit. In this section, we introduce some analytical potentials of the data generated in the app and demonstrate how a combination of the UB toolkit and other open-source software might open for creating outputs that are either analytically informative or - as in our project - can be used in workshops with participants. Note that we only present potentials that can be leveraged with open-source tools, as we intend the UB App and data output to be accessible without proprietary tools or advanced coding abilities.

VISUALIZING IMAGES AND ANNOTATIONS

As part of the UB toolkit, we have created scripts that make it possible to put images in the center of the analytical exploration. First off, the 'convertJsonToCSV' script takes the raw JSON output from the app and converts it to a tabular file, with a row for every image and metadata describing annotations, location, timestamp and other characteristics of each image. Below we illustrate two ways in which images can be the center of visualization. Figure 19 organizes the images visually based on the annotation category they received by participants in and charts them as montages with ImageMagick, whereas Figure 20 uses machine-learning to order them by color. There are many possibilities for processing images with AI, and plotting them in a two-dimensional space based on similarity in visual content can for instance be done with t-SNE or UMAP models like PixPlot, or Visual Network Analysis (Thorsen & Astrupgaard, 2021). The UB project, however, was premised on making participants meet in workshops and using images to elicit conversation about individual and collective experiences. To enable this, we designed two scripts that would give participants access to their own images in an analogue format.

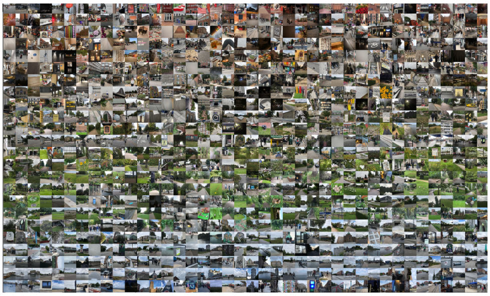

Figure 19-20: Montages of images from the UB App sorted by annotation category (left) and colors (right)

One is called 'photosToFolders' and it takes the raw output from the app and produces a digital folder for each participant's images. The 'createPhotoCards' script then outputs pdf-files for each participant with a deck of images and annotations (Figure 21) that can be printed.


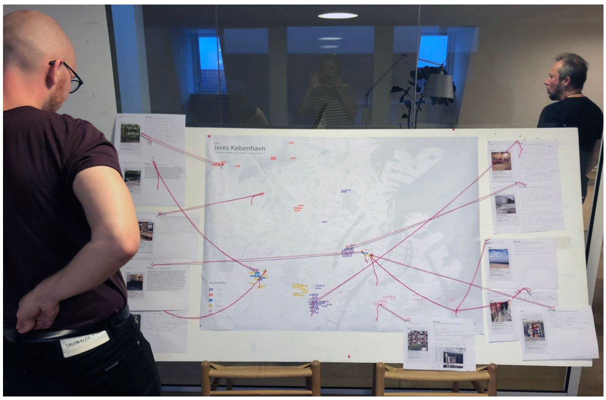

Figure 21-22: The deck of cards and their use in a participatory process as elicitation tools

In our project we used this as a physical prompt to help participants remember the images they had taken, and designed a workshop exercise (Figure 22), where they were asked to select two images, give them a title and a story, and place their stories on a collective map. This image analysis could be much more systematically approached by invoking, for instance, the 'interpretive engagement' framework (Drew & Guillemin, 2014), or the 'SHOWeD' technique (Wang, Caroline & Burris, 1997), which are precisely formulated to support meaning-making of participant-generated visual images and overcome inclusively challenges in such interpretative practices (Cluley et al., 2021).

VISUALIZING SPATIAL PATTERNS

As the 'convertJsonToCSV' script provides latitude and longitude for each image we can also use its output to visualize the geolocation of all images in open-source software like QGIS (Figure 23). The metadata in the csv-file further opens such cartographies up to coloring the map in different ways as exemplified in Figure 24, which displays pie chart of reaction annotations ascribed to photos, opening questions about where people take photos of different things.

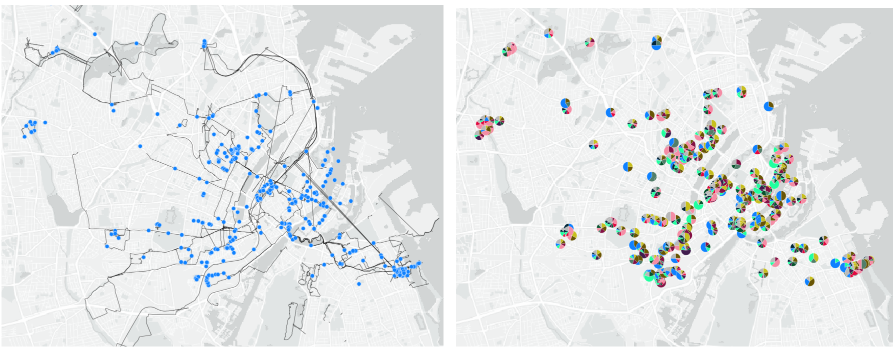

Figure 23-24: Map of image locations and routes walked with the UB App (left), and map with pie charts (right) that show distribution of annotations from reaction-phase about what people notice in the image.

Mapping how participants move between the locations in which they take pictures (Figure 23) can also be used to discover important aspects of their use of the city, and can; give insight into people's place making practices (Rendall, 1984); be used to open questions around politics and cultures of mobility (Sheller & Urry, 2006); and be used to re-examine how the city's spaces are connected and networked in the way people move through and experience them (Massey & Massey, 2005). This is made accessible with the 'convertRouteData' script that outputs the walked routes of all participants together with the location of pictures taken. The images below illustrate how this output can be used in workshops to discuss how not just individual locations, but also the practice of moving through urban spaces create different experiences of belonging, enabling an understanding of places as connected. In our project we used printouts of routes as prompts (Figure 25) to elicit conversations in workshops about positive and negative experiences of moving through Copenhagen (Figure 26), producing individual and collective maps about how belonging is experienced on the move.

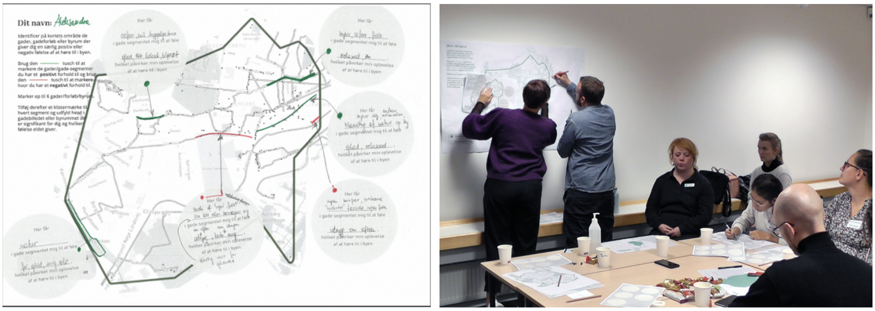

Figure 25-26: Map of routes as analogue prompt (left) and use of it in workshop (right)

VISUALIZING REACTIONS

The data emerging from the *reaction phase* enables us to ask questions about how participants see the photos or 'decode' the city in different ways (Hall, 2003). To leverage this possibility the 'convertJsonToCSV' script produces a datafile with the reactions. It contains a column showing the annotations made by the image author as well as columns showing how other participants have annotated the image when reacting to it.

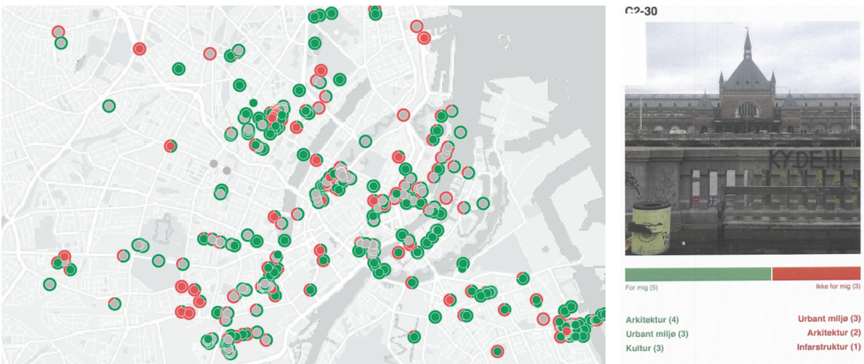

Figure 27-28: Double dot map (left) showing the sentiment of each image as provided by its author (inner circle) and by others reacting to it (outer rim), and a qualitative example of an annotated image (right).

In our project we used QGIS to construct the double-dot map in Figure 27, where each image is represented as a circle and the core is colored by the author's sentiment, while the rim is colored based on distribution of sentiments from reacting participants. This makes visible how some images of the city - generate consensus, while others create contested sentiments. To investigate this further the script entitled 'contestedPhotoCards' creates a pdf-file with a deck of the images which have conflicting sentiments, as exemplified in Figure 28 with a picture of the central station with mixed reactions. In our workshops, we printed the contested photos and hung them on the wall and asked participants to discuss why these images caused such different reactions, opening conversation about aligned or conflicting feelings about the city.

FROM DEMOGRAPHIC TO POST-DEMOGRAPHIC GROUPING

As mentioned already, we designed the UB App to open for *demographic*, as well as *post-demographic* analysis. First, to make it possible to explore experiences among participants who share demographic characteristics or belong to a specific group, the UB App has the feature that a group-identifier can be assigned to user-IDs to make it easy in the backend to distinguish between the images produced by different groups. This was for instance used in Figure 29 to map the locations of photos captured by participants from different groups, indicated by different colors. Such demographic analysis of UB App data can be used to study patterns in various groups' relationship to the city.

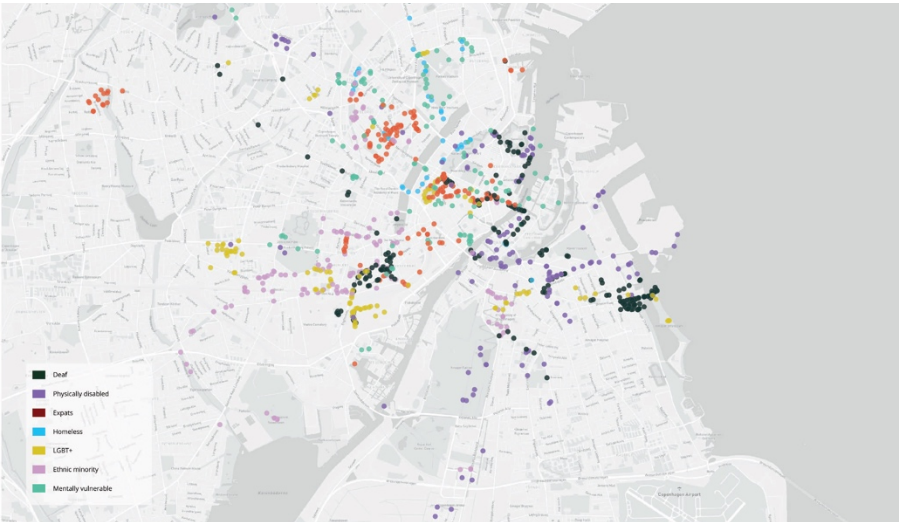

Figure 29: Location of images colored by the organization of their authors.

In the UB project, the first round of workshops was carried out within each of these groups, and we used the group-based user-IDs to filter maps and images so we could present each group with their own data and elicit collective and individual stories *within* the group. Following this, we however sought to mix people based on a post-demographic logic, and place participants in groups based on shared experiences and perceptions of the city, rather than shared identity. The UB App is designed to encourage such analysis in more than one way.

First, the granularity of the spatial data can be used to identify overlaps in where in the city people have been taking pictures. This is seen in Figure 30, where we have plotted all image locations with QGIS, and used the k-means algorithm to identify clusters with a high density of images. We used bottom-up cartographies like this to form groups for workshop 2 based on what areas participants had been photographing.

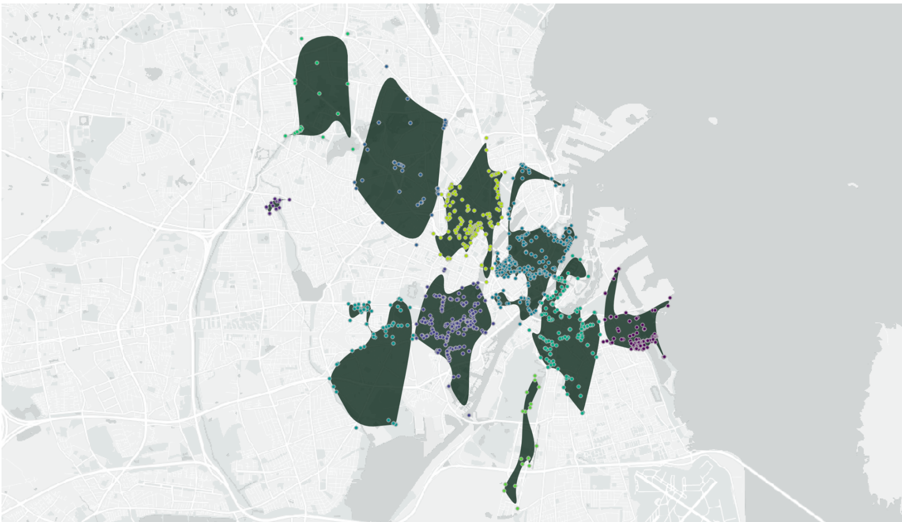

Figure 30: Geographic clustering of images with the 'K-means clustering' and 'Concave hull (k-nearest neighbor)' algorithms in QGIS 3.14 which divides the images into a number of clusters based on spatial proximity and distance.

A second post-demographic strategy is to analyze the participants as a social network (Venturini et al., 2015), leveraging the reactions in the app as relational data. To do so, we built a conversion script called 'networkGenerator' that translates the outputs of the app into two graph files that can be visualized with the software Gephi (Bastian et al., 2009). One network produced is a 'sentiment network' as seen in Figure 31. Here, black nodes represent participants and white nodes the pictures they took. A line connects the two if the participant has reacted to the image with green indicating a positive, and red indicating a negative sentiment. If people gave a neutral sentiment score, there is no line (a choice that poses the thorny methodological question of how participants interpreted the 'middle ground' on the slider).

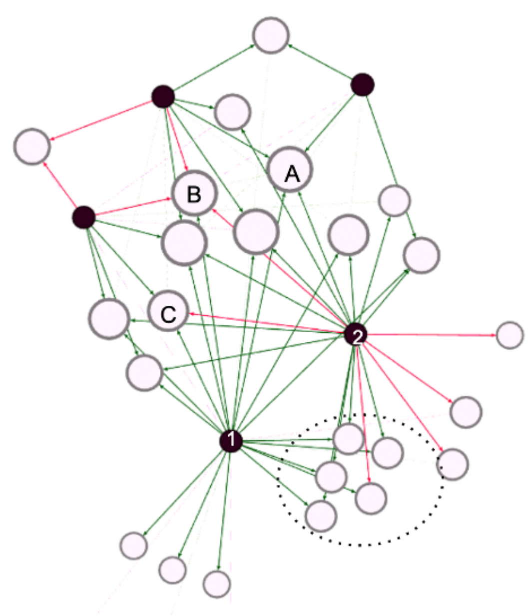

Figure 31: Bipartite sentiment network showing how participants (first nodes) give sentiment to images (second)

Nodes are spatialized with a force vector algorithm that pulls nodes closer if they share connections. The network shows that there is a group of images that only participants 1 and 2 have reacted to (the dotted circle), with a mostly positive sentiment. We can also learn that participant 2 generally has a more troubled relation to the city than participant 1 who only conveys positive sentiments. Leveraging the relational nature of the reaction phase data like this, network analysis allows us to construct a topology alternative to the geographical ones, enabling us to see other patterns in how participants and images are connected.

The images taken by participants 1 and 2 may be geographically far apart, but in the network we learn that they give similar sentiments to the same images. Such outputs can be a strategy for deciding who to bring together in a workshop group to unfold conversations about what people react to. The 'networkGenerator' script also produces a second 'tag network', which is based on the second annotation in the app about what people notice in an image.

The UB toolkit as a contribution to photovoice

As we mentioned in the beginning of this paper, the UB toolkit is designed to enable *photovoice* studies, which builds on, but is different from *photo elicitation* methods. Since these constitute two practices with an intertwined research heritage, some clarifications are helpful to outline why we position the UB App and the accompanying scripts as a photovoice tool.

Photo elicitation is based on the straightforward idea of inserting a photograph into a research interview (Harper, 2002). The method has typically been deployed within visual anthropology and sociology from the sensibility that the use of photographs in interviews (compared to text) can evoke a different kind of information with a greater sensibility to memory, emotions and feelings (Harper, 2002). While the photos used in photo elicitation can span a wide continuum, they are often collected by a researcher through fieldwork, historical archives, or other sources relevant to the object of study (Gubrium & Harper, 2016). Research participants rarely produce the photographic materials used in photo elicitation. However, they may involve the research participants in curating or editing photos (or, in some cases, other visual materials): Visual anthropologists have, for instance, involved local communities in 'collaborative photography', where participants guide the picture-taking (Gubrium & Harper, 2016, p. 69), just as Jean Rouch famously captured video and invited participants to edit it, as a process of engagement (Rouch, 1978, 2012).

While photovoice has roots in photo elicitation studies, photovoice hands the 'representational 'means of production' over to community members (Gubrium & Harper, 2016). An early example of this is seen in the work of Paulo Freire and Augosto Boal, who distributed cameras to residents in a low-income neighborhood in Lima, as an experiment in centering participant-produced images (Boal, 2014). Building on Freire and Boal's work, public health scholars Carolyn Wang and Mary Ann Burris introduced photovoice in the 1990s through a series of articles documenting research in rural China, where local communities were given cameras and asked to capture their health, family, and work lives (Wang & Burris, 1997). Introducing a systematic framework around photovoice, they articulated it as a method in which photos are captured by participants, followed by a process in which participants select photos and use them to elicit groups discussions about how they experience a given issue, leading to conversations about what ideas for change and strategies for collective action could help address the problems depicted in the photos.

Gubrium and Harper identify three signature elements of photovoice, which are helpful in outlining why we position the UB App as a photovoice tool, including that; photos are produced by local community participants; these photos are used to create conversations and narratives in groups that express the concerns and desires of the community; and that these narratives are presented to a wider public or policy makers, making the voices of the community heard. The first element, they write, "places emphasis on photos and seeing from multiple perspectives. (…) Participants then select the photos they see as the most important, or those that are simply their favorite to share with the group" (Gubrium & Harper, 2016, p. 72). The second element, elicited narratives, focuses on generating group discussions based on exposing participants to each others' photographs. The third element, reaching a wider audience, involves using photos and photo-based narratives to inform policy and action or to create public exhibitions to bring issues raised in the research to the attention of a wider audience (Gubrium & Harper, 2016, p. 73). Photovoice is, therefore, often positioned as a participatory action research (PAR) method since it aims not only at producing increased awareness among a community about a given issue but also at "communicating with policymakers and representatives of institutions who are often inaccessible for members of disadvantaged groups" (Gubrium & Harper, 2016, p. 69).

The UB App documented here builds on these foundational principles of photovoice: We frame the app as a *photovoice* tool since it is designed to invite local communities to produce photos of a given issue (in response to a prompt) and make it possible for participants to see and react to each others' photos *within* the app as well as *outside* of the app in workshops, where photos captured in the app can be used to elicit conversation in interviews or workshops. It is important to note that the use of photos to prompt conversation between participants is a shared characteristic between photovoice and photo elicitation methods. However, what positions our application as a distinct photovoice tool is that the app fundamentally centers on participant-produced photos, which is different from photo elicitation in which participants may be exposed to photos by all sorts of sources. Further, as outlined by Wang & Burris (1997) and Gubrium & Harper (2016), it is a built-in part of photovoice research (springing out of photo elicitation) to engage participants after photo collection in selecting among their photos and bring them into collective discussions in groups. The UB App is designed to make this possible.

Further, the quality and standardization of photos captured within the app are intended to create photo collections of good enough quality that they can be used in public exhibition formats. The research takes seriously the potential of the digital for innovating a photovoice-specific data infrastructure. While the high cost and inconvenience of camera equipment used in the 90s and 00s have been replaced with digital and smartphone cameras, increasing the availability and affordability of photovoice studies, there has been little innovation in designing digital tools specifically for photovoice research. Most contemporary photovoice projects simply turn to the camera built into people's smartphones and ask participants to share photos via email or messaging apps like WhatsApp, though these infrastructures are not designed for structuring (or protecting the privacy of) photovoice data. With few exceptions (García et al., 2016, Cila et al., 2016) have we seen humanities scholars, social scientists, urbanists, anthropologists, or others leverage the digital capabilities of mobile technology to imagine what a photovoice-specific data infrastructure might look like. With the development of the UB App, we aim to contribute to this field by developing an open-source photovoice application for smartphones that we present together with a tool-kit of scripts, which make various data exports, visualizations and photo-based elicitation exercises possible.

Further challenges

As demonstrated, our aim was to design a photovoice toolkit that puts narrative power in the hands of participants and create data outputs with high empirical flexibility, while the accompanying scripts are built to enable the researcher to analyze urban attachments from different ontologies. Every tool, however, comes with constraints that influence the type of knowledge that can be produced with it. This section focuses on such limitations and challenges.

THE DIGITAL DIVIDE: HARDWARE AND VISUAL LITERACY

The choice to design an app raises important questions related to people's opportunity to make themselves visible in such a digital infrastructure. From literature on digital divides, we have learned that such questions concern both people's access to digital tools as well as their skills for using them to their benefit (Hargittai, 2001). Both are relevant in the context of the urban belonging toolkit. First, even though mobile phones have a high market penetration, it is not everyone who has access to one. For instance, our project involved working with homeless people, several of whom did not own a phone. Also, the UB app requires that the phone can access either Google Play Store or App Store, that it has a relatively new operating system, a functioning camera and a data connection, which might exclude some participants. In our project we mitigated this by offering phones and also mobile data to those without. Even so, there were still several barriers to who could be a part of the study. Most obviously of course, we missed the opportunity to work with the vision-impaired for whom photography is not accessible. Second, the choice to center photographs means that visual hierarchies and literacies might influence the data collection. It might constitute a bias, and it can be problematic if differences in visual literacy for instance leads to some participant voices drowning, while others are foregrounded. As mentioned previously, the app is designed to minimize such effects in different ways, but does not eliminate them altogether. When that is said, we might also consider if varying visual capabilities say something empirically interesting. Learning from Visual Analytics, (Tifentale & Manovich, 2015), we could think of people's visual styles and aesthetics as practices that say a lot about who they are, if we see it as an opportunity, rather than just a bias.

PRIVACY AND PARADOX OF EXPOSURE

The use of the UB App also raises questions about privacy. The app lets the project manager create anonymous IDs for participants, which means that within the app itself, no one is able to discern who each participant is. If, as in our project, you want to connect the data collected in the app with personal information about who participants are, you need to collect that information outside the app with the consent of the participants. Even so, anonymization is not always enough to keep data private (Douriez et al., 2016). The possibility to plot route data at the granular level might for instance reveal where people live or work, if we can see that multiple routes start from the same spot. Images might also reveal vulnerable information. For homeless people, it might for instance be risky to document places they sleep, or show what parks they like, if authorities should find out and it could lead to increased policing. Thinking about privacy is thus important when plotting maps or showing images from the UB App. On the other hand the app can also empower such groups by making visible where they actually feel a sense of belonging. The fact that visibility can be both empowering and problematic has been discussed as the *visibility paradox* (D'Ignazio & Klein, 2020) and it is important to have in mind when designing a project. This was indeed also problematised in one of our community interviews.

