

Article

GPS Tracking Data on Marginalised Citizens’ Spatial Patterns: Towards Inclusive Urban Planning

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Abstract

Knowledge about how marginalised citizens use urban spaces is hard to access and apply in urban planning and policy. Based on current debates around “smart cities” and “smart governance,” the City of Odense, in Denmark, has tested the integration of “smart engagement” by means of GPS-tracking techniques into the municipality’s cross-sectoral strategy for an “inclusive city.” In a period of austerity, cities have the incentive to optimise public services. Hence, GPS-tracking data was produced by 64 marginalised citizens, resulting in a data inventory covering three weeks of spatial behaviour. First, this article shows how these GPS-tracking data were processed into maps without revealing person-sensitive spatial patterns. Secondly, the article explores whether such maps and the GPS-tracking techniques that underpin them are considered valid, relevant, and applicable to urban planning from the perspectives of marginalised citizens, their representatives, and municipal planners and professionals respectively. The GPS project showed shortcomings as regards the quality of the data inventory and the representativity of the mapped behaviour, which made them inapplicable for optimising dedicated public service. However, the article also finds that the GPS-based maps succeeded in being non-person sensitive and in providing a valuable platform for citizen-centric dialogues with marginalised citizens with the potential for raising awareness and increasing knowledge about this citizen group’s living conditions and urban lives. An important derived effect of the project is that it has ensured ongoing cross-sectoral collaboration among a range of professional stakeholders, imperative for ensuring creating greater equity in urban planning.

Keywords

GPS tracking; inclusive cities; marginalised citizens; Odense; public spaces; smart cities; smart engagement; smart governance

Issue

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1. Introduction

Around the world, cities are striving to become “smarter,” more efficient, and more sustainable. The smart city discourse that began some 20 years ago started as a techno-centred approach (Goodman et al., 2020; Hollands, 2008). However, today it is widely acknowledged that a fundamental tool for a city to become “smart” is to involve its citizens. Hence, more citizen-centric approaches to smart cities have gained support, emphasised by concepts like “smart engagement” and

“smart governance” (Lee & Lee, 2014; O’Grady & O’Hare, 2012). Nonetheless, a recent study has shown that the term “citizen-centric” has various meanings and is not always fully apt (Cardullo & Kitchin, 2019).

Homeless and marginalised citizens’ everyday lives share the characteristic of being “unusual” in many respects, including their patterns of spatial and temporal behaviour, which challenges the shared use of public space. Their urban lives are often regulated by “defensive architecture” (Bauman, 2005), for instance, by removing benches or designing them so that the

homeless cannot lie on them, which makes planning for more just and inclusive cities a difficult task (Fainstein, 2005). Cities around the world are experiencing a period of austerity and a need to optimise public services to save money. Efficiency can be achieved in different ways, for instance, by identifying low-demand shelters or optimal locations of services. For this purpose, solid behavioural and spatial data are required.

Public participation involves many dilemmas regarding how to engage citizens in citizen-centric ways. New technologies for engagement have recently emerged. Global positioning systems (GPS) offer novel possibilities for collecting data on the spatial behaviour of elusive populations (Aasi & Lee, 2020; Gasson et al., 2010). The use of GPS-based techniques for mapping the use of and preferences for urban spaces by the homeless and marginalised citizen groups is considered a unique method of increasing the evidence base for urban planning, and it can help improve public services and protected spaces for these citizens (North et al., 2016; Šimon et al., 2019). GPS/GIS technology has also been suggested as adding spatiotemporal information to qualitative information, as revealed from walk-along interviews (Martini, 2020). However, there is still a need to evaluate the potentials and challenges of such methods to determine whether they are citizen-centric or not, as well as to assess how much they can underpin efforts at smart engagement and smart governance.

1.1. The GPS Project in the City of Odense

The Danish city of Odense (180,000 inhabitants) is a leader among European cities in respect of its inclusive and innovative urban governance (HABITACT, 2015). Its strategy—“The Inclusive City”—is anchored in the cross-sectoral collaboration between the public authorities and civic actors in the city’s Council of Marginalised Citizens, a forum which represents the interests and needs of marginalised citizens by linking the issues of health, social security, urban planning, and housing, and targeting the social integration and spatial inclusion of marginalised citizen groups, both practical and strategic.

The city has worked systematically to provide inclusive public spaces for marginalised citizens