> "Let's say an LGBT+ person takes a picture of a kink shop, because it is a part of the culture. Maybe they are not ready to let others know that they took that photo. It could be uncomfortable to put on display in workshops or in the app. You should let people decide the degree of visibility they are ready to have". - LGBT+ Denmark representative

The paradox of exposure also relates to the issue of 'data ableism', described by Charitsis & Lehtiniemi (2022) as a two-fold mechanism that punishes those who deviate from the standard of data normalcy: *"Data (in)visibility refers to the ability to produce data that render people visible to the system or conversely the ability to hide from it, while data (un)desirability relates to the ability to produce desired data that are deemed valuable and lead to beneficial outcomes*" (Charitsis & Lehtiniemi, 2022): 8). Subverting these tendencies, the app is designed to give those who typically are rendered undesirable or invisible the ability to make themselves seen in beneficial ways by means of data, giving participants as much control as possible over how they are made visible. As it is hard to predict when visibility might be beneficial or harmful to a specific community, we recommend interviewing the involved groups before planning a project, to learn from them as we have done. Also, the newest version of the app includes an option for participants to delete photos they regret submitting. Finally, privacy issues go beyond the participants, since images may include other people who do not know they are being captured. This can be solved by running images through an algorithm like 'Face Blur' that blurs all faces.

DATA ABLEISM AND BLIND SPOTS

In the introduction we argued that digital tools have technical affordances which set the boundaries of their use and the problems they can help solve (Madsen, Anders Koed, 2015). One important affordance in the UB App is that it requires participants to collect data *in situ (Carter & Mankoff, 2005).* This encourages participants to show what matters to them, rather than just talking about it, which following (Plunkett et al., 2013), p. 156), allows photovoice to bring about a phenomenological sort of insight into lived experience, which may be unspoken and not always best understood by words alone. The advantage of images always being anchored in a particular time and space is that photovoice invites a way of knowing that, learning from Haraway (Haraway, 2004), produces tangible insights and a situated, partial perspective on the city. An obvious downside is that people are not always comfortable – or have the opportunity – to be physically present in the places that matter to them. If one has experienced harassment in a specific area, it may be uncomfortable to go back to that place and take a picture, or this may even be an outright dangerous act. The consequence is that the UB App might not be the best method to capture traumatic urban experiences or inaccessible spaces, as also highlighted in our interview with the Danish Disability Association representative: "*How do you want me to go to places I cannot go in a wheelchair, and take a picture of it?*". This shows how the app might also re-produce a sense of 'data ableism', as a technology that comes with ability expectations which risk leading to additional marginalization of underprivileged and less able individuals. This is for instance the case, if we assume that all individuals will be cognitively capable of using a digital app or be physically able to hold a phone. In our study, homeless participants who suffered from cognitive disabilities, for instance, required support to be able to go out and use the app (a companion from Hugs & Food went with them). And participants with physical disabilities who could not hold a smartphone had assistants accompany them, who could help operate their phone. If an assistant is not available, however, researchers might have to go on walk-alongs to offer their own help. This prompts challenges such as ensuring that images are captured from their perspective (i.e. height and angle), or evaluating how it influences the participant that a researcher is present during the photovoice. However, if this is planned well, walk-alongs can give researchers a chance to observe how a participant moves through an urban space, as seen in Figure 34, where two of us went on a walk-along with a participant, feeling how physical obstacles on the sidewalk left no room for a wheelchair and forced us into the street.

Figure 34: Image of UB participant and researcher on a walk-along in Copenhagen.

Adding to that, the situated nature of the method makes it ill-equipped to capture things that existed in the past, as well as really negative settings that could be triggering. To provide an outlet for such stories, our project supplemented photovoice study with participatory GIS mappings and workshops. We highly encourage triangulating photovoice with other methods, which proved in the UB project to be a fruitful way of capturing different aspects of people's urban experiences.

Outro: Use it! Tweak it!

In this paper we have described the UB App and the toolkit of scripts that accompanies it. To summarize, it consists of four components: The first is the UB App, available on Google Play and AppStore. The second is the app API which enables researchers to set up projects and access data. The GitHub repository includes a dedicated Insomnia file that makes it easy to perform calls to the API to export a raw JSON file, export routes and send push messages to participants. The third is the conversion scripts that translate output from the API into data formats that are accessible for analysis. Finally, the source code for the full app is available on GitHub, inviting others to grap and tweak it.

In this paper, we started by arguing for the need to engage in toolmaking, and why it matters to do so with communities and practitioners. We then described the key features of the UB App and reasons for their design. The UB toolkit is shaped for a process where participants are highly engaged in interpreting their own data. Many of the conversion scripts we made support this process. However, we have intended the app to be flexible and the data to come out as '*malleable matter*' *(Baerten, 2020)* that can be sculptured to answer different questions. While this paper has demonstrated some methodological potentials, we are certain there could be many other applications. In fact, the app has already been used in a research project on historical heritage in Italy. In Seattle, the app was recently used by environmental justice group DVSA to invite youth groups in South Park, a predominantly Latinx neighborhood, to document how they experience a range of issues in the area. The insights are being used directly to inform policymaking in the city, and has helped shed new light on how social justice issues in the neighborhood are connected to environmental problems such as pollution of the Duwamish River. In these two cases, we helped change prompts and annotations in the app to fit each project by hardcoding them in the app, which arguably is a technical and time-costly task.

Since then, Gehl Architects has set up their own version of the app called Eye Level City and used it in a project at Stanford University, mapping experiences of belonging among minorities on campus. The app thus already has applications across research, NGO work, and professional planning as intended, and we hope to inspire even more to use it. To make the app more accessible, it has recently been developed further by Gehl Architects, who has found funding via client projects to tweak the app, adding features that make in-app customization of prompts and annotations possible. The newest version of the UB App on GitHub is thus more flexible than the first version and enables administrators to create different photovoice projects in parallel and customize prompts, annotations, language versions, and timeline of tasks directly in the app, giving project managers greater control and ensuring that multiple projects can run at the same time with different prompts and tasks. Engaging stakeholders like Gehl in the design of the app within an open paradigm of innovation (Chesbrough & Bogers, 2014) has thus already proven effective in leading to 'continuous innovation' (Martini et al., 2013) of it based on situated needs and experiences with using it. We hope to see more of that in the future.

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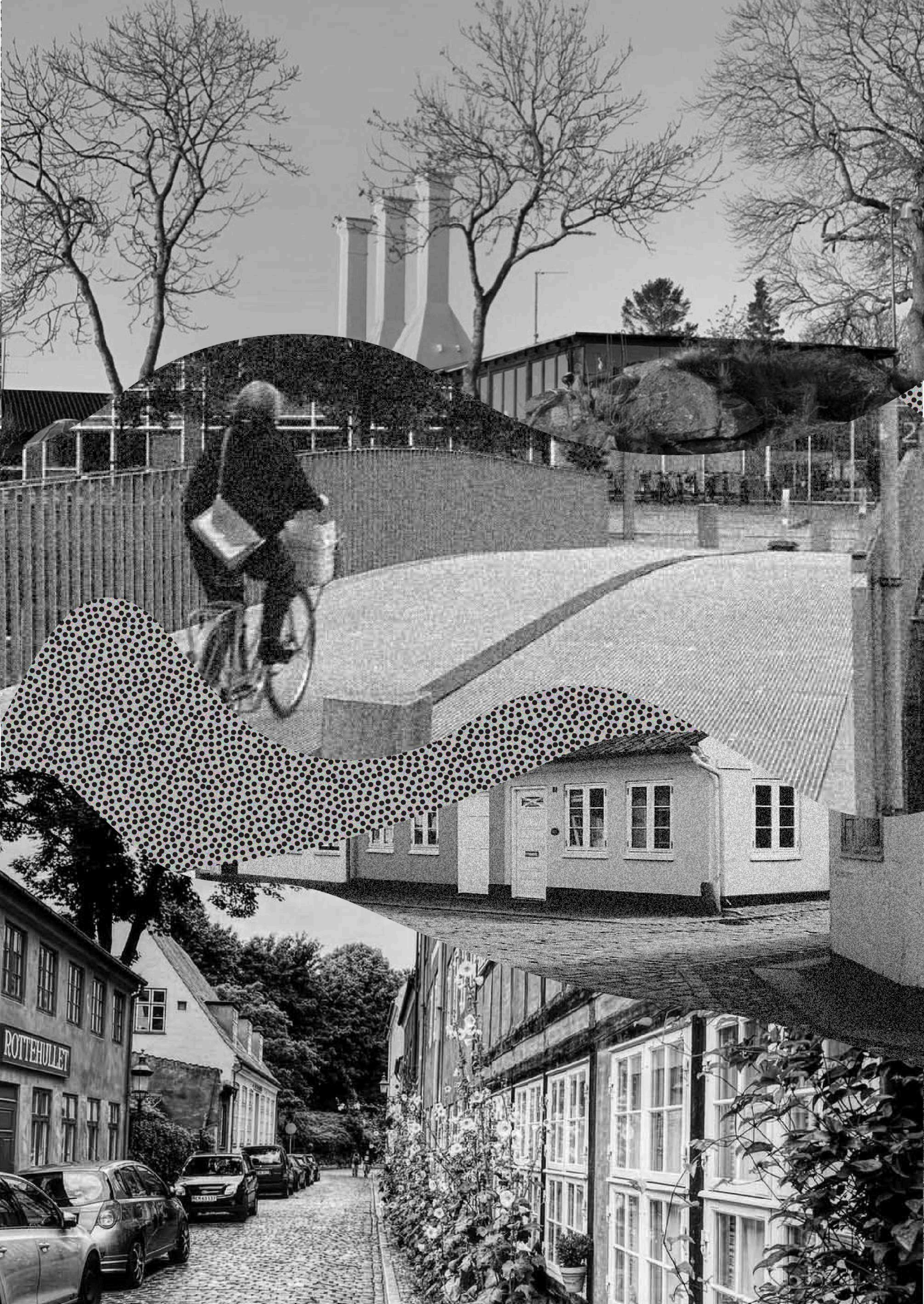

ROTTEHULLET

PART III

Exploring data imaginaries


Tackling Childhood Obesity
Designing invitations for new food behavior

Chapter 08

A situated STS study

A situated STS study

As outlined in the Introduction of the dissertation, this PhD positions itself within Science and Technology Studies (STS), pursuing a research problem that in part centres on innovating visual methodologies for studying urban life with digital and participatory methods, and in part on unpacking the data imaginary in Gehl by observing how they respond to such methods. The two research questions relate in the sense that the PhD experiments with innovating visual data tools and methods for studying urban experiences, as documented in the four articles previously presented, and uses these experiments as devices of intervention into Gehl's data practices; to flesh out the epistemologies and normativities that guide ways of datafying cities within the planning practice.

In this chapter, I present the theoretical framework through which I approach this secondary research question. Within symbolic interactionism and STS there are a longstanding traditions for studying knowledge practices, ranging from Garfinkel's 'breaching experiments' (1991) to Latour and Woolgar's 'laboratory studies' (1982), each presenting different strategies for unfolding tacit and normalized everyday practices among a given knowledge culture. In this project, I build on the framework of 'situated interventionist STS' as conceptualised by Teun Zuiderent-Jerak (2015). The coming section introduces this framework, outlining how interventionism differs from 'detached' and 'engaged' sociological inquiries, before touching upon how we might construe of empirical experiments as an interventionist capacity, drawing on notions of 'crucial experiments' by Ian Hacking (1983) and 'participatory data design' by Jensen et al. (2021). The chapter then introduces how my observational gaze is guided by the concept of data imaginaries. Finally, I outline method and materials, discussing how I have navigated my role as insider and outsider in Gehl, what situations I have primarily observed, and what data collection this has produced.

Theoretical framework

AN INTERVENTIONIST STS AGENDA

With 'Situated Intervention: Situated Intervention: Sociological Experiments in Health Care" (2015), Teun Zuiderent-Jerak launches a framework for thinking about intervention as a topic in STS, examining the problem of how direct involvement of social scientists in the practice they study can lead to production of sociological knowledge. Here, he interrogates the debate that has occupied scholars for more than a century about the role of social scientists in relation to their fields, centred on the normativity and epistemologies involved in how researchers position themselves in relation to the studied phenomena. Tracing this debate back to Karl Marx and Max Weber, he shows how it is polarised along a dichotomist view of the possible roles of the scientist: In one extreme of the scale we find the detached position and in the other a normatively engaged position. Whereas Weber (1918) notoriously argued that sociologists should attempt to describe the social world as objectively and detached as possible, calling for a position that voluntarily blinds itself to utilitarian concern and political demands, Marx (1845) stated that the point was not only to interpret the world but to try to change it, encouraging sociologist to take an engaged, normative position. This binary scale, Zuiderent-Jerak argues, is saturated by a dual fear of the sociologist being either too detached or too involved and struggling to find a position between these equally unattractive poles (2015, p. 14). He problematizes that while the debate through history has provided unlimited variations on the *scale* of partisan and objective scholarship, the *relation* between the ends of the scale is always one of two extremes that consistently separates sociological 'acting' and 'knowing'.

> "The common separation of these domains stems in part from disciplinary self-understandings within sociology that are largely shaped by debates on the need for detached sociological scholarship or its mirror image of engaged social science. Both sides in the debate draw on the problematic idea that knowing and acting are separate entities (…) they differ only as to which side of this dichotomy they privilege" (Zuiderent-Jerak, 2015, p. 3).

Interrogating positions at either end of this binary, Zuiderent-Jerak argues that they both end up assuming forms of epistemic privilege that are equally problematic. Where the 'detached' sociology, which starts from the premise that scientific observations should be objective, has been criticized for being epistemologically defunct, he poses that the 'engaged' sociology simply combines normative activism with scientific authority and rigorous methodology, which is a return to the form of epistemologically privileged positions that critical theory set out to challenge in the first place (Zuiderent-Jerak, 2015, p. 7). Navigating these two extremes has also been a central question for this PhD: Do I enter Gehl with the ambition of neutrally describing the knowledge culture of the company, and is it possible to claim such objectivity in my observations? Or do I enter with a fully formed normative standpoint about what I want to change in the company? While both seem like unproductive positions, I have taken inspiration in the approach to 'making and doing' STS that is formulated by Zuiderent-Jerak. He proposes 'interventionist' research as a strand of STS that sees the involvement of social scientists in the practice they study as an opportunity for production of sociological knowledge that is neither detached, nor working from a pre-set normative agenda. Within STS this has led to the rise of 'Making and Doing' research as its own agenda and a recent publication of the same name (Downey & Zuiderent-Jerak, 2021). The key to this type of STS research, Zuiderent-Jerak (2015) argues, involves shifting attention from 'engaged' scholarship to 'intervention'. Four points can be made about how such interventionist research shapes this PhD.

Intervention as interlocked with representation

Outlining what the shift from engaged to interventionist STS entails, Zuiderent-Jerak (2015) draws on philosopher of science Ian Hacking's seminal work (1983), which construes of 'representing' and 'intervening' as interconnected concepts. In unfolding Hacking's notion of representation and intervention, Zuiderent-Jerak ties it to an allegory of clinical medicine to show how the separation of 'knowing' and 'acting' is an artificial construct that is not helpful in unpacking the reality of practice. Referencing Marc Berg (1997), he explains that while textbooks on decision-making typically pose that clinical intervention comes *after* a medical diagnosis which leads to the proper decisions about treatment, it is more often the case in practice that treatment begins as an experimental way of testing which of several possible diagnoses is indeed correct: "Interestingly, Berg's analysis of medical intervention *as part of* diagnosing resonates with Hacking's analysis of intervening as an important form of knowledge production in the sciences" (Zuiderent-Jerak, 2015, p. 27). From showing that diagnosing and intervening are deeply interrelated within medical practice, Zuiderent-Jerak proposes that we can think in similar ways about the problem of the engaged-detached dichotomy in social science: He argues that we have to accept that interventions in the social sciences need not attach to a pre-defined 'diagnosis' of what the normative problem is, which then leads to a targeted intervention. Rather, intervention is reflectively intertwined with the production of this diagnosis. (Zuiderent-Jerak, 2015, p. 27). Relating this to this PhD, I built my STS research on such theoretical bridging of intervention and representation, or of *acting* and *knowing*: It is through intervening in Gehl and carrying out my own data projects that it becomes accessible to observe something about Gehl's expectations, visions, and practices around data. Zuiderent-Jerak encourages us to see that "intervention precedes or is simultaneous with diagnosis" (2015, p. 28), and this has been the modus operandi of the STS work in this PhD, which means that my observations in Gehl has happened simultaneously with working on data projects within the company. Representation and intervention are interlocked, just as the PhD's first and second research questions are: Exploring the potentials of visual data methods in urban planning (primary question) through empirical experimentation also open up observations about the data imaginary in Gehl (secondary question).

Meanwhile, intervention should not be mistaken here "(…) as if it presupposes a contextual "outside" separate from a practice into which the intervention is "inserted", while the outside remains untouched and unchanged by the act" (Zuiderent-Jerak, 2015, p. 21). This is also the case in this project, where I have not been able to work for three years in Gehl without myself being changed and influenced by the context. As I unfold in the next chapter, my work with innovating visual data methods has often involved running into different epistemic commitments in Gehl that shape their imaginary around data: Sometimes, my experiments could expand or influence existing visions and practices around data. Other times, I had to adjust the methods and empirical work to fit the data culture in the practice (often both things were true at the same time). As an example, I did a project with Instagram data, where I struggled to collect metadata for the photos. This caused a director in Gehl to deem it invaluable. While this at first caused frustration, I used such feedback to examine why especially geotags are central to Gehl's practice (more on this in Chapter 9).

Zuiderent-Jerak's distinction here is helpful to understand that we can speak of a sort of *interventionism* that is not about entering a field from the outside with a predefined normative agenda and changing it, nor about assuming that I can stay above or outside of it and observe it neutrally. Instead, I have engaged and involved myself in the planning practice. Yet, it could also be debated if it is entirely possible to be as agnostic as he proposes. When I enter Gehl, I am not completely *without* any ideas of my own: I enter for instance with the proposition that visual data are underexplored and could be interesting to use in planning. I also draw on Data Feminism (D'Ignazio & Klein, 2020b) and Design Justice (Costanza-Chock, 2020) among other frameworks, and think that they have a critical capacity that might challenge the planner's data practices in productive ways. The important distinction, however, is that I am not insistent on these ideas being implemented one to one in the practice. Rather, I use these propositions to put a "wedge in the wheel" of the collectively held visions around data that has become naturalized in the company. I retain an openness about if and how visual data methods can have value in the planning practice. The agenda is thus not pre-defined, and rather than construing of intervention as a one-directional relationship, I build on Zuiderent-Jerak's (2015, p. 22) notion that intervention is diametrically opposed to implementation.

Intervention as challenging pre-set problem definitions

Another consequence of the shift from engaged to interventionist sociology is found in Zuiderent-Jerak's critique of the tendency to under-problematize the engaged approach, which he particularly associates with the shift happening in academia towards project-based funding of research with increased emphasis on 'knowledge translation' and practical utility of research (2015, p. 6). This, he argues, leads to distinctions between consultancy and sociology becoming blurred as sociologist are increasingly hired in; sometimes with part-time obligations in academic departments, combining research ambitions with the business interest. As an industrial researcher this has been a recurring challenge to think about, as I have had to often negotiate and manage expectations between myself, the university, and the company around the nature of my work. Navigating this, Zuiderent-Jerak suggests that while consultants suffer from accepting the problem definitions encountered in the organization, the engaged sociologist enters the organization with their own normative values and set out to alter the problem definitions that dominate in the practice (Zuiderent-Jerak, 2015, p. 9). In this PhD, I have worked to avoid both of these positions. As already mentioned, this does not mean that I enter Gehl's practice without ideas or propositions about how the company could work with data. But I do not arrive with pre-defined notions about how I wish to change their data practices. Instead, I make it a part of my research question to unpack the imaginaries that shape visions and expectations around data. The challenge then is to not swing into the other end of the spectrum and simply adopt or inherit problem definitions pre-defined by the actors I engage with. What is the crucial difference for this project, is the critique that:

> "researchers who do not question epistemic realism typically are committed to contributing to pre-set problem definitions, rather than taking their research to be **about unpacking such definitions and exploring the action repertoires such definitions imply**" (Zuiderent-Jerak, 2015, p. 8) [author emphasis]

This has not always been an easy feat. A recurring challenge has for instance been repeated requests from the company for being billable on client projects. Especially in the first year of the COVID pandemic which put financial pressure on the company, there were many heated debates around the long-term value of research versus the here-and-now need for making money. In these debates, I had to fight to maintain a position as a researcher, under pressure of helping out with consultancy work. But more than that, Zuiderent-Jerak's critique informs this project with careful attention around not simply accepting and adopting problem definitions of the company. Instead, I have made it a part of the research to empirically unpack the problem space within which different expectations to data-driven urbanism is imagined and enacted in the company. Rather than adopting pre-set problem definitions, the PhD was designed to unsettle established way of working with data in Gehl, and to unpack and complexify the visions and normativities that guide expectations to data-driven urbanism in planning. Interventionism is hereby framed as an epistemological exercise, rather than a political once. It is concerned with creating knowledge, more than political change.

Intervention as situated knowledge(s)

The reconfiguration of the engaged-detached dichotomy found in Zuiderent-Jerak is also heavily inspired by feminist STS, which has been productive in reconfiguring the knowledge-power nexus around what counts as valid knowledge. He especially draws on feminist scholar Donna Haraway's conceptualization of "situated knowledges", with which she critiques the notion of objectivity that characterize much of scientific knowledge production (D. Haraway, 1988). Taking a non-relativist and non-positivist position, she interrogates what counts as valid knowledge claims in science, being critical both of positivists claims to any absolute truth, and the total relativism that has made it impossible to qualify that some knowledge is better than others. Using the metaphor of vision, she insists on the embodied nature of all vision, and is critical of science that claims the ability leap out of the marked body and into a conquering gaze that can see everything from nowhere; what she calls the 'god's eye trick' (D. Haraway, 1988, p. 589). She opposes the idea of such disembodied observation and continues the metaphor of vision when stating that there is no "unmediated photograph or passive camera obscura in scientific accounts" (D. Haraway, 1988, p. 581). Rather, seeing is always a question of power and depends on the position and perspective of the one is doing the looking. She therefore proposes a reconfiguration of the power/knowledge nexus in science that replaces claims to objectivity with a situated, embodied knowledge that is locatable and can be held responsible:

> "So, not so perversely, objectivity turns out to be about particular and specific embodiment and definitely not about the false vision promising transcendence of all limits and responsibility. (…) Feminist objectivity is about limited location and situated knowledge" (582-583)

This informs the formulation of interventionist STS as a *situated* practice as Zuiderent-Jerak (2015, p. 29) extends the Haraway-inspired notion that the only way to find a larger vision is to locate your viewpoint and observe the world from somewhere. On this, she writes:

> "I am arguing for politics and epistemologies of location, positioning, and situating, where partiality and not universality is the condition of being heard to make rational knowledge claims. (…) I am arguing for the view from a body, always a complex, contradictory, structuring, and structured body, versus the view from above, from nowhere, from simplicity. Only the god trick is forbidden" (D. Haraway, 1988, p. 589).

It is about recognizing that sociological knowledge production about for instance the data imaginary in Gehl is not free from interpretation. Rather, my STS study in Gehl is a process of ongoing interpretation and produces a situated partial perspective. This relates to the final point about what 'intervention' I am doing, which configures interventionism as experimental knowledge.

Intervention as experimental knowledge

In 'Representing and Intervening' (1983), Ian Hacking proposes experimental intervening in knowledge production as a key to productively challenge the dominance of theorizing in science and address the long-standing debates in philosophy of science around 'realism' versus 'relativism'. He proposes intervention as an opportunity for coming to pragmatically reliable knowledge, seeing intervention as an activity that in of itself is producing of reality. Drawing on this, Zuiderent-Jerak (2015, p. 20) poses that scientists intervene to explore and produce robust forms of knowledge**.** The ontological position underlining situated interventionism hereby takes a pragmatic and empirical approach to producing realities, framing intervention as an empirical topic and a form of experimental knowledge. But which experiments are we talking? Within interventionist STS, Zuiderent-Jerak (2015, p. 20) distinguishes experimental knowledge from the common-sense understandings of the experiment as a scientific method to test which of two theories that have competing truth claims is correct. Instead, he proposes to understand "experiments" as devices for heightening reflexivity and opening new questions, rather than bringing interpretation to an end and closing down reflexivity. Where scientific discourse typically frames the experiment as a device of controlled demonstration to produce evidence for a particular claim, Zuiderent-Jerak (2015, p. 20) hereby frames experiments as far more tentative and creative, emphasizing their surprising and generative capacity for opening new insights and sensibilities to what is at stake in the field.

This informs the way that data projects are construed in this PhD as devices of intervention; not to test a particular assumption, claim or hypothesis about a certain data method, but rather to open up reflection about what matters to urban planners when datafying cities. This is also inspired by recent contributions to the literature on 'making and doing STS', where scholars like Jensen et al. (2021) have demonstrated that 'participatory data projects' are productive in creating such experimental situations: Participatory data projects bring together STS researchers and stakeholders from a particular field around collecting and generating data in ways that is relevant to a particular problem, negotiating what are relevant data practices and ways of understanding a given problem. The work with visual data carried out in my PhD have functioned in a similar experimental and participatory way, constructing "data as a boundary object" (Jensen et al., 2021, p. 118) between myself and the professional planners at Gehl. When I develop and test different data projects in the company, discussions about datafication, visualization and so on forces explication about the planners' ideas and expectations about how data can be used to problematize cities.

Figure 8.1: 'Project Review Session' in Gehl, where planners present projects and share feedback across teams. A context that I have also shared my research in. Credit: Author.

As emphasized by Madsen (2023) digital data – such as the ones used in this PhD - moreover present a particularly interesting opportunity for creating participatory data projects with a highly experimental capacity, because digital data typically "presents us with a vague empirical world that unsettles established links between measurements and values". This, in my experience, has been especially true when it comes to large datasets of *visual* digital data, which have been described as 'messy', 'wild', and 'complex' by my colleagues in Gehl: Whereas the company has not been used to working with visual data in structured ways, it has confronted the planners with uncertain and vague empirical situations, when I have introduced large digital datasets of citizen-generated maps and images in Gehl. This creates productive dissonance and friction, since the planners' established frameworks for interpreting and using other data cannot be modelled on to the images and map data examined in this PhD. This, Madsen (2023) states, creates inherently experimental knowledge, because the planners and I are forced to verbalize the different visions, assumptions, and interpretative frameworks with which we normally look at data and to co-create new concepts and operationalizations that help us navigate visual datasets. I leverage this by using my empirical projects, reported in Part II, as experimental and participatory situations in Gehl that open the company's data imaginary up to observation.

THE CONCEPT OF DATA IMAGINARIES

Neither Zuiderent-Jerak nor Haraway prescribes any methodological guidelines or methods that are key to empirically unpacking the field or culture within which one intervenes. Instead, these must be tailored to the research question in front of us. Guiding the observational gaze in this project has been the concept of data imaginaries. Extending on the concept of 'sociotechnical imaginaries' (Jasanoff & Kim, 2009), Rieder (2018) introduces the notion of 'big data imaginaries' to describe collectively held narratives, visions and epistemic commitments that contribute to the production and perpetuation of the role of data in society. Also drawing on the concept of socio-technical imaginaries, Mager and Katzenbach similarly discuss that different to ephemeral visions and partisan ideas, "imaginaries are collectively held and institutionally stabilized." (2021, p. 223). With a critical perspective on such imaginaries, Markham uses the concept of 'discursive closure' to describe how "particular values and (infra)structures are naturalized, neutralized, and legitimated, closing off discussion of alternatives that might counter current hegemonic power" (2021, p. 382).

The STS study of Gehl builds on these concepts to answer the PhD's secondary research question and unpacking the data imaginary in Gehl, construing this data imaginary as a heterogenous, multivocal and non-stabile phenomenon (more on this in Chapter 9). The concept of 'data imaginaries' is productive for the STS study for at least three reasons: First, it encourages an analytical lens that, different from other concepts such as 'professional vision' by (Goodwin, 1994), is not just concerned with how data-driven urbanism is *practiced* in Gehl, but also how it is *imagined*. Jasanoff and Kim for instance describe socio-technical imaginaries as operating "in the understudied regions between imagination and action, between discourse and decision, and between inchoate public opinion and instrumental state policy" (2009, p. 123). Second, the concept of data imaginaries is productive because it is less oriented with looking back and explaining retrospectively, and instead has a forward-gazing purpose that directs attention to how a data imaginary enacted in the present moment acts performatively to shape which data futures it is possible to imagine. This is especially described by Mager and Katzenbach who write that imaginaries are "concerned with the function, power, and performativity of future visions and how to relate them to the making and governing of digital technology" (2021, p. 225). When I began in Gehl in 2019, there were for instance a lot of interest in social media data, which was imagined to be an abundant, ready-made, and streamlined source of data, just waiting to be harvested for analysis. Although there was not practical experience with this method yet, social media data was a part of a vision of a digital future, which informed the company's investments in this PhD and other initiatives in the R&D team, hereby manifesting the very future that was envisioned (albeit a different version of it than what was envisioned). Third, the 'data imaginary' concept is a productive lens here, because it covers an inherently pluralistic and multivocal phenomena and does not assume that there is a fixed data imaginary in Gehl that it is my job to describe and distill as accurately as possible. While imaginaries are collectively held and professionally stabilized, Mager & Katzenbach argue that they are nonetheless ”multiple, contested, and commodified rather than monolithic, linear visions of future trajectories" (2021, p. 223). They also change over time, and are not fixed, but in motion. Gehl's organisation has for instance been constantly changing since the moment I began the project in 2019. The R&D team, for instance, has changed again and again, and has also undergone a strategic transformation, being redubbed from Innovation Team to R&D team, as result of changing visions and ideas about the role of the team in the company. Meanwhile, the rest of the company has equally changed. This is important to note since it also means that the company that I am observing is not constant, and therefore no coherent or absolute observations can be made about its data imaginary. It would be impossible, in fact, to identify one set of attitudes and practices around data that is coherent and consistent across time, and across the company' offices in New York, San Francisco, and Copenhagen. Building on such conceptualizations, the STS analysis explores the more durable and prevailing parts of the data imaginary in Gehl that is made up of epistemic commitments and discursive closures in the practice.

Method

While the previous section laid the theoretical fundament on which the dissertation builds its STS ambitions, this section describes what strategies I have taken to navigate a close-up study of Gehl.

POSITION AND STRATEGIES FOR INTERVENTION

A central challenge for this PhD has been how to position myself in the company where I am at the same time an insider and outsider. In scholarship on organizational sociology, it is typically highlighted that taking the 'outsider' position is advantageous when one seeks to create change in the organization, as Smith writes: "*In order to change, we need outsiders who are not contaminated by 'insiderness'*." (Smith, 2009). Meanwhile, the insider holds insights on the everyday practices that is grounded in the activities, relations and experience of everyday life, and Smith explains that this capacity of the insider is necessary when seeking to make change, because it creates legitimacy and relevancy when proposed changes are rooted in intricate insights about the practices of the company (Smith, 2009, p. 171). It is therefore suggested that the ability to 'challenge as an outsider' and 'know as an insider' is key to creating change in the organization, and that there is an advantage in being in-between the insider-outsider role. This is also the position I have taken in this study.

As a strategy for making and doing STS, I have built on Wickin & Crossley (2016) who propose that a researcher's role along the insider-outsider continuum can 'shift' over time and does not need to take a fixed position throughout the project phases, but can adapt fluidly along the continuum. Instead of getting fully immersed as an insider. Instead, it is suggested to take an 'alongsider' position; a hybrid between the insider and outsider that leverages the different methodological advantages of different positions during the research process (Wickins & Crossley, 2016, p. 236). But while advantageous, there are also challenges in trying to take an in-between role. One of them is to maintain boundary drawing, which I have experienced as a recurring task and obstacle if not constructed and uphold right, since too much nearness can be just as undermining as too much otherness and distance (Smith, 2009, p. 174). Boundary drawing and boundary maintenance has involved striking the balance of integrating and becoming a natural part of the team and the company, while still maintaining enough of a position as an 'alongsider' which makes it legitimate that I do something else than most colleagues; be it working on research instead of client projects, or recordings meetings as part of my observations in Gehl (Smith, 2009, p. 175).

To observe Gehl planners' everyday practices around working with data, it was crucial first to get close to these processes. To integrate into the company as an 'insider', I have for instance made it an ambition to sit permanently in Gehl's office, either in Copenhagen or New York to have an everyday presence in the company, take part in office meetings and social activities, and build relationships to the company planners as a fellow colleague. To make Gehl my 'home', I have only visited the university for meetings and workshops. This has been a radical choice, as most Industrial PhDs split their time between the university and company, to have a presence in both places. Sitting in the company was a deliberate choice taken to integrate into the company and break the perception that dominated in the beginning of me being an 'alien', 'unicorn', or 'special' guest. Meanwhile, Alvesson (2003) has pointed out how being too much of an insider can also lead to struggles with closeness and closure. Disadvantages of being too close to the field include potentially developing blind angles and/or normalizing practices in ways that may blur the observational gaze or make parts of the culture unobservable altogether. While I do not presume to have entirely prevented this, I have taken certain steps to produce healthy, critical distance to the company. Two years into my PhD, I for instance spent a full semester as a visiting PhD fellow at Massachusetts Institute of Technology in Boston, which took me out of the Gehl office at a moment where everyone (including myself) had indeed naturalized my presence. This produced physical and mental distance, as it took me away from the daily operations, the chats at the coffee machine and so on, and reminded everyone of my position as a researcher. To produce distance, I also have designed my experiments with visual data reported in Chapter 4, 5, and 6 as independent projects that have not been attached to a Gehl client but funded through collaborations with university partners alone. This was a productive way to ensure that my methodological innovation was not limited by the demands of company projects where short timelines and demand for fast results leave little space for the reflection that is demanded of a PhD. Instead, I would carry out independent research projects while getting input and feedback from Gehl colleagues. After my experiments, I would evaluate them with the R&D Team and help colleagues start to use the methods in client projects.

Another method for dealing with too much closeness is what Alvesson (2003) describes as "self-ethnography", which is different from auto-ethnography: Where auto-ethnography is introspection-based and typically about the researcher's own lived experience with an inward-looking gaze, the object of study with self-ethnography is not one's own experiences, but one's cultural context. Self-ethnography, according to Alvesson, describes a cultural setting to which the researcher has "natural access" as an active participant on equal terms with other participants. While I chose to refer to my work in Gehl broadly as a qualitative STS study, rather than any particular form of ethnography, Alvesson's notion of self-ethnography is a good description of how I have used my natural participation in the company in this case study. Different from participant observation, this research is not the main reason why I have spent the three years in Gehl: I have been there primarily to experiment with innovating methods for using visual digital data in studies of cities. Observations about the data culture in Gehl has been a secondary, reflective task: As Alvesson writes:

> ”The person is thus not an ethnographer in the sense of a professional stranger or a researcher primarily oriented to studying the specific setting. Participant observation is thus not a good label in this case, observing participant is better. Participation comes first and is only occasionally complemented with observation in a research- focused sense.” (Alvesson, 2003, p. 174)

These distinctions are useful to help situate the sort of observations I am doing here. Alvesson, further argues that while conventional ethnography is a matter of the stranger entering a setting and “breaking in”, trying to understand the natural participants in a field from their point of view, self-ethnography is more a struggle of “breaking out” (Alvesson, 2003, p. 176). While I have already touched upon some strategies for boundary work, the approach proposed by Alvesson suggests that the acts of doing observations, writing notes, and making recordings of the cultural setting can in itself help upkeep a critical distance to the practice I am studying and add reflection to it.

OBSERVATIONAL SETTINGS AND CASE SELECTION

The three data experiments carried out with social media data, photovoice, and participatory mapmaking have been designed in this PhD as interventionist strategies that bring visual and digital methods in ‘critical proximity’ (Madsen & Munk, 2019) to Gehl’s knowledge culture. In doing so, they disturb, irritate, augment and challenge established ‘ways of knowing the city’ (Kurgan & Brawley, 2019; Pink, 2013) among the company’s planners, making it possible to study their data imaginary up close. As briefly touched upon in the Intrudoction of the dissertation, the three visual methods have been selected as sites of experimentation in collaboration with Gehl, hereby anchoring the experiments with social media, participatory GIS, and photovoice in innovation streams in the company. To re-iterate: When I started in Gehl in 2019, I had no idea which visual data sources it would be relevant to work with. Meanwhile, I saw that the company often talked in projects and pitches about basing urban design and strategy on studies of ”lived experience”. Meanwhile, none of their core methods at the time captured citizens’ lived experiences. As Chapter 9 will show, Gehl’s methods primarily involved planners observing and counting how many people use a space at a certain time, without involving citizens' in reporting how they experience the city. Observing this disconnect between what Gehl was interested in and what their data methods captured, I made the decision to only work with citizen-generated visual materials to anchor my experiments in data sources that could indeed foreground lived experiences. Following this, I took different strategies to involve Gehl in selecting three visual methodologies as sites of experimentation: Social media analysis was selected by a 'follow management' logic, being a method that the Chief Innovation Officer, Jeff Risom, was interested in, when the PhD began in 2019. Participatory GIS was selected as the second experiment with a 'follow the tools' logic, from the observation that at the time the PhD begun, Gehl had just started using the tool Maptionnaire to make spatial questionnaires. Finally, photovoice method was selected from a 'bottom-up team' logic: Presenting different sources of visual data in a workshop with the R&D Team, the team and I decided together that it would be most relevant to test photovoice as the PhD's third experiment.

Carrying out experiments with these three data methods have been the main setting of my observations in the STS study and has entailed a process in which I continuously presented my empirical work to company supervisors, the R&D team, and the rest of office. In this process, I have taken notes of and recorded in different ways how the people in Gehl responded to the data projects in different ways. What were they excited about? Which choices or aspects of the data experiments did they question? When were there disagreements or uncertainty? Aside from the experiments themselves, however, my observations have also focused on three other settings. I have observed existing methods and practices, by studying old cases and collaborating on projects in the company. I have followed the 'social life of methods' (Savage, 2013), examining when and how Gehl began to integrate the methods used in my PhD in other projects. Finally, I track what tools and methods are developed in the R&D team in parallel to my research. To summarize, I do observations in four setting:

1. *Existing methods & practice*: What methods are used in Gehl projects, and which traditions for studying public life have been stabilizes over years in the company?

2. Carrying out empirical experiments: How are the visual data used in my PhD interpreted and framed in Gehl? Do they add to, irritate, augment, or disturb current practices?

3. Following the social life of methods: When and how does Gehl begin to integrate the tested methods in their projects? What are they used for, and how is visual data framed?

4. *Tracing initiatives in the R&D Team*: What innovation streams happen in parallel to my own research in the R&D team? Which data tools and methods are being developed?

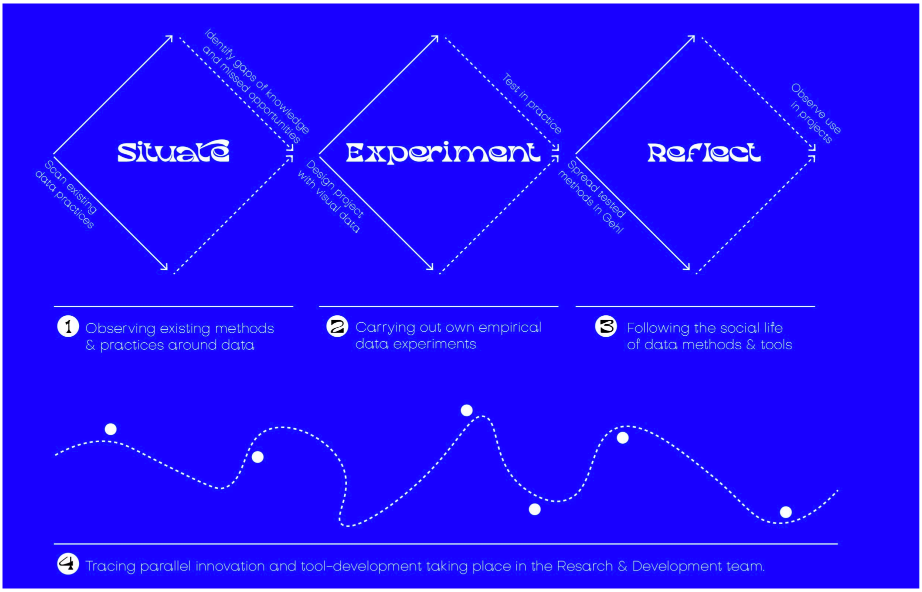


Figure 8.2: The four settings of observation that I base my STS study on.

The observations carried out across these settings (visualized in Figure 8.2) have for the most part been what we could call a 'secondary' activity that happened in naturally occurring situations, in which I simply remembered to document whenever a meeting, project, workshop another interaction in Gehl gave rise to interesting insights about the company's data imaginary. Most observational materials are from such naturally occurring situations that had their own purpose, and involved writing notes in a research journal, taking photos, saving a presentation or document, taking screenshots (there were a lot of Zoom meetings), recording meetings and brainstorms, or something else. This was, however, supplemented by situations designed by me as moments to inquire about the data culture in Gehl. This has involved inviting colleagues for workshops or brainstorms to talk about data culture, doing interviews, or something else. In the first month, I for instance carried out short interviews with members of the R&D Team to ask they thought about innovation in the company. I have also done independent interviews with co-founder Jan Gehl in 2020, and CEO Helle Søholt in 2021, and organised workshops with team leaders to learn what role data plays in projects in different teams. Over the years, I have built a research collection of +2000 entries and a research journal that I use as the empirical base in my qualitative analysis of the data imaginary in Gehl.

Materials: A hybrid collection

The materials in the observational collection consist of digital and analogue notes, sound recordings, found images and document on Gehl's server, my own photos from within the office, screenshots, recordings of meetings and brainstorms, company newsletters, emails and Slack correspondences, project reports and slide deck presentations, among other materials, that exemplify a certain process or way of working with data in the company. With the help of two students assistants, this primary material has been compiled into a digital archive in the software Atlas.ti, where it has been aggregated, synthesized, and structured into a cohesive dataset (Gitelman, 2013) through a process of transcription, classification, and coding of overall themes.

ETHICAL CONSIDERATION

The first point of ethical consideration to take is of course that Gehl as a company has been informed from the beginning about the STS study I carry out. Early in the process, I informed the company PhD supervisors and the Data Protection Officer (DPO) that I would be collecting observations throughout the PhD. They consented that I was allowed to do so. To protect the anonymity of individual colleagues, I also made an agreement with the company's DPO that I would not share any of my observational materials with the company but store it separately on university servers. In the complex power-dynamic between employees and partners, this was important to ensure that management could not access my observational materials and use it to "listen in" on what employees, partners, or clients discuss in closed meetings that I have been permitted to record. To formalize this as a legal frame, we made a data processing agreement between Aalborg University and Gehl that allows Aalborg University to store and process the observation material, and that Gehl as the "data controller" would revoke rights to ask for this material to be handed out to them.

To inform colleagues in Gehl about my observation work, I asked the company CEO to include a message about it in the monthly newsletter as well as to mention it on the monthly company meeting. The message informed everyone that I would be doing observations of Gehl as part of my PhD of the data processes in Gehl. The message invited colleagues to tell me not to record if they did not consent to be a part of the study, and stated that colleagues could always ask to have observation materials deleted. In this way, I ensured an *active* consent from management and accepted a *passive* consent from colleagues. I moreover have invited everyone who is cited in the analysis in Chapter 10 to review and approve their quotes before publication. While I offered all an option to use a pseudonym in the analysis, every colleague has approved that I use their real names.

In doing this STS study, a central question has also revolved around what sort of access and editing right Gehl as a company should have over the analysis in Chapter 9. My choice not to let Gehl have access to the observation materials as a dataset was a deliberate choice to not just protect privacy of colleagues, but also to avoid giving Gehl editing rights over the materials. To ensure an independence in my analysis of Gehl's data imaginary, it was important not to hand over authority or power-over-narrative to the company. Differences between doing observations 'upward', 'downward' or 'sideways' (Cassell, 1988; Schrijvers, 1991) creates different methodological concerns about power and authority in the relationship between observer and observed. In my case, I am doing observations 'upward', since I am an employee trying to describe a knowledge culture in a company that pays my bills and decides if I have a new contract with them on the other side of the PhD. Gehl, moreover, through their long legacy of publications has a well-documented history stretching back to before I was even born, being solidified, and carefully constructed over decades in books, projects, professor-ship titles, and so on. In this power configuration, it has been a choice to not hand over any authority over the STS study to Gehl. This also means that I am fully and solely responsible and accountable for the observations presented in Chapter 9, which represent my partial perspective. Meanwhile, it has been important to treat Gehl and my colleagues with the same 'ethics of care' (de la Bellacasa, 2017) that I treat research participants in my urban research. Prior to publication, I have therefore shared the forthcoming analysis of Gehl's data imaginary with the company's CIO and DPO for the sake of transparency and have given the CIO a chance to respond to my observations by suggesting nuances and contextualisation that I have used to qualify the analysis.

Chapter 09

Unpacking GenAI's data imaginary

Unpacking Gehl's data imaginary

Whereas the previous chapter outlined how I approach the study of Gehl's data culture, this chapter dives into an analytical, qualitative reading of data imaginaries in the company, construing 'data imaginaries' in line with Rieder (2018), Mager and Katzenbach (2021) and Markham (2021) as collectively held visions, epistemic commitments, and discursive closures that guide the production and perpetuation of the role of data in planning. First, though, a few high-level remarks are in order.

For one, unpacking data imaginaries is a complicated task, since an imaginary is constructed, deconstructed, and reconstructed continuously (Jasanoff & Kim, 2009; Rieder, 2018). It is both formalized through strategic visions and defined top-down, but also emerges as bottom-up practice when employees across different teams and offices work on different data projects. It is also susceptible to what clients are requesting, what datasets collaborators make available, and how competitors work with data. In the early 2020s for instance, several planning studios were bought up by engineering companies, meaning that Gehl's competitors might begin to work with data in new ways. And when collaborators at Google share a unique air pollution dataset, it gives Gehl the opportunity to link datasets and connect the built environment to public health (more on this later). The data imaginary in Gehl is the result of all these factors, external as internal. Put differently, the imaginary is as Mager and Katzenbach (2021) explain not monolithic and stabile, but multivocal. While I speak of 'the data imaginary' in singular, I thus reference a phenomenon that is inherently pluralistic and consists of a multiplicity of visions about what data are and can be used for - sometimes aligned, other times contested or in motion. Of the multiple imaginations at play in a knowledge culture, however, some tend to be more *durable,* as argued by Jasanoff and Kim (2009, p. 123). These, I focus on here.

Second, these observations are not meant as an unproductive critique from the outside of a knowledge culture which I see myself as exterior to. Rather, I see myself embedded in this knowledge culture and am invested in cultivating it. The observations are therefore meant as a constructive contribution to how planners think about the power and performativity of their own imaginary, and how the expectations and visions that are enacted every day guide the making and governing of data technologies and practices in the company. My study of the data imaginary in Gehl, thus come from an interest in evaluating how the collectively held visions around data that are enacted in the *present* materialize in shaping what data *futures* it is possible to imagine.

Third, I do not claim that the following observations represents every part of a data imaginary in Gehl. For instance, it is central to many knowledge cultures working with data to believe that data visualization is a more convincing way to present insights than sending clients a spread sheet; or that storing data digitally is preferable to chiseling in stone. These are cire beliefs about working with data in most knowledge cultures and are not unique to Gehl. Most data projects are also shaped by practical conditions related to time management, budgets, client demands, and so on. We might imagine such core beliefs and practical conditions as aspects of the data imaginary that make up its middle: Just like the magma floating around in Earth's center, they make up the core and inner shell (see Figure 9.1). This is, however, not what I focus on here. Instead, I am interested in identifying the epistemic commitments and collectively narratives that outline the contours of the data imaginary in Gehl and draw up boundaries of what is included and excluded in the company's data practices. Continuing the previous metaphor, we can imagine these as tectonic plates: They shape the "ground" that the data practice stands on. Meanwhile they are not fixed but can shift and move.

Fourth, these observations offer what Haraway (1988) would call a 'partial perspective' and represent only what has been observable to me throughout my three years in the company's R&D Team. That being said, this chapter dives into seven epistemic commitments that I identify as part of the data imaginary in Gehl:

1. **Visuals as non-data**: Images framed as output, not input.
2. **An inherited observational gaze:** Little involvement of citizens.
3. **Universalistic assumptions**: We experience cities the same.
4. **Negotiating spatial ontologies:** the objective/subjective binary.
5. **Innovation equals tool making**: Technology over practice.
6. **Leap frogging**: Incremental over radical innovation.
7. **Commensurability**: Connecting the dots creates the magic.

In practice, these commitments are entangled and unfold together, making the act of separating them an artificial exercise. Still, I describe them one by one to give a distinct idea of how they shape data practices in Gehl. To discuss how each part of the data imaginary can be expanded upon, I end every section by linking back to my own data projects that exemplify how digital and participatory visual methods might make alternative data-driven practices possible.

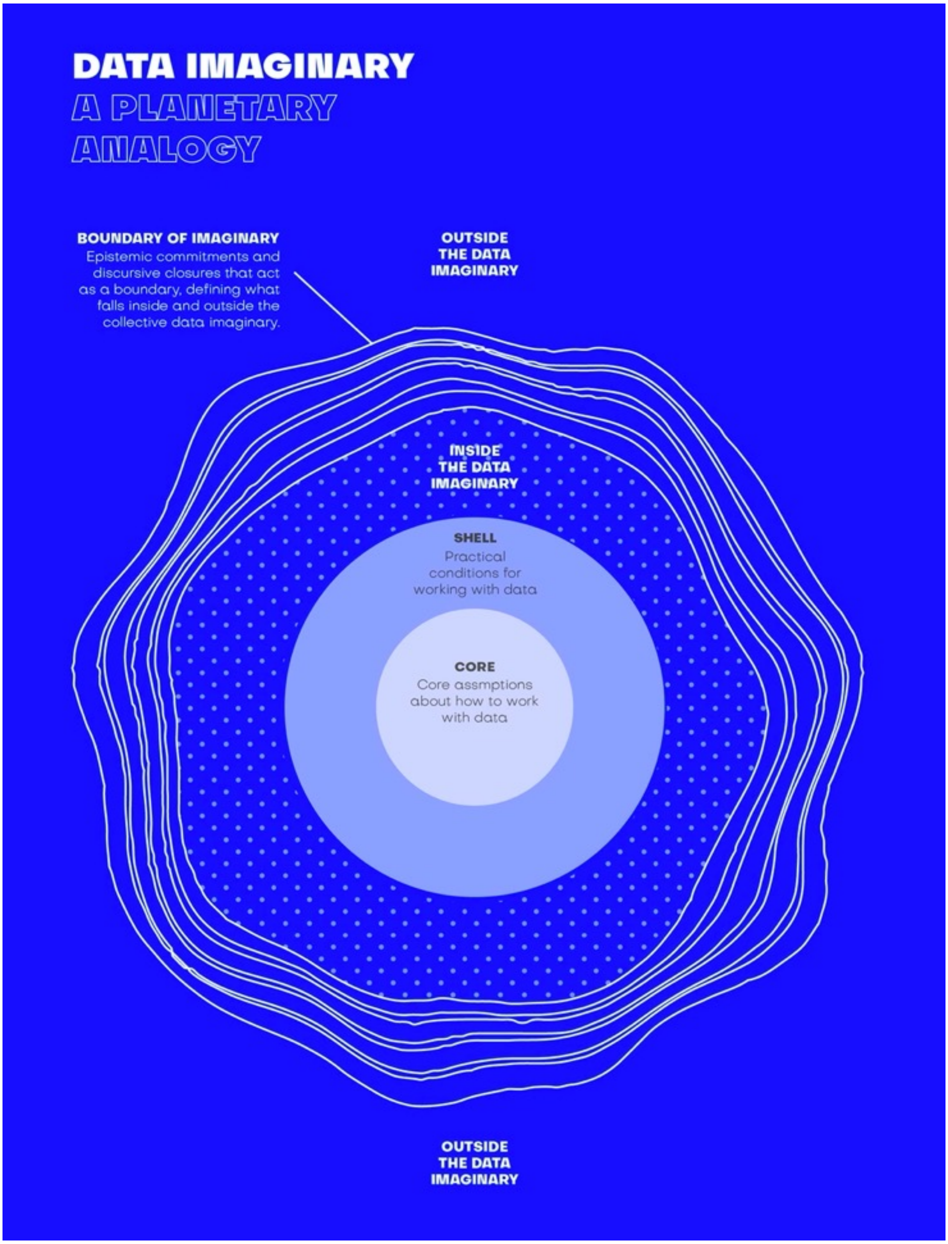


Figure 9.1: Illustration of a *data imaginary* consisting of a core, shell, and boundary: While the 'core' is foundational premises for working with data, the 'shell' is practical conditions of data projects. The 'contour' references epistemic commitments that define what falls in- and outside the imaginary, which is what I explore here.

1. Visuals as non-data

To understand the role of visual materials in Gehl when starting my PhD in 2019, I spent my first weeks studying old projects, and asking people if visual materials was used as data in their work. Nobody seemed to have a strong sense of this, but many referred me on, saying "you should talk to Vanessa", who at the time worked in the communications team. "She is looking at photo data and AI", they said. So, I set up a meeting with Vanessa and explained that I was hired to do research on visual data and computational methods and was curious to learn how she was working with this. While we met in good spirit, confusion emerged when I explained that I was interested in collecting images from for instance Instagram and use them to see how citizens experience cities. To Vanessa, what was relevant was not to collect images from citizens, but to become smarter about using the photos that Gehl's planners produce. Discussing this, she said:

> "Vanessa: We have a lot of photos. We have like 1.3 terabytes, but it is all raw stuff out of which I would say 30% is useful. We struggle every single day to find good images and spend a lot of time on that. The majority are from projects where the team goes on site visits and takes images.
>
> Sofie: Does Gehl also collect images from locals?
>
> Vanessa: No, we don't ask locals to take photos. They would be bad quality. Our planners are way better at capturing a place. We used to have a structured folder with the best photos, but it's totally out of date. (…) People hoard images on their own hard drive or store them in project folders. So, it's been an issue for the past eight years to figure out what to do with all our images. I am looking at digital libraries like Binder that sort images with AI."

Since Vanessa worked in the communications team, it should be noted that she was answering this from a perspective of how images can be used to disseminate projects and Gehl's brand. She was not working on using data in projects. Still, what became clear from this interaction was reflected in most other interactions I had: Whenever I had talked about visual data in my first weeks, most colleagues thought of the photos produced by the planners in the company, while I on the other hand was thinking about citizen-generated visuals. While I was implicitly interested in citizen-generated visuals as *input*, a source of data with which to learn something about how people use public spaces, most colleagues I spoke to thought that the 'visual data' I talked about referenced Gehl's own images and the way that the planners used photographs as *output* to communicate observations about cities. The visual, I experienced, was perceived as valuable in its capacity to make convincing arguments, in line with Latour's notion of *inscriptions*:

> "What is so important in the images and in the inscriptions scientists and engineers are busy obtaining, drawing, inspecting, calculating, and discussing? It is, first of all, the unique advantage they give in the rhetorical or polemical situation. 'You doubt of what I say? I'll show you.'" (Latour, 2011, pp. 67–68)

In Gehl, such visual inscriptions are produced every day by the planners who make architectural drawings, maps, renderings in 2D and 3D, illustrations, models in foam and Lego (see Figure 9.2), and use photography to document and communicate about the urban environments they work in. Planners might also use Google Street View and Google Earth to get a sense of a new site, before being able to go and visit it themselves, hereby depending on computational visual technologies to get to know the city. But despite constituting a highly professional visual practice, the planners did not collect visuals from *citizens* as input to their studies of public life, which depend on other data (more on this later).

Figure 9.2: Use of the visual as design tool and output: From looking at data visualizations, prototyping with Lego, and modelling, to drawing on maps. Credit: Author's photos.

A first observation about the imaginary in Gehl is therefore that although the company has a deeply visual practice, visual materials created by citizens were not construed as *data* when the PhD began in 2019. This is interesting, since what counts as 'data' in any context is not a neutral question. With the book 'Raw Data is an Oxymoron', Lisa Gitelman (2013) has showed that there is no such thing as "raw" data, and that we should think of data as culturally curated rather than a naturally occurring resource. Data are not 'found' but made (boyd, 2021), and datasets come into being through a process of curation, and classification. What is and is not considered 'data' thus is a key part of any data imaginary. In that light, I was surprised to learn that visuals by citizens were "framed outside of Gehl's data toolbox", as expressed by the Chief Innovation Officer, Jeff Risom.

INVITING IN THE VISUAL AS DATA

While literature reviews in the articles in Chapter 2 and 4 showed an over-commitment in urban studies to textual and numerical data, I thus found a similar omission of visual data in the planning practice in 2019. This has however since changed: As I have carried out the experiments documented in Chapter 4, 5, 6, the company has been quick to shift their imaginary of what counts as data to also include visuals created by citizens. The company has adopted all three methods tested in this PhD, and has already used social media images, participatory mapmaking and photovoice in various projects, albeit with varying results and different methodological adaptations, as I shall get back to. Figure 9.3 exemplifies this with snapshots from three projects: One example is from 2020, where Instagram data was used in a mobility study of Hamar, Norway to investigate how far outside the physical city that people associate Instagram images to Hamar city. A second is from 2021 where Gehl colleagues in New York used Instagram data to study place identity of sites across Akron, Detroit, Philadelphia, and San Jose, combining Instagram data with more traditional Gehl data sources. A third example is a study for an American university where a Gehl team in the US used photovoice to examine students' on-campus experiences of belonging with the photovoice app developed through this PhD (documented in Chapter 7). These cases also show that while the experiments documented in Chapter 4, 5, and 6 were carried out in Copenhagen, the three methods have been tested across all Gehl offices and used in projects at a global scale: in Europe and the US primarily as seen in the examples, but also in projects in the Middle East and Southeast Asia.

Figure 9.3: Use of Instagram data (left and center) and photovoice (right). Courtesy of Gehl.

As hinted in the Preface of this dissertation, the omission of visual data in planning hereby did not stem from a lack of interest, but rather a lack of rigorous and scalable methodologies that make it possible to work with big datasets of visual materials. As expressed by the CIO, the reason why Gehl was not working with visual materials as data in 2019 was primarily because "tools to invite and understand visual materials were analog and unsophisticated". This makes clear that materials are considered data in Gehl when they can be aggregated and analyzed in numbers. By leveraging the capabilities of digital methods, the empirical experiments in Chapter 4, 5, and 6 productively have demonstrated that working with photos and spatial data need not be a manual and unstructured task. Instead it can involve aggregating images as datasets and leveraging GIS techniques, user annotations, and computer vision to sort and classify images, evoking a turn from manual and individual image analysis to computational pattern-recognition across a group of images as unit of analysis, as proposed by Colombo (2019). Today, this has invited the visual into Gehl's imaginary as data.

When citizen-generated visual materials were omitted in Gehl, they might also be left out among other urban actors or data-driven consultancies. But it could just as well be that there are other data sources that are overlooked even though they could be of value to the field of study. The invitation for any knowledge practice who seeks to expand this part of their imaginary is therefore to ask the question:

What sources of information are construed as potential "data" within the data imaginary in your practice, and what are you hereby excluding as non-data?

This part of the imaginary, construing the visual as something the architect works with to communicate and illustrate, relates to the second observation.

2. An inherited observational gaze

> "I have never really used surveys or interviews that much, and I was never a big believer in citizen assemblies. I have always had the opinion that via my research, I knew more than people do themselves. People cannot always articulate why they do something. We can observe it, better than they can explain it themselves. "

Such says Jan Gehl to me in an interview in 2020, three months into my PhD. Jan is retired and no longer working in Gehl, and his viewpoints do not reflect the company's one to one. Yet, his approach to studying cities has shaped the practice and continues to constitute an intellectual and methodological legacy that underpins the data imaginary in Gehl today. The statement above explicated what I had seen a glimpse of early on and have since been able to observe as a trend in the company's projects: While data methods vary[10], most projects use data produced *about* citizens, and rarely data produced *by* citizens when studying public life. The practice, in other words, is characterized by an observational gaze with which the planners look onto the city and dissect urban life without engaging citizens. This is already exemplified in the previous section, where it was made clear that Gehl planners take many photos of the city, but seldom ask locals to document how they see a place. Unfolding this, I asked Jan if he has ever used participatory methods to which he responded that he has not been interested in that and instead seen observation and photography as the architect's core methods for studying cities. In our interview, I followed up on this by asking:

> Sofie: So, observations give a better idea of what people do than asking them?
>
> Jan: Yes. Because what happens, happens. And of course, you can make wrong observations or take bad notes, but nobody can change that you saw what you saw. That is more reliable than asking people what they think they are doing. We for instance once studied suburban gardens in Australia and saw this lady come out five times on a Sunday to check her mailbox. Even though mail is not delivered on Sundays, she kept coming to get a chance to run into the neighbor. People would not be able to explain that if you asked, but we can observe it."

Inherent in Jan's quote is a particular epistemic commitment that frames the architect's ability to observe public life as more trustworthy than what accounts would come from doing interviews with people. This observational gaze is also deeply ingrained in Gehl's core methodology, the *Public Space Public Life* (PSPL) survey, which entails doing quantified counts of how people stay in or move through a space, as well as observing various features of the environment.

This is a methodology tested and refined over many years, and documented in publications like 'How to Study Public Life' (Gehl & Svarre, 2013). In short: *Public life* is typically surveyed quantitatively by sending planners or students to a given site, asking them to stand in the same place and count how many people pass by, while registering people's perceived age and gender (see Figure 9.4). This

[10] Data methods vary a lot across teams: In projects where Gehl works in an existing neighborhood, there is possibility to collect data about public life and use it to inform strategy and design. When doing masterplan development in brown or green field sites with no public life to observe, project teams typically depend on other data methods that for instance simulate expected effects of a masterplan on housing, climate and so on. What I speak to here is projects where Gehl is studying public life.

gives a sense of how a space is used at different times of day and over different weekdays.

Figure 9.4: Snapshots of the PSPL toolkit. Left: Photos of observer doing public life counts with printed maps. Right: Schematic for studying façade quality on maps. Courtesy of Gehl.

Aspects of the *public space* are also observed qualitatively by planners with standard frameworks such as '12 quality criteria' and 'façade activation' (Figure 9.4), or registration of the urban furniture in a given site. This PSPL methodology provides the empirical foundation in most Gehl projects and links observations about *public life* and *public space* together. Returning to my interview with Jan, it becomes clear why such observation has been useful, when we continue our talk:

> Jan: In the 60s and 70s, cities all over the World had traffic units collecting data about cars and traffic flows. But not *one* city was collecting data about public life, pedestrians, or bikes. This wasn't being counted. And since there was no data, it was never on the agenda in decisions about the city. (…) This part of the urban life was totally understudied. But because there was a lot of traffic data, cities were being planned to be effective for cars, rather than good for humans. Copenhagen was the first city to start doing studies with the Public Space Public Life survey."
>
> Sofie: And what did this mean for planning?
>
> Jan: Suddenly we had data about where people spend time. That made it possible to see patterns in how urban design affects people's use of cities. This enabled us to put public life on the agenda and suggest how to improve it. The company started from this. We did PSPL studies in a myriad of cities. Nowhere did they have data about people. (…) That is why we say that "what you count, you care for". If you don't measure something, you cannot put it on the agenda."

Retracing the origins of the company's data practice like this makes clear why the observational method has been pioneering: In a context where nobody had any data about how people use the city, a lot of ground needed to be covered by simply observing public life and standardizing methodologies for registering it. There are no doubts that the counts of public life and qualitative observations of public space have been (and continue to be) valuable in providing an empirical foundation for data-driven urbanism that centers people, as opposed to cars for instance. But as Jan's quote in the opening illustrates, the observational gaze is so strong that little value is ascribed to interviews with citizens or other participatory methods that involve or elevate local knowledge. To be sure, there are anthropologists, sociologists, and planners in Gehl who see value in qualitative methods like interviews and focus groups, and push to integrate them more in projects. Sometimes digital surveys are sent out or intercept surveys are done on the street. It is also more common in Gehl's US offices to use participatory methods, which might indicate that the 'inherited' observational gaze is less strongly framing the data methods used outside the Copenhagen office. Yet, such methods are not a part of the PSPL toolkit, and it is more the exception than the rule engagement methods are used to involve citizens.

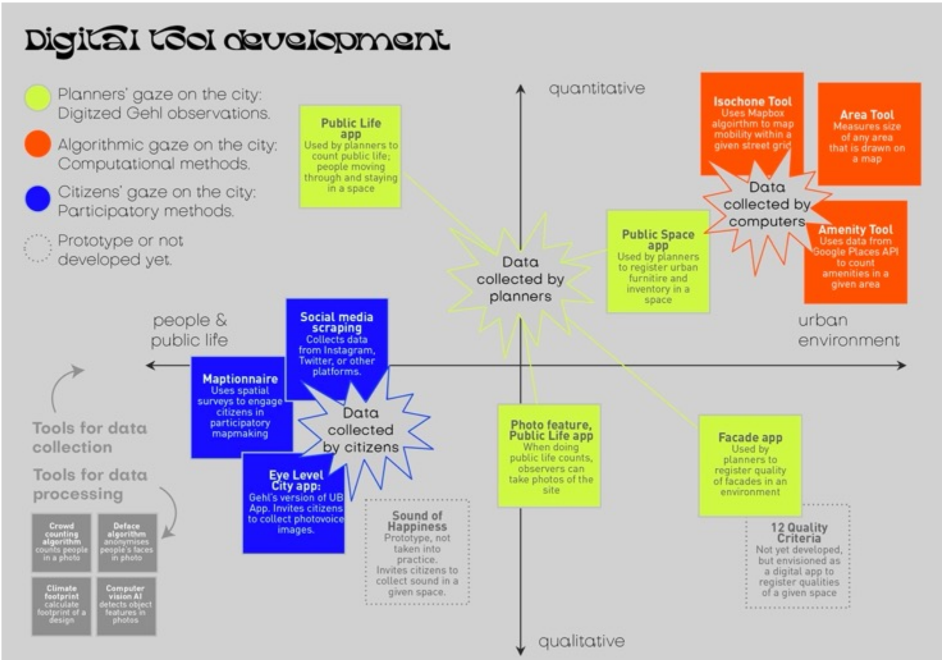


Figure 9.5: Map of tool development in the R&D team from 2020 to 2023. By author.

The observational gaze also saturates the technology innovation that has come out of the R&D team in the past three years. This became apparent when Technology Lead, Nina, and I mapped the tools developed, as seen in Figure 9.6, placing them in a matrix according to whether they collect qualitative or quantitative data (or a mix), and if they collect data about people or urban space. What is evident here is that there has mostly been focus on creating tools that collect data about the urban environment in qualitative or quantitative ways (right side of matrix).

Aside from the three methods tested in this PhD, which all fall within the bottom-left corner of the matrix (blue in the Figure), only one tool has been developed to collect data about people; the Public Life app which is a smartphone app for doing public life counts digitally (more on this later). All these tools extend the planners' observational gaze. Nina also spoke to this during our mapping exercise:

> "The tools we have developed over the past three years primarily do one of two things: Either they introduce a computational gaze on the city by for instance drawing in Google data about amenities in the public realm, or they extend Gehl's professional gaze with apps that planners or others can use to count public life in digital ways. In contrast, it has not been high priority to make tools that lets the citizen capture data about their urban experiences."

The observational gaze hereby guides the company's innovation and development of data methods, privileging tools that can allow the planners to observe the city at a distance. An important nuance to add here is that a lot of energy has been spent in Gehl on packaging the Public Life App as a digital service that clients can subscribe to, in which case they get access to the application and can use it locally to collect public life data themselves. There are thus increasingly instances, where it is local communities and not Gehl's planners who are using the app to register public life. Meanwhile, this still extends the planners' observational gaze, since local communities are simply trained to do the observation counts that Gehl normally does. As Figure 10.4 shows, no tools other than the ones tested in this PhD engage citizens in collecting data about how *they* experience the city, as also spoken to by Nina. The part of the data imaginary that is shaped by this observational gaze hereby materializes in the making and governing of digital technologies within the practice, demonstrating as Mager and Katzenbach says, how imaginaries are "productive in the actual construction of the future" (2021, p. 224). Such investment in data infrastructures reproduces an inherited observational gaze from Jan Gehl's original studies, locating the observational capacity within the professional planner and ascribing little value to citizen's local knowledges.

SEEING CITIES THROUGH THE EYES OF CITIZENS

The observational gaze that characterizes the data imaginary assumes that the planners in the company hold a privileged epistemic position from where they are able to look upon urban life and decipher and decode it, with the input of citizens being an add-on, rather than a necessity. This resembles the epistemic position that Haraway (1988) has called the 'God's eye trick' and critiqued as a disembodied vision that assumes the ability to 'see everything from nowhere'. Taking steps to unsettle this, the visual experiments carried out in this PhD have demonstrated what can be gained from supplementing Gehl's observation method with approaches that engage citizens in reporting how they experience the city. Whereas the Instagram analysis, Chapter 4, showed how we can use social media images to study place attachments through the eyes of citizens, the articles in Chapter 5 and 6 took steps further 'up' the ladder of participation (Arnstein, 1969) and used photovoice and map-making to also involve citizens in data *analysis* and *interpretation*, hereby locating interpretative power in participants. While hereby creating different degrees of involvement of the citizens, it is important to be transparent about the fact that the three visual methods tested in these experiments still involve a central role for researchers in for instance designing the process, inviting communities, and deciding what data methods to use. Participatory methods, in other words, do not get rid of the expert altogether. But as demonstrated in the Urban Belonging Project, participatory data approaches offer a chance to involve citizens in co-producing knowledge and can hereby contrast the professional observational gaze in ways that elevate community voices and foreground local lived experiences.

Evaluating the three methods of social media, photovoice and map-making against each other through frameworks like Data Feminism (D'Ignazio & Klein, 2020b) and Design Justice (Costanza-Chock, 2020) it could moreover be questioned if the use of social media data in studies of cities risks extending the observational gaze. As seen in my own Instagram study in Chapter 4, a social media analysis can often be somewhat extractive, and has limited opportunity for involving citizens in co-producing knowledge in a participatory workshop. The Soft City Sensing article in Chapter 2, similarly critiqued that social media data is often used to study the city in a 'hard city sensing' interest, that mainly use geotagged social media data to study the flows of people in urban space, without much attention to how citizens experiences cities. This might be problematized as a form of 'geosurveillance' (Kitchin, 2015), and social media analysis can in its most problematic applications hereby extend a deeply observational gaze and contribute to what Haraway critiques as the God's eye trick. In that regard, it is relevant to echo Loukissas' credo from *All data are local*: "treat data as a point of contact, a landing, an opportunity to get closer, to learn to care about a subject, or the people and places beyond data. Do not mistake the availability of data as permission to remain at a distance" (2019, p. 196). With this credo, social media data can also be used to get closer to citizens' experiences as demonstrated in Chapter 4's Instagram study.

Returning to Figure 9.5, the bottom-left corner shows that the three experiments documented in Chapter 4, 5, and 6 have contributed new data methods in Gehl that augment the observational gaze by centering participatory, citizen-led data.

Any practice who seeks to examine this part of their imaginary could ask:

With whom do you locate the observational capacity in data projects, and how might you resituate this to embrace a pluralism of perspectives?

3. Universalistic assumptions

The observational gaze in Gehl is also correlated with a universalistic approach which assumes that people experience cities in the same ways, and that it is possible to make generalizable observations about how a space works for all people. A part of the PSPL toolkit for instance is a standardized schematic called the '12 Quality Criteria' (see Figure 9.6).

Figure 9.6: Left: The 12 Quality Criteria tool for registering public space. Middle: Public life app interface for counting people in a space. Right: Dashboard with public life data. Courtesy of Gehl.

Planners use this on site visits to register different qualities of a space; how is the microclimate, noise levels, protection from traffic? Is there option to sit? An invitation to play? This tool has been refined by Gehl throughout many projects, consolidating years and years of observations into twelve criteria that in the planner's general experience influence the quality of a space for humans. Relating back to Jan's description of the lack of knowledge in the 60s and 70s around public life, it is understandable why such general rules about what makes a space attractive for people has been highly warranted and helped put human-scale cities on the agenda in planning.

Such criteria, however, also assumes that all humans have the same needs and preferences in urban spaces. Contributions within *data universalism* (Milan & Treré, 2019), and *data feminism* (D'Ignazio & Klein, 2020b) would for example challenge the idea that a planner (or any one person) can register how much protection from noise there is in a space, since this might be experienced differently by blind people, children, elderly, and mentally ill, just to name a few. What feels like good protection from noise for one of Gehl's planners, might not be the same for all others. But such difference in experience is omitted as long as core data methods used to study public life depend on the planner's observations, as previously discussed, without engaging citizens in reporting their urban experiences.

While this part of the data imaginary has been stabile for years, it is slowly starting to stir. The BlackLivesMatter uprising in 2020 for instance launched renewed discussions around bias as expressed by the CEO in the monthly newsletter:

> "I highly appreciate the conversations that have taken place in all teams discussing the brutal murder of George Floyd and the subsequent reactions to end structural racism and discrimination. We too need to take our own medicine when talking about building cities for all, and we too can do better in terms of understanding the issues, our biases and how we can then respond (…)"

This and other events have instigated a gradual shift in the culture in Gehl from using data methods that build on universalizing assumptions to becoming attentive to the need for more diversified data methods, especially in response to changes in the market where diversity, equity, and inclusion is increasingly on clients' agendas. Despite growing awareness, however, the practice has been slow to rework their data methods. The universalistic approach is not only baked into the *public space* study as exemplified with the 12 Quality Criteria. It also permeates the *public life* data collection where observers count how many people move through a space, while registering people's age and gender as perceived by the observer (see Figure 9.6). This not only extends the observational gaze already discussed with the assumption that an observer can correctly gauge people's gender and age without talking to them. It also divides the urban population into binary categories like 'men' and 'women', which do not necessarily reflect how many people identify, and assumes that for instance all 'women' experience cities the same, without taking other factors into account such as ethnicity, physical and mental ability, and so on. As an approach to studying public life, the PSPL method hereby tends to assimilate the heterogeneity of diverse ways of experiencing the city and gloss over differences in people's premises for taking part in urban life, resembling the data universalism critiqued by Milan and Treré (2019) and D'Ignazio and Klein (2020b). Adding to this, public life observations are never carried out after 11 pm, meaning that there is not empirical attention to public life at nighttime, and how it differs from how the city is used during daytime. Returning to Haraway's (1988) notion of the 'God's eye trick', she argues that this universalizing gaze entails an erasure of the particularity of a visuality which means it does not lend itself to be held accountable, because it presents as universal and disembodied, rather than partial and situated. To design cities for all people, it seems important to diversify this universalistic approach and question which citizens the data methods make visible, and who they make invisible in Gehl's studies of public life. Such reflection was also expressed by one of the directors, Louise, in an interview in 2021, where she reflected that an inherent bias in the on-site observations involves that the public life data only captures those who already are active users of a given space:

> "We say that "we measure what we care about", but is that actually what we do? Or are we just measuring what we *can* measure by observing who is already in a space? When we go out and do observations, we only see people who already feel included and welcome in a given space. So how do we see the people who are not there? Who don't feel like they belong in the city?"

When Gehl bases a study of public life in a space mainly on on-site observation, the empirical foundation on which the future of the city is planned only includes the users of the city who are already *there*. I will pose that this risks creating what Costanza-Chock (2020, pp. 77–78) calls a "spiral of exclusion" with which planners center the most socio-economically powerful users, while other groups, are systematically excluded as imagined users of the city. Meanwhile people who are not already present in a space are beyond observation and do not become visible in the datafication of public life, as long as participatory methods are not used to engage other citizens too. To diversify planners' ideas about who they design for, it is imperative to cultivate data methods that diversify such universalism and include citizen-led and pluralistic perspectives on how cities are experienced differently by different people. As formulated by Costanza-Chock, this is crucial "(…) both because justice demands it and also because the tacit and experiential knowledge of community members is sure to produce ideas, approaches, and innovations that a nonmember of the community would be extremely unlikely to come up with" (2020, p. 94). Augmenting universalistic insights hereby is related to challenging the observational gaze previously discussed and embracing citizen-led data collection that captures how differently cities are experienced by people.

DIVERSIFYING DATA WITH INTERSECTIONAL, PARTICIPATORY METHODS

To expand this part of the data imaginary, my own experiments have consistently centered on citizen-generated data and used such data analytically to showcase a diversity and pluralism of viewpoints and experiences in the city. The use of photovoice and participatory GIS in the Urban Belonging Project, in Chapter 5 and 6, was specifically designed to in response to this part of the imaginary; to produce diverse and nuanced insights about the experiences of different marginalized groups that we cannot assume are gaining visibility, when planners go out and register the existing users of a space with PSPL method. While this has augmented the universalistic approach on the level of *data collection*, the data feminist techniques of mapmaking in Chapter 5 moreover experimented with doing so on the level of *data visualization*, challenging the tendency in Gehl (and other urban research) to represent the population through a binary of 'men' and 'women'. To experiment with non-universalistic ways of representing identity in maps, for instance, the gradient mental maps in Chapter 5 suggested an intersectional strategy for representing identity. As also discussed in the article in Chapter 5, I do not hereby suggest that we should (or could) stop categorizing data altogether, since data always involve some classification (Bowker & Star, 2000). Meanwhile, the experiments with social media data, participatory GIS, and photovoice have been productive in showing how participatory visuals methods can be used to foreground diverse, lived experiences, and that creative data visualization can be used to capture more nuance and complex stories about cities and its residents (Bravo et al., 2022). These projects have also shown how data feminist principles (D'Ignazio & Klein, 2020b) can inform more critical data practices. This has generally been well received in Gehl, as exemplified in a feedback session on the Urban Belonging project, in which director Birgitte said:

> "I'm thinking about what Jan always says about that humans have so much in common. I think there is something very sympathetic to that,

> but I also agree that we have to qualify it, so we don't just say that "oh, we're *all* the same". We need to add another layer to this. So far it has more about assuming that we have the same biology and can identify things that are 'human scale' for us all."

Inspired by this, a question that can be used to expand the data imaginary in other knowledge cultures could ask:

Are any universalistic assumptions about your field built into your data tools and methods, and how can you begin to diversify that?

4. Discarding subjective data ontologies

In January 2020, Gehl was introduced to Maptionnaire; a digital platform developed by researchers at University of Helsinki that creates spatial surveys (also used in the Urban Belonging Project documented in Chapter 5). The platform can be used to ask a mix of quantitative, qualitative, and spatial questions to which participants respond by drawing dots, lines, and polygons on base maps. As a new data tool, the opportunity to work with such spatial questionnaires enabled Gehl to do digital participatory mapping with citizens, and the company quickly started testing it. The first substantial use case came in March 2020 when the COVID-19 pandemic caused a lockdown across Denmark. Commissioned by Realdania, Gehl was asked to investigate the impact on urban life in Copenhagen and sent out a Maptionnaire survey in April 2020 to around 1200 people in the Citizen Panel, asking questions about changes to their mobility routines and use of public space. Maptionnaire data was included many places in the report to Realdania[11], which also contained observation data collected with the PSPL method. Noticeably though, almost none of the *spatial* questions were used, as explained by Miriam:

> "The data from Maptionnaire is super messy. It was difficult to work with and read. So, it was not used in the Realdania report. We ended up just using some of the simpler diagrams and not the maps. We don't know what to do with them."

Instead, Gehl's use of data in the report (snapshots in Figure 9.7) shows that there is a preference for visualization and maps that present data as discrete and

[11] Gehl's COVID study for Realdania is open access online, where reports can be found and where collected public life data is presented as an interactive dashboard: https://covid19publiclife.herokuapp.com/.

undisputable. This prompts the question: What were the 'messy' spatial data that was excluded? Asking Miriam this, she showed me the examples in Figure 9.8.

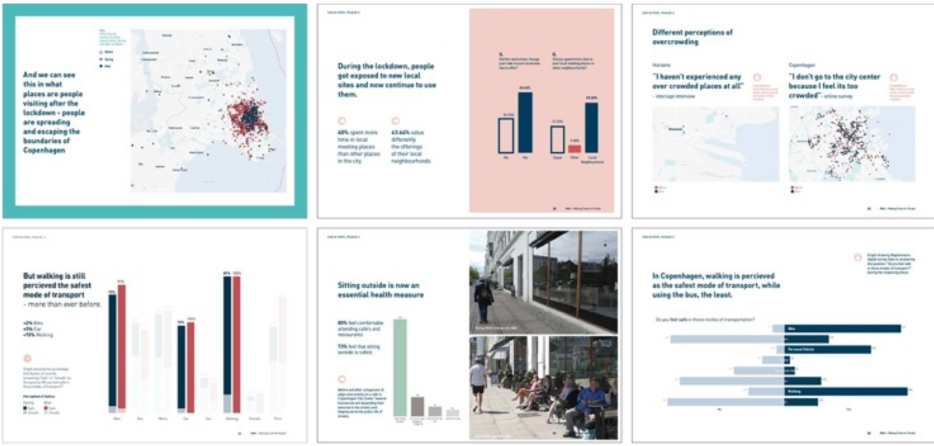


Figure 9.7: Pages from Realdania report that use Maptionnaire data. Courtesy of Gehl.

Figure 9.8: Maptionnaire data not used in the report. Credit: Author's illustration.

Discussing what these spatial data represent, Miriam mentioned that they challenge Gehl's typical approach to working with maps. Elaborating, she said:

> "They have a lot of lines and dots and polygons all in a big mix. It is multilayered with several hundred polygons on top of each other, and while some respondents put polygons, others put a bunch of pins. We also realized that questions that asked people to draw lines onto a map were way too difficult to analyze after, so we actually didn't ask line data questions in the second and third questionnaire "

It is hereby clear that while Maptionnaire presented new opportunities for collecting data, the citizen-drawn maps also challenged the imaginary in the company. But why do such polygons and lines get pushed aside in preference of pillar charts and dotted maps? An explanation might in part be that, as Miriam states, the multilayered polygons are difficult to read. This can be linked to insights from gestalt theory or Edward Tufte's (1990) notions of effective and minimalist data visualizations, which have suggested that it is easier for the human eye to recognize discrete patterns in diagrams with mutually exclusive colors and clearly separated shapes. In contrast, it is more complex to decode overlapping and relational visual elements, such as the ones in Figure 9.8. Yet, Gehl is a highly visual practice and is used to working with complex and multilayered visualizations when making architectural drawings. The difficulty with handling visual complexity around citizen-generated spatial data thus suggests that something else is at stake, relating to more the ontological status of the data. Since the Realdania case, Gehl applied Maptionnaire in many other projects in 2020, using the tool as a digital replacement of site observations during COVID. In an evaluation session about the tool's potentials among first adopters, others echoed Miriam's experience:

> "In Houston and Philadelphia we are using it now. I see the most insane shapes coming in. It's crazy what people are doing when they don't understand how to use it. Even if we have instructions, videos explaining what to do." Sophia

> "For us to use it, it has to be precise! It matters *exactly* what route people take; we cannot connect the dots for them. The imprecise maps are useless to us." Louise

> "Last time I used it we only asked route and dot questions. If you just bring the lines into QGIS it becomes really messy – even in a heatmap. As soon as someone draws off grid, it comes off weak graphically. Then we need to redraw it" Martin

These reactions demonstrate that the planners do not trust – or know how to interpret – the spatial data coming out of Maptionnaire. Most comments expressed concern about the ambiguousness and inaccuracy of the spatial elements drawn by citizens. As the quotes exemplify, this is often interpreted as a reason not to ascribe validity to data, which leads to confusion about what the maps then represent. What is spatial data, if we cannot assume that a dot or a line is drawn in the exact place where something has happened? Such questions were raised by everyone in the evaluation session, and there was consensus that the spatial data is not useful if it does not represent factual reality. This reveals a part of the data imaginary in Gehl that is used to construing of maps as objective and accurate representations of technical information. This is engrained in planners and designers who are trained to make architectural drawings as construction documents that instruct exactly where something is supposed to be built and how: In an architectural drawing, the placement, scale, and thickness of every single line *means* something precise. Similarly, the observation counts collected by Gehl planners with PSPL are registered as objective representations of exactly where people have been in the city. Dots on a map indicate that someone has indeed been *here* and not *there*. It is not open for interpretation. Meanwhile, the Maptionnaire data troubles this ontological status of map data, when citizens draw polygons which cover areas in the water or closed industrial areas where they technically could not go. What does such a map mean? When the citizens draw such messy dots, lines, and polygons with varying spatial accuracy, it confronts the planners with their expectations to what a map is and introduces a mode of subjectivity that conflicts with the objectivity they expect from it. Following this it was questioned by Louise in our sessions what the point is then of *spatial* surveys:

> "I can sense that there are potentials, but for now Maptionnaire has been reduced to an online questionnaire in the way we see it. What is the unique thing about this tool? How can we make more and better use of the spatial component?"

The commitment to objectivity hereby acts like a discursive closure that prevents the planners from leveraging spatial data from Maptionnaire. In the Realdania case this meant that most spatial data was not used. In projects since, many planners have stopped asking spatial questions that ask people to draw polygons and lines.

ACCEPTING ALTERNATIVE ONTOLOGIES

This part of the data imaginary does not only prevent Gehl from leveraging Maptionnaire for participatory mapmaking. I also notice in my work with social media and photovoice data that the objectivist ontology prevents Gehl from taking seriously the potentials of using other citizen-generated spatial data to re-situate urban issues in subjective, experience-based topographies. To expand this part of the imaginary, it is key to introduce alternative spatial ontologies, as posed by for instance cognitive mapping (Lynch, 1960) and Kitchin & Dodge, who write:

> "A de-ontologized cartography is on the one hand about accepting counter mappings as having equal ontological status as scientific

> cartographic (that there are many valid cartographic ontologies) and, on the other, deconstructing, reading differently, and reconfiguring scientific cartography (to examine alternative and new forms of mapping)." (2007, p. 334).

Similarly, it has been posed by Williams (2020)that while there has been much criticism of using data scraped from social media, from arguments that the data is skewed, such bias need not mean that the data is off limits. Rather the bias – or subjectivity engrained in data – can be of interest analytically, and Williams encourages us to "embrace biases in data to tell new stories" (pp. 113-114). This is also what the 'Soft City Sensing' article presented in Chapter 2 proposes, arguing that alternative forms of mapping might come from leveraging granular geolocated data produced by citizens to study subjective topographies. The experiments with visual spatial data in Chapter 4, 5, and 6 has acted as speculative demonstrations of what this can look like, using different cartographic techniques like mental mapping, K-means clustering, and Voronoi plotting to foreground citizens' experiential realities, as seen in article snapshots in Figure 9.9. Such mapping experiments have showed that it is possible to create a different frame of interpretation around subjective spatial ontologies and use citizen-generated drawn maps to study people's perceptions and experiential realities. The work with *participatory* mapping in Chapter 5 furthermore exemplified that while the citizen-generated maps might be difficult to interpret on their own – as voiced by Gehl colleagues – there is great potential in using maps as elicitation devices with citizen in a participatory setting, where they do the interpretational work.

Instagram images of forest versus cityscape as Voronoi plot, in Chapter 4. "Zones of belonging" and "zones of exclusion" with Maptionnaire data in Chapter 5. Mental maps of the city from Maptionnaire data, in Chapter 5. K-means clustering of photovoice images of 'belonging' in Chapter 6.

Figure 9.9: Snapshots from experiments where Instagram photos, Maptionnaire data and photovoice data used to map subjective topographies. Credit: Author illustrations.

This is also proposed within Design Justice (Costanza-Chock, 2020) and Data Feminism (D'Ignazio & Klein, 2020b) which insists that participants should have a seat at the able in all stages of a data project. To expand the imaginary in Gehl, this is key to unlocking a different interpretative frame around subjective data.

While the negotiation of *spatial* ontologies is key to Gehl's work, this might look different in other knowledge practices. A productive question could therefore be:

Which data sources do you construe as 'objective' or 'subjective', and what does that mean for how you ascribe value to them? What alternative ontologies could be accepted, and how might this reframe the problems you work with?

5. Innovation equals toolmaking

> "I think a good way to measure the success of the R&D Team could be to ask projects to register whenever they use different tools. That would give us numbers to compare and get an overview of how often the different tools that you have developed are actually being used".

Such says Helle Søholt to the R&D team in 2022 when she joined a team meeting to give us a quick brief on how management envisions to evaluate the impact of the team's work, making it more clear than ever how central toolmaking is to the innovation strategy in the company. I have already touched upon the tool development taking place in Gehl over the past three years in a previous section (see Figure 9.5). Whether it be apps, platforms, or other digital technologies, the innovation strategy for the R&D team in the past three years has focused almost exclusively on toolmaking, seemingly equating innovation of data practices to making digital technologies. In 2019, when this PhD started, there was already an innovation strategy centered on 'digital transformation'. Investment was first put into making a 'PSPL platform' which collects all the public life data collected in Gehl over the years and presents it in a digital map that gives planners an overview of what data the company has. A few months later, however, the COVID pandemic completely challenged the modus operandi of the company: When cities went on lockdown and travel became restricted, it was difficult for Gehl to do site visits and carry out public space observations as usual. This put the digitization strategy on steroids and made the demand urgent for creating *digital* tools to remotely study urban life, as expressed in the Gehl newsletter in March 2020:

> "The global challenges we are now experiencing are unprecedented. (…) Right now, we are doing a lot of testing. (…) We are testing new ways of gathering digital data off-site and producing analytical insights"

Innovation in the past three years has followed this ethos and centered around making tools for on-site or off-site data collection. For one, the R&D team has developed the Public Life app, which can be used to do on-site observation counts (see Figure 9.10), providing a digital version of the public life method which had until recently depended on analogue pen and paper.

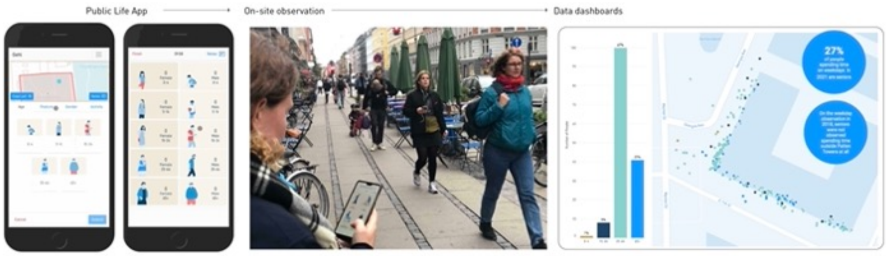


Figure 9.10: Snapshots of the Public Life App developed in Gehl. Credit: Gehl.

More than that, the R&D team has created different public space tools (see Figure 9.11), sourcing digital data about the built environment: The 'amenity tool', for instance, queries the Google Place API to show amenities within a 500m radius of any point selected on a map. The 'isochrone mapping tool' hooks into Mapbox and uses information about the street grid to draw an isochrone polygon showing how far from any input point citizens can travel when walking, cycling, or driving.

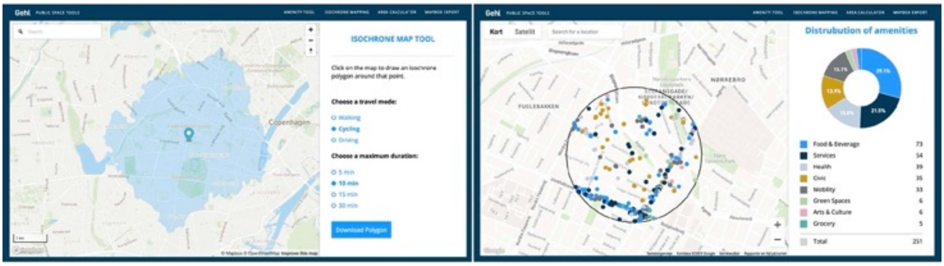


Figure 9.11: Snapshots of digital space tools developed in Gehl. Credit: Gehl.

What is a noticeable throughline here is that there is less attention to innovating *practice*. We might say that Gehl is more focused on developing a digital hammer and computational nails, rather than experimenting with the practices and methods with which a carpenter would apply such tools to build a house. If we recognize, as is proposed by most STS and post-phenomenology (Verbeek, 2005), that technology is non-deterministic and does not prescribe a certain use, then it seems crucial to bring more attention to practice, method and methodology. This has also been discussed in Rogers' (2010) scholarship on the 'diffusion of innovation' in which he argues that while we use the word "innovation" and "technology" as synonyms (p. 12), many organizations make the naïve assumption that new technologies can simply be sent out into teams where people will automatically know what to do with them. In light of that, it could be questioned if the tool-fixation in Gehl is diverting the planners from innovating data *practices*, and if toolmaking is becoming an end-goal in itself instead rather than a means to enable and explore new modes of datafying urban problems. With reference to Mager & Katzenbach's notion that imaginaries co-produce the making and governing of technology, this could indicate that the methodological innovation has been a secondary priority in Gehl, and that the future visions primarily imagine digital solutions for the data practices that the company already use. Such concern is also expressed by one of the company's directors, in an interview with me:

> "We have developed the PSPL app as a digital version of the observation method, but is that enough? We must not forget that the core methods came into being because Jan spent five, seven, ten years sitting on squares, refining his method. In the old days of the company, we used to have these "method days", but that is a long time ago."

The most recent tool developed in the R&D team is a digital app with which planners can use to register how active facades are, digitizing what used to be an analog pen-and-paper observation method. In contrast, the development of the Eye Level City App (the Gehl version of the photovoice app, UB App, see Chapter 7), breaks this cycle as a tool that also enables an entire new *data method.*

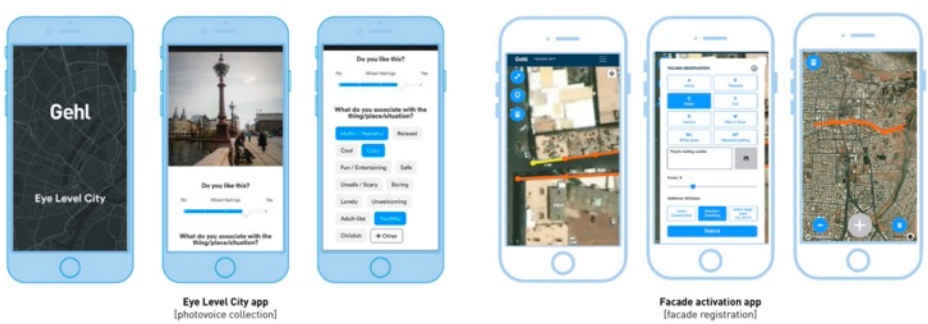


Figure 9.12: Eye Level City app (left) and Façade Activation app (right). Credit: Gehl.

Since the first use case in the Urban Belonging Project, many projects in Gehl have expressed interest in using the photovoice app, while less interest has been placed on trying out the participatory methodologies also developed in the project. An example of this can be seen in a project from 2022 for an American university, where Gehl was tasked to study how students experience belonging on campus. The project team was the first to use the Eye Level City app and used it to engage students in collecting photos of where they felt belonging on campus. While I instructed the team both on how the app works and how they could use it within a participatory methodology that involves participants in data analysis, the project team was less interested in method and more focused on the app. They ended up using the app to collect photovoice data without involving the students in interpreting photos – due to tight budgets of course (here I refer back to the 'practical conditions' in figure 9.1), but also a belief that it was not *necessary*. The assumption was that planners could analyze data without involvement of the participants, but in evaluating the project, the team expressed that it had been difficult to interpret the photo data. They stated that next time they would probably carry out workshops: "The students probably know better than we do, why they have taken a certain image", the project manager said.

Such experiences are slowly prompting planners to focus more on methodology and practice, but also demonstrate that with the tool-fixated strategy for innovation, attention to practice and methodology can get lost in translation or be underprioritized. Another example of that is the use of Maptionnaire which, as previously discussed, Gehl was quick to start using the tool, although without necessarily knowing how to get the most out of the *spatial* data it produces. This shows that while the tool is being used often, there is a lack of innovation on practices for interpreting the data.

PUTTING METHODOLOGY BACK IN 'INNOVATION'

In 'The Sense of Dissonance' from 2009, David Stark argues that in face of uncertainty around what has worth, many organizations spend time clarifying a simple and often numerical logic used for evaluating worth. This is also what we saw in the opening of this section, where the quote from Gehl's CEO suggested to measure the success of the R&D team by how often its tools are used. In challenging this logic, Stark argues that a company could be better off, especially when navigating change and searching for new knowledge and methods, if they allow multiple logics of worth and did not discourage uncertainty (Stark, 2009). He shows that the *friction* between competing criteria of worth can promote an organizational reflexivity that makes it easier for a professional practice to change and innovate, and that the dissonance of diverse principles can lead to discovery

(2009). Learning from this, we can challenge Gehl's focus on innovation as toolmaking, and the inclination to measure the success of innovation by counting how often new tools are used. Taking a purely quantitative approach, it would for example seem like the use of social media data in Gehl has been the very successful, since many projects have either used Instagram data or proposed it in pitches to clients (look ahead at Figure 9.13), while photovoice on the other hand has been used less so far. But if we instead take a qualitative approach and ask how much value these methods have provided on projects, and whether or not they have made new modes of knowing possible, I will claim that social media has shown the *least* promising potentials of the three tested methods. It has for instance proven difficult to scrape and collect in structured ways due to closure of platform APIs, while social media analysis also has limited participatory potentials for involving citizens in interpretation and reappropriates 'found' images that users have captured for reasons unknown (downsides also discussed in Chapter 4). More importantly, social media data has not made a big difference because it has most often been envisioned in Gehl as a replacement of PSPL, rather than as a data source to imagine new data practices (more on this in the next section). In contrast, the use of photovoice in the study in Chapter 6 has not just contributed a new *tool*, the photovoice app, but also introduced new participatory data *methods* that involves citizens in collecting photo data in response to a prompt.

The visual experiments carried out in the PhD hereby unsettle this part of the data imaginary by showing as much attention (if not more) to developing data practices and methodologies, as opposed to simply introducing a new tool. Contributing to this "push" towards method as a point of innovation has also been my experimentation with data visualizations, which has been key to demonstrating that innovation need not only emerge from new tools, but might equally come from reconfiguring practices for analyzing, processing and visualizing data. Especially the use of photovoice and participatory map-making described in Chapter 5 and 6, have put methodological innovation on the agenda, launching conversation about for instance how to measure 'belonging' in cities.

Learning from this, a productive question for other data-based practice could be:

What value do you ascribe to toolmaking versus innovation of methods in the development of your data practices?

6. Leapfrogging

In relation to the intense focus on *tools* within the innovation culture, I observe another characteristic of the data imaginary related to focus on "leapfrogging".

This started to show only two weeks into my work, when I did interviews with colleagues in the R&D Team to present my research and ask what they thought the potentials of digital visual data methods could be. To this, Alexander said:

> "The lowest hanging fruit is that we have evidence to speak for a type of public space, a decision we're making on the design. If we can say that "90% of the pictures uploaded by locals in public spaces are next to water" that gives us the case to tell clients; if we want to make public spaces more successful big open water places are a must! That's leapfrogging the normal Gehl methodology [the PSPL survey], because we don't have to go and count every single lake."

The quote here exemplifies the expectations that shape how new data sources are imagined to be relevant in the practice; through their ability to leap-frog existing methods, make effective and optimize what the company is already doing. Put differently: new data sources are not evaluated for their potentials to open new questions, but to optimize existing ways of knowing cities.

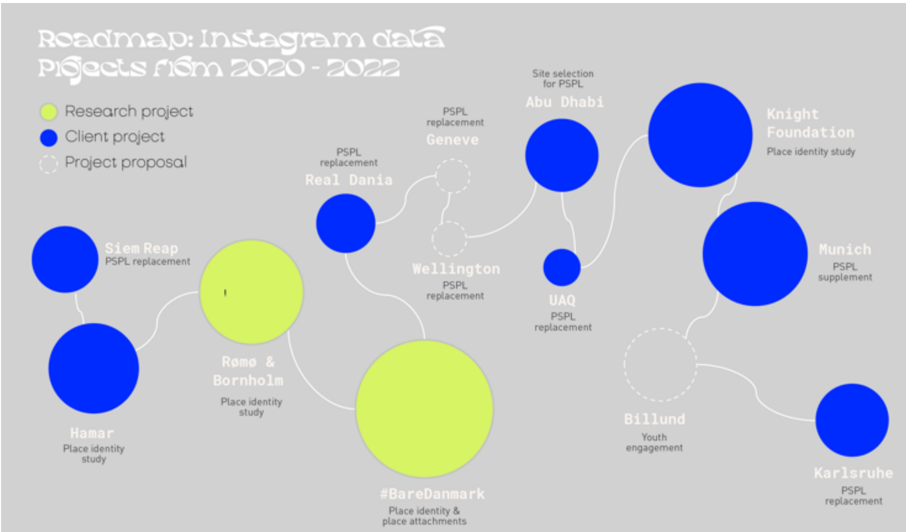


Figure 9.13: Roadmap of projects from 2019 to 2022 in Gehl that used social media data.

During COVID, there was widespread interest among colleagues in using social media data in this ethos; as a replacement for PSPL in projects where lockdowns and travel restrictions prevented Gehl from carrying out on-site observations. Interest came especially from the expectation that social media data is abundant, easily accessible, and always geolocated, and can be used to register activity across a city in more efficient and remote ways than costly, on-site observations. Because of this vision, Instagram data was written into many projects in 2020. The roadmap in Figure 9.13 tracks 'the social life of the method' (Savage, 2013) and outlines all projects where data from Instagram was involved from 2020 to 2022. The two yellow dots represent research projects carried out by me without a Gehl client, with the #BareDanmark being reported in Chapter 4. Blue dots represent Gehl client projects that used Instagram image data with my consultation, and grey dots represent proposals where social media data was written in, but never used.

Social media data was, with few exceptions, primarily envisioned as a replacement or supplement to the PSPL: to count frequency of users in different parts of the city. Meanwhile, this has not been very successful, when we have tested it. As it turns out, Instagram data is not as abundant and ready-made as the planners expected. We for instance tried using social media data in replacement of PSPL in a project in Karlsruhe, Germany. The planners would show me a map with highlighted areas (see Figure 9.14). Before COVID, the team had promised the client to do public life counts in these locations, and asked if I could collect social media data here, since now they were not able to travel there. When we tried, it turned out that we could only identify hashtags or location IDs in some of the locations. In others, there was no data, or no hashtag that was so site-specific that we could know for sure matched the desired spaces. We learned that scraping data from Instagram is *not* abundant at the hyperlocal level, all across any town.

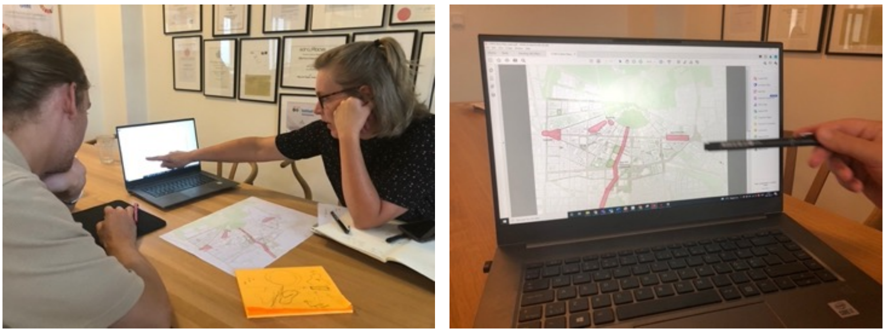


Figure 9.14: Meeting about collecting Instagram data from Karlsruhe. Author's photo.

This disappointed the team and Instagram was deemed irrelevant, even though we could scrape photos from most areas. Another example of how leapfrogging affects the imaginary around data in Gehl is found in the company's use of Maptionnaire in projects. I have already referenced how after a year of testing the tool, we held an evaluation session with the first users within the company to talk about experiences so far. When it came to assessing potentials applications, most planners in the session talked about ways in which Maptionnaire could be used to replace or supplement existing methods:

> "I used it in our Thrive zone project to complement our PSPL counts. (…) I also used it for our Geneve pilot project. We would get limited public life counts, so we used it to get more data as a supplement to our observations" - Louise

> "Maptionnaire can replace the intercept survey in a meaningful way. It gives us something more than intercept surveys in terms of types of questions we can ask. I like that. We can get spatial answers to questions" - Sophia

Sophia also envisioned using Maptionnaire for site selection in combination with the PSPL: "There is good potential in using it to do site selection, before we go and do a PSPL. This can be useful; having citizens or local partners point out where we should do observations". The main interest expressed was hereby to use Maptionnaire in place of or in combination with the established Gehl methods, and the PSPL toolkit in particular. This shows that the data culture is geared more towards imagining ways of optimizing what Gehl already is doing and making it easier to collect public life data in remote ways, more than asking how Maptionnaire might open for new approaches to studying cities. Louise and Miriam underscored this point, when saying:

> "It's great if we can do more surveys from afar. COVID has taught us the need to be agile. It has pressured us to find ways of studying public life of cities and places in a remote and digital way." - Louise

> "My take away is that Maptionnaire fills two needs: 1 Replacing intercept survey (especially in times of COVID), and giving us more complexity and flexibility in that area. 2 replacing or adding to stationary PSPL observations" - Miriam

This focus on leapfrogging existing methods, rather than imagining new ones, is indicative of a data culture that prioritize *incremental* over *radical* innovation (Corso & Pellegrini, 2007), and shows that the future use of data methods for studying cities are mainly imagined as an extension of existing ones. This limits the options for imagining alternatives and relates back to a previous section which showed that most tools developed in the past years in R&D have been digital versions of data infrastructures that Gehl has been using for decades.

(RE)PROBLEMATIZING THE CITY WITH DATA

While it is common among organizations to frame the digital as an opportunity to optimize or tweak existing methods, the leap-frogging tendency also presents a limitation to the data imaginary as long as it means that Gehl's planners are not exploring how new data tools make it possible to ask new questions about cities. This is exactly what my empirical experiments have attempted to trouble; using digital and participatory approaches to visual data to re-problematize the city and ask new questions about cities, such as: How do people attach to different types of spaces during COVID (Chapter 4), and how do various communities experience belonging in the city in different ways (Chapter 5 and 6)? Each of the empirical experiments have attempted to *add to,* rather than replace or optimize the existing methods in Gehl, examining new opportunities for studying cities with data. The problem of prioritizing between incremental and radical innovation, moreover, is not unique to Gehl but has been a hot topic in innovation management for decades, as exemplified in Martini et al. (2013), who describe incremental innovation as a strategy that builds on existing knowledge and seeks to gradually improve such existing knowledge. In contrast, radical innovation involves exploration of new and uncharted territories as a form of innovation that deals with discontinuities of existing knowledge. As Martini et al. writes, such discontinuities are characterized by more uncertainty, but also holds potential to "redefine the space and the boundary conditions and open up new opportunities" (Martini et al., 2013, p. 15). Balancing incremental and radical innovation is thus also a strategic decision of prioritizing between *exploitation* and *exploration*, as described by Corso and Pellegrini (2007). To examine this part of the imaginary in other practices, a key question could be:

Is innovation of your data practices guided by incremental or radical strategies, and what is the consequence of this for how you are able to imagine data futures alternative to the present?

This leads to the seventh and final observation about Gehl's data imaginary.

7. Commensurability culture

Early in testing the use of Instagram data in an analysis of place identity in Rømø and Bornholm, two Danish islands, I set up a feedback meeting with the director Birgitte. I explained that it was not as straightforward as we had hoped to get metadata when scraping Instagram because of how the platform had closed off its API, meaning we could collect photos associated to hashtags, but without metadata. This caused confusion in the meeting, as we continued talking:

> Birgitte: So, you cannot get geotags for this data? Could you try to another way?
>
> Sofie: I am not sure. This might be really tricky.
>
> Birgitte: OK. But I think you should try. That would be more valuable.
>
> Sofie: But what if instead we could use image recognition to process the content of the images and identify the types of space depicted in the images? Maybe we do not need to know the exact geolocation if we use AI to recognize that the images depict streetscapes, squares, or other environments. Could this work?
>
> Birgitte: But what can we use it for if we cannot put it on a map? We need to be able to connect the data to physical space. I agree that the typology is interesting, but it might be difficult to sell to clients.

While Birgitte didn't see the value in data without the geolocation, I, on the other hand experienced a lack of curiosity in our conversation about how we could still use the data to understand people's relationship to space. I was surprised that mu idea was rejected as not relevant for client projects. Why was this the case? While it was clear to me that I had missed something, my initial perplexity would turn into clarity as my years in Gehl went on and I grew more sensitive to what was at stake in this way of evaluating new data sources. As I continued my work in Gehl, this question led me to understand two things: First, there is a commitment in Gehl to the *physical* environment in a way that positions the digital as 'second-best': Rather than seeing digital spaces as in of themselves being spaces in which a part of public life plays out, as has been suggested by scholars like Halegoua (2020) and others (Moore & Rodgers, 2020), Gehl perceives digital spaces like Instagram as a reflection of what goes on in the physical city. Data from digital platforms is therefore mainly interesting if it is locatable and helps understand what goes on in the 'real' city. Meanwhile a second and related reason for why Birgitte was stern on getting the Instagram images georeferenced started to crystalize as I kept hearing planners say again and again that "the Gehl magic happens in connecting the dots" between datasets. This also came up in a meeting with CIO Jeff Risom, when I asked if Gehl had tried using photovoice before, to which he responded:

> "Actually, we've tried to use it [photovoice] in the first stages of a project in London, but it had minimal use. (...) One issue was to collect enough data in a structured way. Another was being able connect the dots, tying the photovoice data to our other datasets. It was too tough to tie it into the other data we use."

What becomes evident here is that in Gehl, data is evaluated by its degree of *commensurability*; how easily it can be related to and layered with other datasets. Commensuration, defined as the comparison of different entities according to a common metric, has a long history as an instrument of research and is described by Espeland and Stevens (1998) as a 'vehicle of rationalization' that creates relations among data that are otherwise fundamentally different. In Gehl's quest for such commensuration, the ultimate 'common metric' is, not surprisingly, the geotag or geographic coordinates that enable the planners to tie otherwise disparate data entities together on a map with a shared spatial reference. When co-creating the photovoice tool, the UB App (as documented in Chapter 7), this part of the data imaginary also showed up when Gehl's main request for the app was that it collected geolocated metadata for both photos and walked routes. Similarly, building geotagging or geolocating into the data infrastructure is foundational to all toolmaking efforts in the R&D team discussed previously, meaning that for instance public life counts and façade registrations get recorded in digital, spatial formats that are commensurable. This makes it possible to connect them not only to each other, but also to third party datasets.

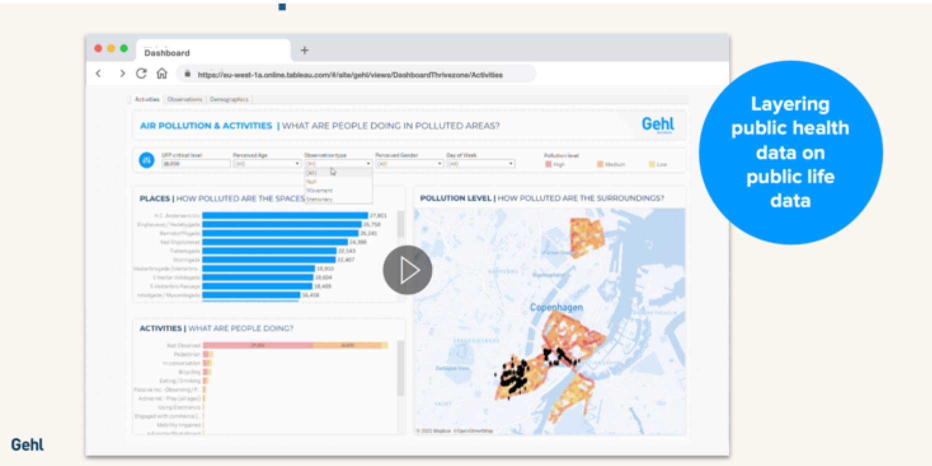


Figure 9.15: Snapshot from the air pollution project: A dashboard that combines particle measurements with public life counts from Gehl, layered together on a map through geotags.

An example of this is the air pollution project, which started because Google had collected a hyperlocal dataset by sending a car out to measure particles in the air on every street in Copenhagen, with each measure being precisely geolocated. When they shared this data in a project, it opened novel opportunities for Gehl to study relationships between public health, public life, and public space. Linking the air pollution data to Gehl's public life counts for instance made it possible to identify locations in the city where there is a high concentration of polluting particles and where kids spend time. The air pollution data could also be connected to observations about the qualities of the environment: Are there more particles in streets with fewer trees? Such insight, Gehl showed, could be used to design interventions that aim at reducing pollution in populated streets, or inviting people to use other, less polluted spaces through design of the city.

Because the air pollution data was spatially commensurable with Gehl's public life and public space data, it became possible to address air pollution as a design issue. Connecting different types of data via geolocation hereby enables Gehl to relate complex urban problems to the built environment. This is crucial to how the planners develop new services, enter new markets, and make themselves relevant to new clients: As it is Gehl's business to design interventions in the physical city – whether as street transformations, masterplans, policy, programming, or pilot projects– being able to show that an urban issue is *spatially* anchored is key to arguing that it should be addressed through urban design and ensuring a role in finding such solutions. This is indeed where the magic happens: Other creative connections in Gehl has for instance link observations about individual food habits to qualities of urban environments, resulting in a new foodscape service.

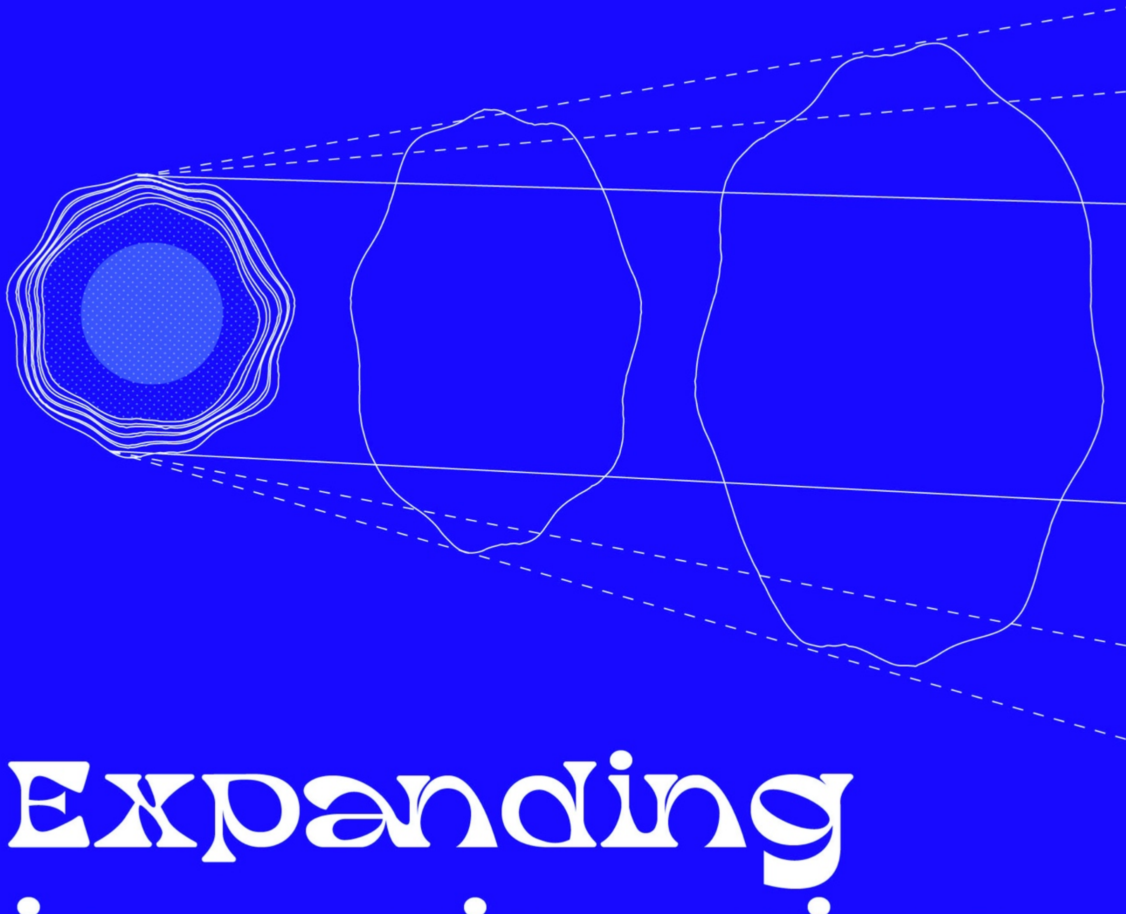
Now, understanding the centrality of the commensurability criteria in Gehl's work, it also makes sense to me why social media data has been the one of my experiments with visual data which has had the *least* success, if we evaluate that through the lens of how much it is used today. This is not due to the fact that social media images could not be of interest if it was not the case that most social platforms have closed their APIs (Bruns, 2019), shutting off access to metadata like geotags when scraping data. In a culture where commensurability is key, this makes the social media data less useful than data from Maptionnaire and the Eye Level City photovoice app, where data always comes in structured spatial formats.

SEEING BEYOND THE COMMONSURABLE METRIC

While commensurability is hereby a productive part of the data imaginary in Gehl, expansion of the data imaginary could still come from asking two questions: First, what might be alternative ways of tying datasets together? As suggested in the three visual experiments in Chapter 5, 6 and 8, we might also discover similarities in visual content across or between different datasets of photos. With tools like computer vision, natural language processing, and network analysis, among other techniques, it is possible to tie datasets together based on other metrics than the geotag. Second: What are the potentials in data that we are missing when we become too fixated on the geotag? The article in Chapter 2 on Soft City Sensing and the review in the Instagram article in Chapter 4 both discuss how there is tendency in digital urban projects to fixate on the geotag as the main analytical unit. Projects with Instagram data rarely look at the image content, but simply use geotags and timestamps to create maps of the frequencies and flows of people in a space. Such fixation has caused scholars like Crampton et al. (2013) to call for urban research that goes 'beyond the geotag'. The Instagram article in Chapter 4 demonstrated strategies for doing so, and showed what can be learned by using the visual content of photos in combination with computer vision to study how different types of spaces are depicted online. While I do not suggest that Gehl moves away from commensurability itself, there are thus potentials for expanding this part of the data imaginary by asking how data can be connected in other ways, and resisting tendencies that the geotag becomes the main unit of analysis.

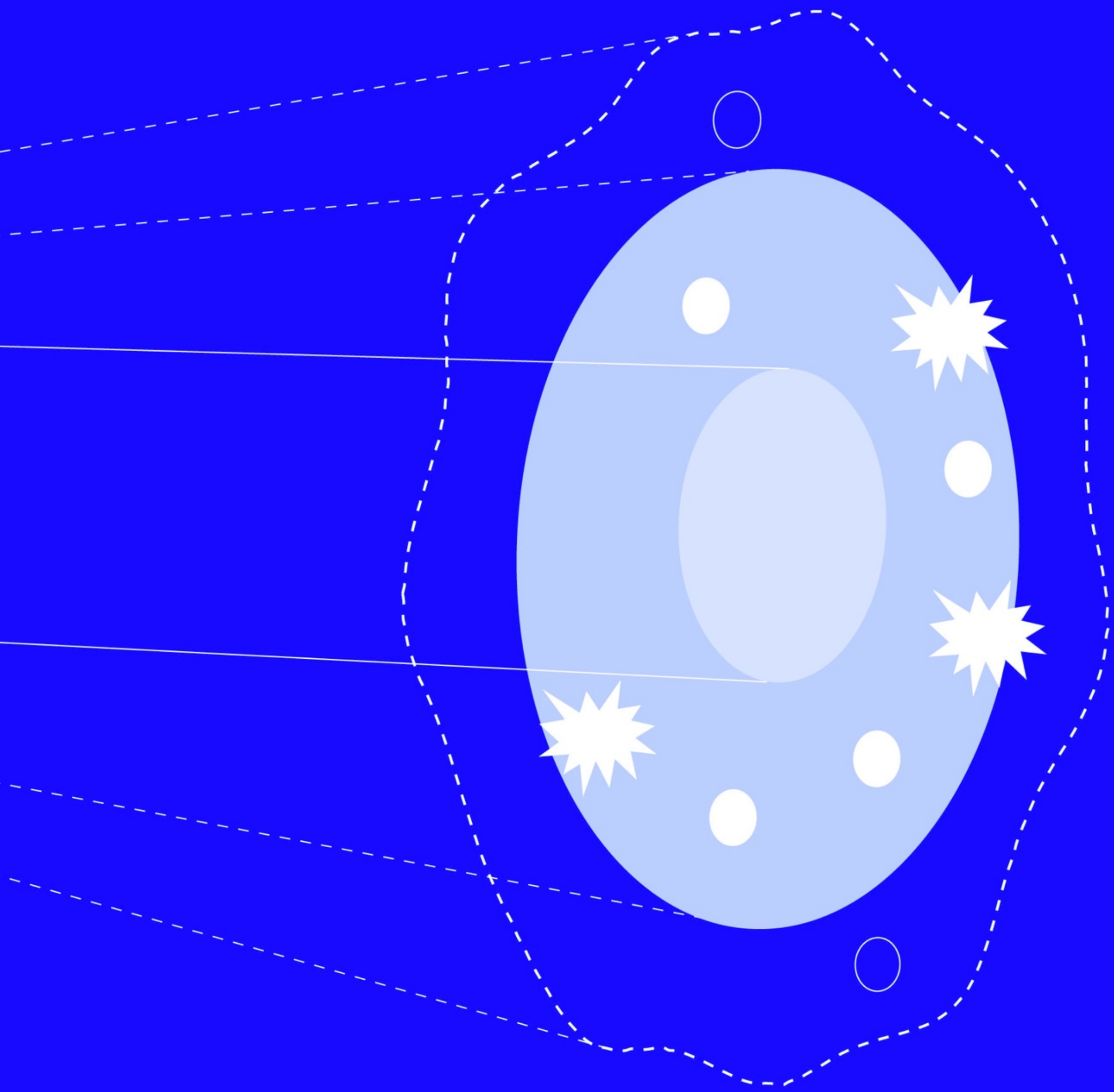
A question with which to explore this part of the data imaginary could thus be:

Which metrics are central to how you connect datasets, and could there be other modes of commensurability? What role does the commensurable metric play in analysis, and do you risk missing other aspects of data by overcommitting to it?



Expanding imaginaries

Chapter 10



Expanding imaginaries

As stated in the beginning of the previous chapter, a data imagery is not a stable, fixed, or monolithic phenomenon. Consequently, it is fair to remind the reader that the data imaginary in Gehl is multivocal and consists of many facettes that cannot all be captured here. Even so, my three years of working in Gehl have led to observation of at least seen epistemic commitments and collectively held narratives that I have unpacked in the previous chapter. I have described each commitment in the previous chapter as more distinct and delimited than they might be experienced in the everyday, for the sake of discussing them methodically. In practice, the seven commitments are interrelated aspects of the data imaginary in Gehl that work together to shape the role of data within the practice. In summary, these include (1) a tendency to frame visuals as non-data; (2) an inherited observational gaze; (3) universalistic assumptions that people experience cities the same; (4) an objectivist ontology of spatial data; (5) a tool-centric innovation culture; (6) a focus on "leap-frogging" and incremental innovation; and finally (7) a data culture of commensurability in which data has value when and if it can be combined with other datasets through spatial geotags.

While these parts of the data imaginary are productive in some ways for structuring Gehl's study of cities, they also act as what Markham calls 'discursive closures' in so much that they normalize certain ways of datafying urban problems and public life that limit planners from envisioning alternative practices of data-driven urbanism. While we all hold the capacity for imagining something new or different, Markham posits that the available material for any imaginative act is shaped by prior imaginations (2021, p. 385). In that light, she uses 'discursive closure' to describes the systematic processes in which alternative imaginaries are closed off in the face of dominant frames of inevitability:

> "the ability to imagine differently about the near or distant possible futures for life with and within digital and data technologies requires first breaking out of a current discursive frame (…) and then creating a new forward trajectory. These moves are hampered by at least two forces: First, the invisibility of the boundaries of our everyday frames for

> thinking (…). Second, the power of trajectorism to create a predetermined narrative arc" (Markham, 2021, p. 386)

Noticeably, Markham does not distinguish *deliberate* from *accidental* acts of closure (2021, p. 396). It seems only appropriate here to not assume that there is intentionality behind the parts of the data imaginary in Gehl that close the planners off from imagining alternative data-driven practices. With that in mind, my observations suggests that Gehl's data imaginary is characterized by discursive closures that have taken form over the 20+ year history of the practice. Markham's notion of *trajectorism*, mentioned in the above quote, seems especially relevant to the planners' situation where a strong core story about the company's origin in Jan's research and the long history of using the Public Space Public Life method provides a solidified narrative about how to study cities. This might in part explain why innovation of data methods seems to be primarily incremental and aimed at leap-frogging methods; exploiting existing practices rather than exploring new ones. As Markham argues, the ability to imagine alternative futures necessitates breaking out of the current discursive frame: "Like maps, [discursive] frames orient and guide us. It is not until the map has been turned upside or otherwise disturbed that we notice it was operating on our sensibilities in the first place" (2021, p. 386). The study in Chapter 9 contributes to this, unpacking the discursive frames that shapes Gehl's imaginary and practice.

Speculative data futures

The next step has been to use interventions to show alternatives data practices. I have exemplified what this can look like, by building on a situated interventionist STS approach (Zuiderent-Jerak, 2015), using my own visual data experiments as demonstrations of how it is possible to expand each part of Gehl's data imaginary and open it up to alternative modes of knowing cities. Linking observations about Gehl's data imaginary to the empirical projects in Part II, Chapter 9 showed that it is possible to not just observe data imaginaries at work, but to engage actively with imaginaries as a "trait d'union between grassroots data practices and the emergence of alternative data epistemologies" (Milan & Treré, 2019, p. 328). My experiments with digital visual data contribute to this and overcome the observed trajectorism by exemplifying what alternative data practices might look like. In relation to that, it is clear that the discursive closures that outline the data imaginary in Gehl set limitations not only for how data-driven urbanism is enacted today but also what futures can be imagined. Figure 10.1 illustrates this relationship between imaginaries and the future, connecting the 'data imaginary' model presented in Chapter 9 to my own adaptation of the 'futures cone', introduced by Hancock and Bezold (1994), distinguishing probable, plausible, possible, and preferable futures. In the model, we can imagine the 'probable' space as the data future that Gehl is able to envision, as long as their current data imaginary is characterized by the trajectorism and seven discursive closures observed here.

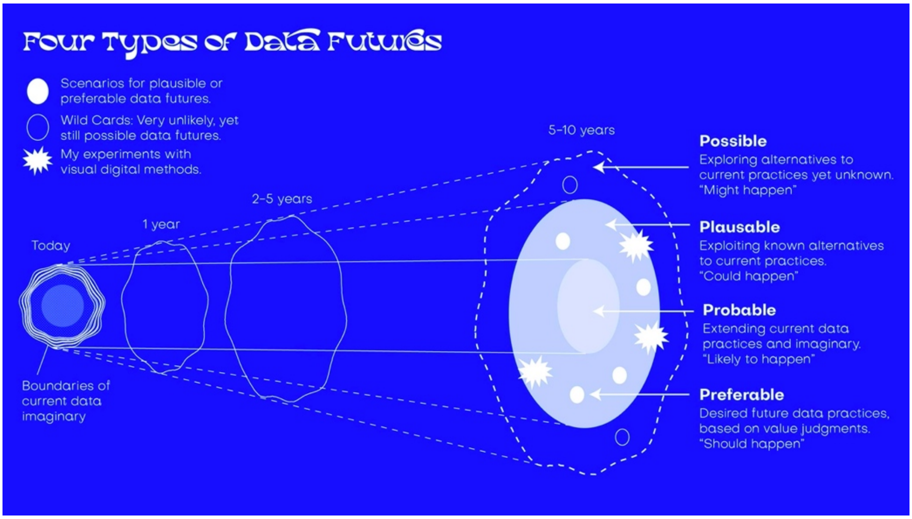


Figure 10.1: Extension of the 'data imaginary' model from Chapter 9. Here the data imaginary is illustrated to the left, and is connected to the 'futures cone' framework developed by Hancock and Bezold (1994), to show that the visions and epistemic commitments that shape a data imaginary today has consequences for what data futures can be envisioned.

In contrast, exploration of alternative scenarios within an expanded 'plausible' and 'possible' space of data futures can come from experiments like the ones carried out in this PhD (indicated in the figure). By exploring ways of working with data that are alternative to or outside the existing data imaginary, such experiments can expand the space of possibility for what data futures can be imagined. Which futures scenarios are then deemed 'preferable' will always be a question of value judgment and depends on who is making this evaluation. While frameworks around data feminism (D'Ignazio & Klein, 2020b) and design justice (Costanza-Chock, 2020) have informed my own assessment of such a question, I appreciate that it might be evaluated differently within Gehl. For the company, what constitutes 'preferable' data futures might depend on a strategic decision about how to position themselves in different markets and coordinating their data practices with the company's design and strategy operations.

Whatever evaluation is made, the key assumption behind Hancock and Bezold's (1994, p. 23) model is that the future is not fixed, and thus should not be approached with inevitability or passivity. This is an attitude that I also take here on my work with data imaginaries: The future of data-driven urbanism is plastic and does not exist. Yet is enacted, and materialized through the imaginaries that frame what roles planners imagine data to have their work. Cukier et al. (2021) similarly emphasize that while such frames often act upon us passively, framing can also be reclaimed as an active exercise of reconfiguring problem spaces to ask new questions and come up with new solutions beyond what anyone could have previously imagined. This dissertation contributes to such an active engagement with the future, by connecting the empirical projects in Part II of to reflections about Gehl's data imaginary in Part III. As given away by the title of the dissertation, I have not only set out to unpack the data imaginary at work in Gehl, but also sought to expand it. Because of that, I propose to view my work as *speculative* interventionism, guided by Haraway's notion of speculative feminism as storytelling and the patterning together of possible worlds. On this, she writes:

> "It matters what thoughts think thoughts. It matters what knowledge know knowledges. (...). It matters what worlds world worlds. It matters what stories tell stories." (2016, p. 35)

While Zuiderent-Jerak's notion of 'situated interventionism' is helpful to describe my approach for producing knowledge about Gehl's data imaginary, I draw on Haraway's sentiment when proposing that a *speculative* form of intervention offers additional capacity to STS for engaging actively with a data imaginary. Such a speculative interventionism need not be pre-normatively configured (as is Zuiderent-Jerak's critique of engaged scholarship), as it is about showing which alternative data futures are possible, without prescribing a particular normative way forward. In that light, I do not conclude that the three methods tested in this PhD are necessarily the best way (or the only way) forward for Gehl. They are an exercise of expanding the space of possible futures and opening it up for discussion. By exploring data opportunities outside the existing imaginary, the data experiments with visual data tell other data stories and build other data worlds. They showcase just some of the ways that participatory digital visual methods could be used to enable alternative modes of knowing cities.

Returning to the case study

As a sandbox for experimentation, Gehl has kindly lend themselves to this research as a case study from which other can learn, and through which novel knowledge has been produced about the inner workings of a data imaginary and how it produces and perpetuates particular roles for data in studies of cities. In the Introduction of this dissertation, I presented Gehl as a 'most-likely' case (Flyvbjerg, 2006) from the rationale that with their (a) investment in innovation, (b) interdisciplinary culture and staff, and (c) 20+ year history of bridging urban design and data methods, the company is a most likely actor to be able to take in new data methods such as the visual ones tested here. Learning from previous analysis and discussions of trajectorism, however, it might be questioned if the long history of studying cities also poses a barrier to take in new methods. This is not written in the stars, but seems to depend on strategic decisions and priorities that either steer towards incremental, continuous innovation or towards radical, discontinuous innovation. This is choice of balancing exploration of new methods and exploitation of existing ones (Corso & Pellegrini, 2007). Navigating that, I have offered up a set of frameworks in this dissertation that the company, and other actors, can use to actively engage with their own imaginary. Returning to Hancock and Bezold, they write about this:

> "future works needs to be both imaginative and plausible, but it also has to confront the organization's will to act. To be helpful, it has to influence the organization's learning and its commitment to action – and inspire it to question its sacred assumptions" (1994, p. 23).

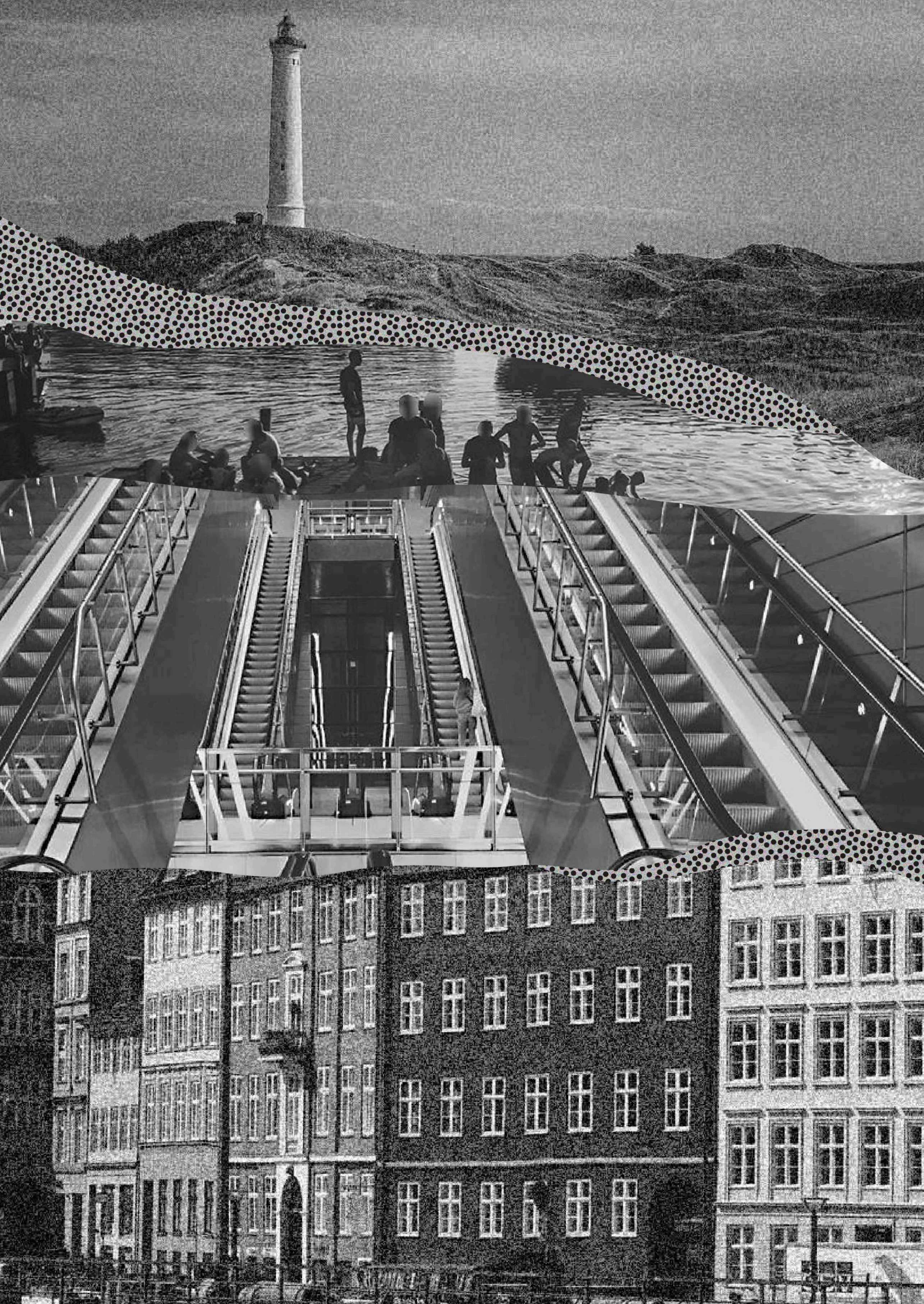
By unpacking major trends in Gehl's data imaginary (in response to the secondary research question) and engaging with methodological innovation through tangible data experiments (in response to the primary research question), I hope to empower an active engagement with the future of data-driven urbanism.

Framing Gehl as a case study, I anticipate that the trends observed in the company's data imaginary are likely to also be observable in some shape or form among other urban professionals or data-driven consultancies. But as the observations have been specific to Gehl, they will likely look different for other knowledge practices. To provide a toolbox for how other practices can unpack their own data imaginary, I therefore use the seven observations to formulate a set of questions that should be of relevance to others too.

These questions have been presented continuously in the analysis in the previous chapter, but are repeated here below:

1. **What sources of information are construed as potential "data" within your practice, and what are you excluding as non-data?**
2. **With whom do you locate the observational capacity in data projects, and how might you resituate this to embrace a pluralism of perspectives?**
3. **Are there any universalistic assumptions about your field built into your data tools and methods, and how can you begin to diversify that?**
4. **Which data sources do you construe as 'objective' or 'subjective', and what does that mean for how you ascribe value to them? What alternative ontologies could be accepted, and how might this reframe the problems you work with??**
5. **What value do you ascribe to toolmaking versus innovation of methods in the development of your data practices?**
6. **Is innovation of your data practices guided by incremental or radical strategies, and what is the consequence of this for how you are able to imagine data futures alternative to the present?**
7. **Which metrics are central to the way you connect datasets, and could there be other modes of commensurability? What role does the commensurable metric play in analysis, and do you tend to overlook other aspects of data by overcommitting to it?**

In a world where cities are increasingly shaped by data-driven processes, I will argue that it is not just appropriate but imperative that actors who contribute to decision-making around urban issues cultivate critical reflection about how their collective visions materialize and become co-constructive of certain data futures. This includes urban planners like Gehl, but might also involve researchers, public institutions, private developers, policy makers, and others whose data imaginary shapes data-driven urbanism. I also offer these questions up as a toolbox that can be used in citizen science or by communities and NGOs to hold institutions of power accountable for how their data imaginaries frame the way urban problems are being datafied and hereby what solutions we can envision for them.



PART IV

Final reflections

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Chapter 11

Concluding Remarks

Concluding remarks

This dissertation has examined two research questions pertaining to the potential role of digital and participatory visual methods within studies of cities. While I have responded to these questions in different chapters throughout the dissertation and discussed them in Chapter 10, I here provide some overall concluding remarks. To start, the dissertation has examined the primary question:

> ***How might different forms of visual data created by citizens be leveraged in digital and participatory ways to situate our understandings of urban issues in local lived experiences?***

This question was addressed in the dissertation through five journal articles. The theoretical article (Chapter 2) has reviewed current trends in digital urban studies. The three method-specific articles (Chapter 4, 5 and 6) demonstrated how participatory and computational approaches can be combined to study social media images, collaborative maps, and photovoice images created by citizens in ways that foreground community voices and local lived experiences. Additionally, the article about the photovoice application, UB App, (Chapter 7) showed how the innovation of digital and participatory visual methods in this PhD project also has involved co-designing new tools with practitioners and local communities. When brought together, the five articles establish a new space of opportunity for using digital and participatory visual research in studies of cities, where the role of visual methods has been underexplored and siloed along methodological separations of quantitative computational approaches on one hand and qualitative visual ethnography on the other. Traversing such separations, the articles demonstrated diverse potentials of visual research and situated them in a shared digital and participatory methodology.

To reflect on what such visual methods might add to the data practices of urban planners, this dissertation has examined a secondary research question:

> ***Which epistemic commitments and discursive closures shape the data imaginary in Gehl, and how can participatory digital visual methods expand this to include more diverse data futures?***

The dissertation investigated this question in Part III. Chapter 8 first presented a theoretical framework regarding how I have approached the study of Gehl, drawing on Zuiderent-Jerak's (2015) formulation of "interventionist STS" and Haraway's (1988) notion of "situated knowledges". Chapter 9 delivered a qualitative analysis and identified seven epistemic commitments that shape the data imaginary in Gehl. These included: (1) framing visuals as non-data; (2) an inherited observational gaze; (3) universalistic assumptions that people experience cities the same; (4) an objectivist ontology of data; (5) a tool-centric innovation culture; (6) a focus on leap frogging; and (7) a data culture of commensurability in which data has value if it can be combined with other datasets through geotags. While these commitments have in some ways been productive for structuring the way Gehl planners use data to study public life, the dissertation discussed that they also act as "discursive closures" that prevent planners from envisioning alternative data practices. Linking each observation to my own empirical experiments, I demonstrated how it is possible to augment each part of the data imaginary with participatory and digital visual methods. Discussing this in Chapter 10, I suggested that, more than simply unpacking the data imaginary at work, it is possible to intervene in and expand it. To do so, I framed my three experiments as *speculative* interventions that illustrate how it is possible to imagine different data futures and make alternative 'modes of knowing' cities possible. And to engage others in exploring this, the dissertation finally presented seven heuristic questions that anyone can use to start exploring the data imaginary at work in their own practice.

Where do we go from here?

The main contribution of this dissertation has been methodological. Rather than simply being concerned with describing methods, my focus has been to synthesize theoretical, conceptual, and practical elements of visual approaches to studying cities. But the project has also produced empirical and theoretical knowledge, as theoretical contributions have sprung out of empirical experimentation as a form of incremental, "middle-range" theory (Merton, 1968) that offers the reader a toolbox of concepts, distinctions, and terminology to guide empirical inquiry and distinguish different approaches to visual digital research. In this last section, I reflect on these contributions as well as what possibilities digital and participatory visual research could continue to explore.

Connecting visual, ethnographic, and spatial analysis

Whereas most existing urban projects have focused on textual forms of data and shown little attention to visual analysis, this research has demonstrated that in the study of cities and urban issues, there are great potentials for using citizen-generated visuals combined with algorithmic 'ways of seeing' image content to study urban trends. This contributes to existing research in digital visual method studies, which has been progressive in exploring the possibilities of linking computational ways of processing images with situated ethnographic analysis. Taking this one step further, however, the project has advanced this by showing that computational GIS technologies can empower visual digital research that, more than just mapping images as dots on maps, leverages the granular and geolocated nature of data to find spatial patterns in urban life from visual datasets. In the Instagram analysis in Chapter 4, for instance, I used computer vision AI to label images according to similarities in visual content and used K-means clustering techniques to map the spatial distributions of photos of nature in Copenhagen, taking these as indications of where residents found refuge during the COVID-19 pandemic. In the analysis in Chapter 5 I combined participants' annotations of photovoice data with spatial clustering techniques to identify "zones of belonging" and "zones of exclusion" in Copenhagen.

While I see much potential in urban studies for bringing GIS analysis, computational processing of images, and ethnographically situated analysis together, this requires not only bridging of tools between digital methods and urban studies, but also new takes on methodological design and practices. This dissertation provides a couple of experiments on this, but there are great potentials in exploring and advancing interdisciplinary practices further.

Putting 'data feminism' and 'design justice' in action

The projects reported in Part II have illustrated concrete ways of putting a data feminist approach to work, showing that computational ways of seeing and mapping data need not be an exercise of top-down classification and oppression. Rather, such techniques can be used to re-draw boundaries in the city from the bottom up and situate the spatial framing of an issue in community-led perspectives. In particular, the article in Chapter 5 contributed to operationalizing a data feminist approach to citizen engagement and mapping in both its topic, process, and form. This, among other things, included using mental mapping to chart intersectional identities of marginalized groups and utilizing participatory GIS as a reflective exercise within Gehl to map blind spots among planners.

The research in this PhD has also showcased new *participatory* potentials and applications of digital visual methods. This was especially established with the participatory GIS and photovoice studies in Chapter 5 and 6, which were designed with a jumping-off point in design justice (Costanza-Chock, 2020) and involved community members and organizations from A to Z in framing, collecting, and interpreting data. These chapters highlighted that most citizen engagement methods are *either* qualitative and focus on a single minority group (as seen in most photovoice projects) *or* quantitative and engage a large public (as seen in most participatory GIS). In contrast, the work in the Urban Belonging Project took steps in a new direction, proving that computational and digital data analysis can be used for community-led research. GIS and computational techniques were for instance used to create visualizations as elicitation devices in workshops, connecting instead of separating computational and participatory agendas.

With this, the dissertation has indicated how a computational and participatory approach can put 'data feminism' and 'design justice' to work in practice and give local communities a greater voice in urban planning. This, I believe could be pursued further as strategies for citizen science. Working with a bottom-up approach that invites communities be part in framing problems, designing new tools, collecting, and interpreting data, these studies are more time consuming and require great flexibility. But through my examples here, I hope to have shown how we can involve citizens more in datafying urban problems, and why it matters.

Designing new visual research tools like the UB App

One of the major barriers for visual digital research is the lack of tools, which can invite citizens to generate situated visual data. A major contribution of this PhD is therefore the development of the UB App as an open-source digital photovoice application that can be used by scientists, practitioners, public institutions, and local communities and NGOs alike. As a contribution to the open science and citizen science agenda, the app makes a digital form of photovoice accessible to community engagement and citizen science projects in all fields, not just urban research. In short, the app enables smartphone-based photovoice data collection at scale and lets the administrator invite users in groups and control prompts and timelines of photo tasks. It collects timestamp and geolocation metadata and traces the routes people walk when taking photos, while asking participants to annotate their photos and react to others' photos. Designed to protect participants' data, it moreover presents a digital tool that can be used to (re)build trust with communities who otherwise experience citizen engagement as extractive or exploitative. It hereby offers a wealth of epistemological flexibilities that I hope can inspire many more to use digital photovoice research in their work. The app has for instance been used in Seattle by a local NGO to engage the youth in South Park to give input on policy making, while planners in Gehl are already using it in many different projects.

Data Visualization as a critical practice

Central to my analytical approach to all empirical projects in this PhD has been the use of data visualization as a technique for exploration, inspired by, among others, Niederer and Colombo (2019) and Jensen et al. (2021), who argue that visualization can be an essential practice of discovering analytical insights, not simply communicating them. Therefore, the articles in Chapters 4, 5, and 6 contributed to innovation around how visualizations can be used to arrange and rearrange visual materials in ways that open them up to different analyses. The articles have individually experimented with various visualization and mapping techniques that use citizen-generated data to subvert hierarchies and binaries and redraw maps and boundaries of the city based on local perceptions of an issue.

This has contributed to a lineage of feminist and anti-racist engagement with *information design*, which can be traced back to W.E.B. Du Bois' (Battle-Baptiste & Rusert, 2018) creative use of data visualization to subvert dominant narratives about Black people in America, and which finds contemporary expression in data feminism (D'Ignazio & Bhargava, 2020), can calls to see data visualization as a site of potential "non-oppression" and "co-liberation" (Bravo et al., 2022). As visualizations and maps play a central role in fields like data science, digital methods, and urban studies, I find a great need for continuing to rethink how design and visualization techniques can bring forward more nuanced, diversified and heterogenous understanding of cities and those who live in them.

Adding diverse and intersectional perspectives on the city

The participatory GIS and photovoice study in Chapters 5 and 6 contributed novel empirical insights about how marginalized communities experience belonging in the city. This is significant because it offers new insights to theoretical debates about what "belonging" means in an urban context, and how it is perceived as an issue by different people and groups. However, this was also significant because it co-produced insights about the city from the perspective of seven marginalized groups that are often underrepresented in planning; including LGBTQ+ people, physically disabled people, mentally vulnerable people, ethnic minorities, international expats, deaf people, and homeless people. While many existing projects have equally studied the experiences of such marginalized groups in urban research, these communities are rarely *brought together* as seen in the Urban Belonging project. Moreover, relatively few studies in Scandinavia and Denmark have focused on such groups (arguably because marginalization and inequalities are assumed to be less intense in this region compared to other parts of the world). When discussing the project with Gehl's CEO, Helle Søholt, and the City Architects of Copenhagen, Camilla van Deurs, it has for instance been voiced that we do not have enough knowledge about these groups in Copenhagen. The research documented in Chapter 5 and 6 has added new knowledge to fill this gap: Findings in the photovoice analysis included examining barrier around accessibility to feeling belonging in the city, while showing through photovoice storytelling how differently communities experience accessibility as an issue. The photovoice and participatory GIS studies were used to identify "zones of belonging" and "zones of exclusion" in the city, based on participants' positive and negative experiences. They also problematized notions of universally inclusive spaces by showing that participant feel belonging in places that are 'for them' and not for others, indicating a need to design for ownership.

To diversify our perspectives on the city, further studies are warranted that produce insights about groups that were not a part of our study such as refugees, elderly, kids, blind and vision impaired people, just to name a few. In that face of political polarization, more insight could also be useful on how people from different ends of the political spectrum experience the city. Additionally, this PhD has indicated that we need greater attention to how multifaceted identities are. I thus urge planners and researchers to create more intersectional knowledge.

Putting 'data imaginaries' on the agenda

With its empirical investigations of the data imaginary in Gehl, the dissertation has also produced theoretical models and frameworks that can help others unpack how collectively held visions and epistemic commitments shape the production and perpetuation of the role of data in society. This, I hope can invite scholars and organizations to scrutinize the power and performativity of such imaginaries in shaping what futures it is possible to imagine for a datafied society.

How to create impact beyond academia

In the Introduction of this dissertation, I posited that, as an industrial PhD, this project has been guided by a dedication to bridging the so-called "rigor–relevance gap" between researchers and practitioners (Kieser & Leiner, 2009) and doing research that has impact beyond academia. The dissertation has discussed how this was achieved in Chapter 9, which showed how the PhD has introduced new data practices in Gehl. Beyond industry and academia, however, the research has also offered itself up to the wider public, to community organizational work, and to citizen science at large. For example, the Urban Belonging Project has been presented as a public exhibition twice in Copenhagen, as documented in Chapters 5 and 6, and has been invited to the next Ars Electronica Festival in Austria due to winning the 2023 Diversity & Collaboration Award of the European Union Prize for Citizen Science. This brings the research in dialogue with a societal public, starts conversations around issues of belonging and diversity, and means that the methods and tools used in this project will be exposed to a larger audience of planners and policy makers. It is my ambition to continue working at this nexus of research, industry, and local community organizations in projects that bring such actors together around innovating the tools and methods with which we understand urban issues.

Chapter 12

Summaries

Summaries

English summary

"Expanding Data Imaginaries in Urban Planning" synthesizes more than three years of industrial research conducted within Gehl and the Techno–Anthropology Lab at Aalborg University. Through experiments with social media images, digital photovoice, and participatory map-making (also called 'participatory GIS'), it takes a broad lens on exploring how visual materials created by citizens can be used within a digital and participatory methodology to reconfigure the empirical grounds of data-driven urbanism. Drawing on a data feminist framework and participatory design, it leverages such data methods to elevate local community voices and situate urban issues in lived experiences, exemplified by three empirical projects.

One experiment uses around 39,000 Instagram photos from a COVID-19-related hashtag in Denmark to study place attachments during the first nine months of the pandemic in 2020. A second experiment reports on the use of participatory GIS in the Urban Belonging project, in which members from seven marginalized communities in Copenhagen were invited to map their experiences of belonging individually and collectively. A third experiment reports on the use of photovoice in the Urban Belonging project, in which participants were asked to document when and where they feel a sense of belonging in the city by taking photos with the UB App, a photovoice tool developed for the project, while discussing their photos together in workshops. This dissertation presents these experiments as independent journal articles, together with a theoretical article that reviews trends in two decades of urban digital research and an article that documents the design of the UB App, developed through this PhD project.

As an interventionist form of Science and Technology Studies research, the project utilizes its industrial position as an opportunity to study Gehl's data practices up close, unpacking collectively held narratives and visions that form a particular "data imaginary" in the company and contribute to the production and perpetuation of the role of data in urban planning. This dissertation identifies seven epistemological commitments that shape the data imaginary in Gehl and act as discursive closures. These include: (1) framing visuals as non-data; (2) an inherited observational gaze; (3) universalistic assumptions that people experience cities the same; (4) an objectivist ontology of spatial data; (5) a tool-centric innovation culture; (6) a focus on "leap frogging" and incremental

innovation; and (7) a commensurability culture in which data has value if it can be spatially linked to other datasets.

To illustrate how planners might augment these commitments, the dissertation uses its own data experiments as speculative cases that demonstrate how participatory digital visual methods can expand each part of this imaginary to include alternative and diverse modes of knowing cities. Encouraging others to become responsible and reflective about the power and performativity of collectively held visions, I use the case study to formulate seven questions that can be used as heuristic starting points for anyone interested in unpacking their own data imaginary. The PhD hereby contributes with critical perspectives about how the expectations and visions about data that are enacted today within professional cultures, shape the role of data in designing cities.

Dansk resumé

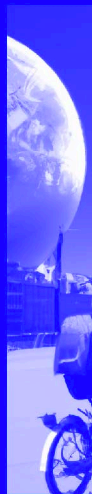
‘Expanding Data Imaginaries in Urban Planning’ sammenfatter mere end tre års erhvervsforskning udført inden for TeknoAntropologisk Laboratorium og virksomheden Gehl. Gennem eksperimenter med billeder fra sociale medier, digital photovoice, samt participatorisk GIS undersøger jeg, hvordan forskellige billede- og kort data, skabt af borgere, kan bidrage til digitale og deltagerbaserede metoder indenfor studier af byer og byliv. Med afsæt i data feminisme, data visualisering og participatorisk design udnytter jeg visuelle data til at fremme lokale samfundsgruppers stemmer og forankre forståelse af urbane problemstillinger i borgeres oplevelser og perspektiver. Dette udfoldes igennem tre empiriske projekter: Ét eksperiment bruger omkring 39.000 Instagram-billeder fra en COVID-19 specifik hashtagkampagne til at undersøge, hvordan borgere i Danmark formede tilknytning til byer og steder under de første ni måneder af pandemien i 2020. Et andet eksperiment anvender ’participatorisk GIS’ i Urban Belonging projektet, hvor medlemmer fra syv marginaliserede samfundsgrupper i København blev inviteret til individuelt og kollektivt at kortlægge hvor og hvornår de oplever at høre til i byen. Et tredje eksperiment undersøger metoden photovoice igennem Urban Belonging projektet, hvor marginaliserede grupper har brugt en ny smartphone app udviklet til projektet til at tage mere end 1400 billeder af steder og situationer i København der giver dem en positiv eller negativ følelse af at høre til i byen. Afhandlingen præsenterer disse eksperimenter gennem tre forskningsartikler. Disse kædes sammen med to yderligere artikler, hvoraf den en teoretisk artikel diskuterer tendenser indenfor digital byforskning, mens en metodeartikel dokumenterer udviklingen af den photovoice applikation, UB App, der er udviklet igennem dette PhD projekt.

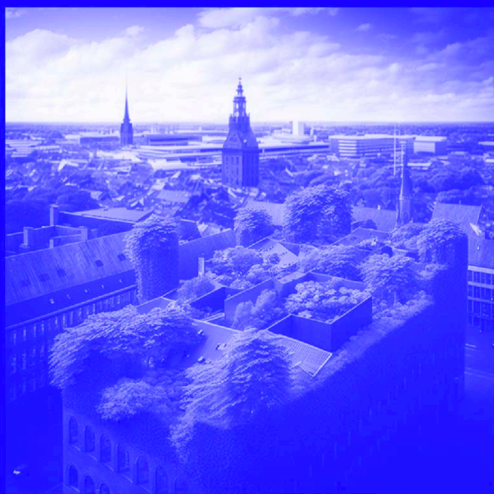
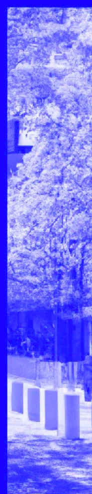
Som et interventionistisk STS studie udnytter projektet desuden sin erhvervstilknytning til at studere Gehls datapraksis, hvor kollektivt afstemte narrativer og visioner udgør en særlig 'data imaginary' som rammesætter virksomhedens ideer og forventninger til brug af data i byplanlægning. Afhandlingen identificerer syv epistemologiske tendenser, der former Gehls 'data imaginary'. Disse inkluderer: (1) at se visuelle materialer som ikke-data; (2) et nedarvet observerende blik på byen; (3) universalistiske antagelser om, at folk oplever byer ens; (4) en objektivistisk ontologi omkring data; (5) en innovationskultur fokusere på teknologiske værktøjer; (6) fokus på 'leapfrogging' og inkrementel innovation; samt (7) en kommensurabilitets-kultur, hvor data først har værdi, når de kan forbindes med andre datasæt igennem geografiske metadata.

Ved at bruge mine egne dataeksperimenter som spekulative case eksempler, illustrerer afhandlingen hvordan byplanlæggere kan udvide hvert aspekt af denne 'data imaginary' gennem participatoriske, digital visuelle metoder, for herved at gøre mere diverse data fremtider mulige. For at inspirere flere til at reflektere over og tage ansvar for den magt of performativitet der ligger i vores kollektive forestillinger omkring data, anvender jeg til slut de syv observationer i Gehl til at spidsformulere en liste af spørgsmål, der kan danne heuristisk udgangspunkt for alle videnspraksisser, store som små, der er nysgerrige på at undersøge og udvide deres egen 'data imaginary'. Hermed bidrager afhandlingen med et kritisk perspektiv på, hvordan kollektivt afstemte forventninger til data former og styrer de data fremtider, der er mulige at forestille sig.





EPILOGUE

The new frontiers of digital visual research

Epilogue

I began this project with puzzlement about the underexplored role that *citizen-made* visual digital data has had in studies of cities. Now, as I conclude this work, it is crucial to make note of how much is changing in visual and digital technologies. With the current revolution in artificial intelligence, advances in *generative AI* are rapidly altering the nature of visual data that we are surrounded by. Danish futurist Sofie Hvitved recently speculated that by 2030, we might live in a new reality where 99% of content we engage with online has been produced by artificial intelligence. Adding to that, historian Yuval Noah Harari has claimed that by being able to manipulate and generate words and images, AI has "hacked the operating system of our civilization" (The Economist, 2023). While it is hard to foresee exactly what the impact will be, there is no doubt that with AI models that can create realistic images and videos from scratch, we are entering a new era of visual digital content, which will have implications for urban research.

Architects are for instance already using this technology, as seen with French ūti architectes who have created 'The Hidden Skateparks of Paris' series with Midjourney (see image to the right). Planners in Gehl, have equally been quick to test applications of these tools. While some are concerned that generative AI may lead to a loss of human touch in design, others see potential to use it as a speculative tool to discuss how complex issues like climate change will impact cities. As these AI models are trained on historic datasets, we might also construe them as 'cultural custodians' that we can use as conversation partners to become more knowledgeable about our own past, as seen with the 'Venice Time Machine' project which reconstructs local history from 1,000 years of archive records.

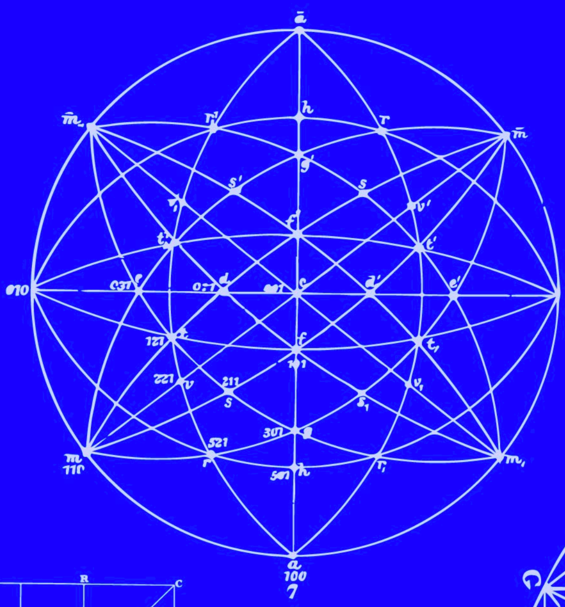
A potential avenue for future research could also explore the use of generative AI for engaging citizens more in participatory planning, by creating renderings of proposed interventions and letting citizens debate them. The technology could even make it accessible for non-experts to create their own renderings of urban environments (see my own example to the right) and participate in visuals debates about the city's future(s). We might, however, also see the opposite if these technologies are used to create new hierarchies between those who have and don't have the skill to make their voices heard. The new landscape of digital visual research in other words offers exciting possibilities for urban research, but also presents new challenges and ethical issues. Grappling with this will demand that visual researchers develop new theory and methods and work side by side with planners, local communities, and others to engage with this new reality.

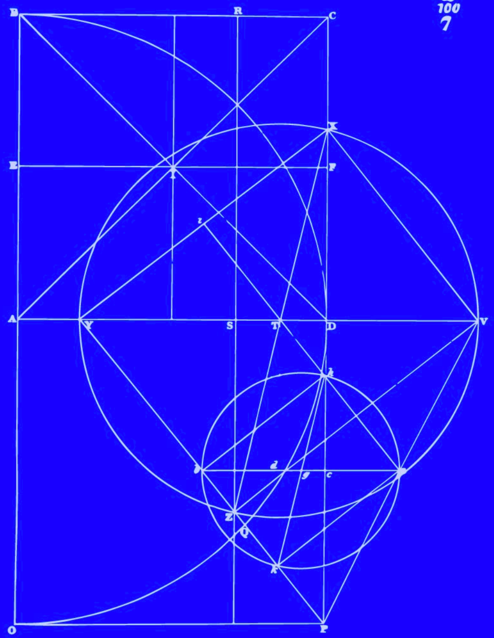
Welcome to the new frontiers of digital visual research!

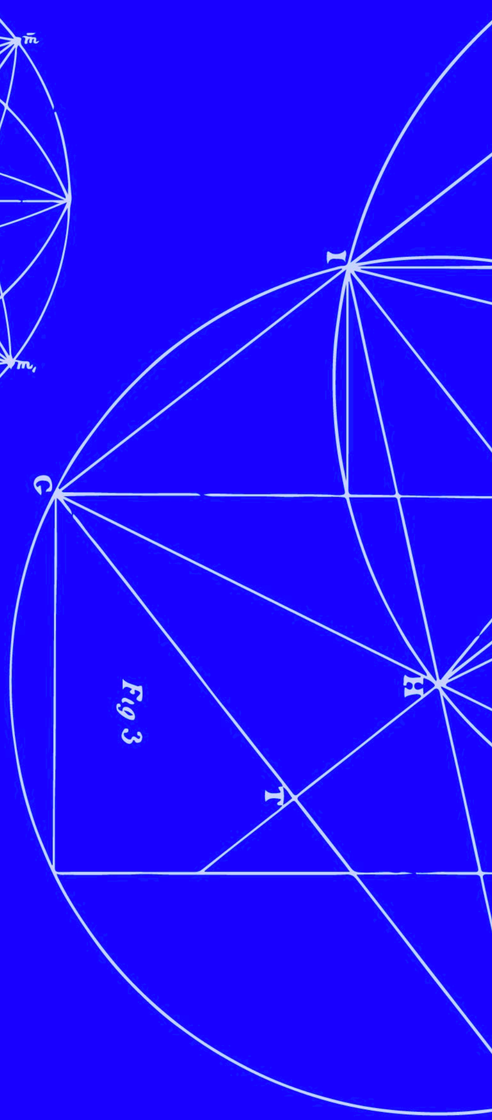
Figure 13.1: "Hidden Skateparks of Paris". By ūti architects

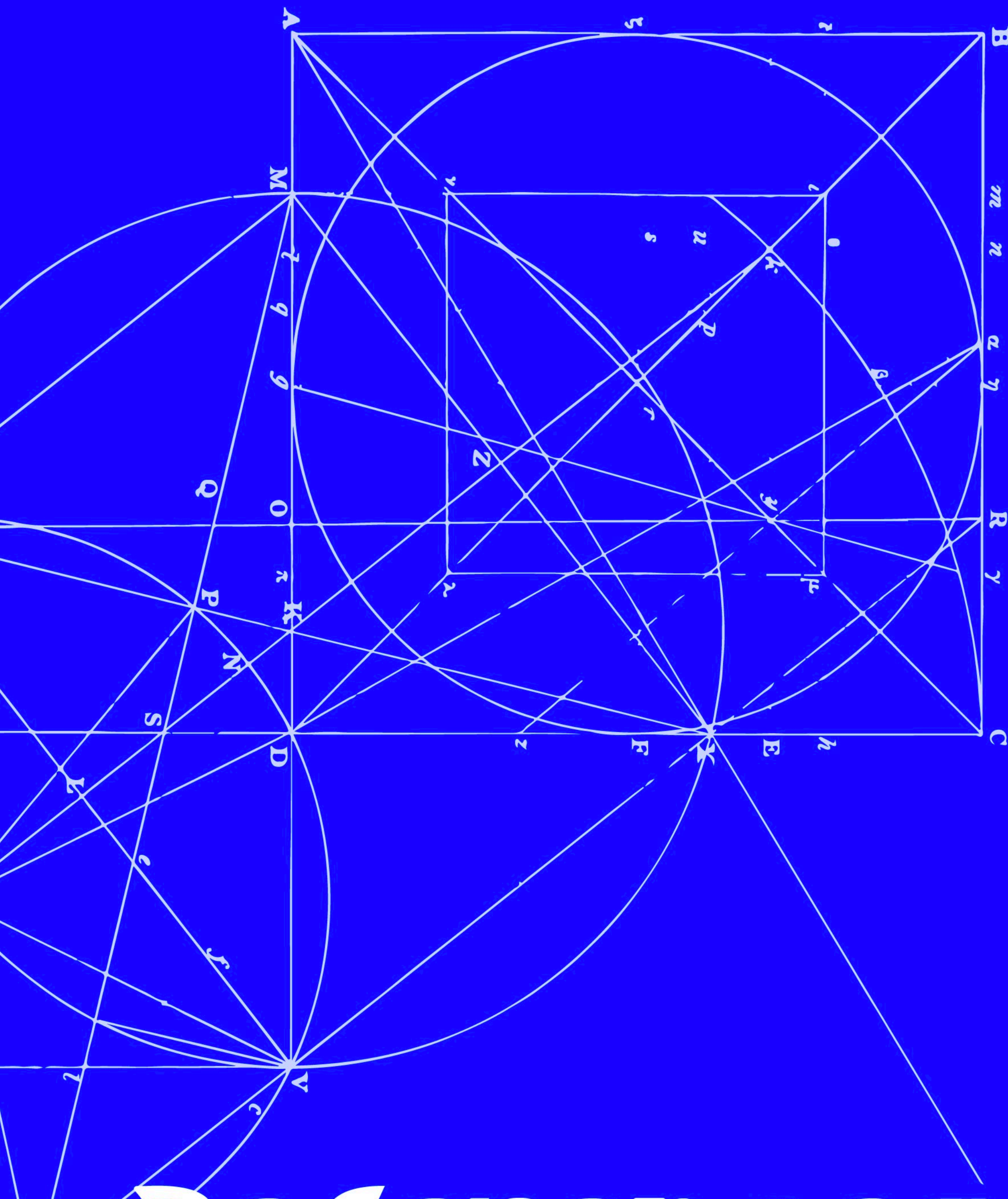
Figure 13.3: "Rooftop farms in Copenhagen". By author.

Chapter 14









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“Expanding Data Imaginaries in Urban Planning” synthesizes more than three years of industrial research conducted within Gehl and the Techno-Anthropology Lab at Aalborg University. Through practical experiments with social media images, digital photovoice, and participatory mapmaking, the project explores how visual materials created by citizens can be used within a digital and participatory methodology to reconfigure the empirical ground of data-driven urbanism. Drawing on a data feminist framework, the project uses visual research to elevate community voices and situate urban issues in lived experiences.

As a Science and Technology Studies project, the PhD also utilizes its industrial position as an opportunity to study Gehl's practices up close, unpacking collectively held narratives and visions that form a particular “data imaginary” and contribute to the production and perpetuation of the role of data in urban planning. The dissertation identifies seven epistemological commitments that shape the data imaginary at Gehl and act as discursive closures within their practice. To illustrate how planners might expand on these, the dissertation uses its own data experiments as speculative demonstrations of how to make alternative modes of knowing cities possible through participatory and digital visual methods.

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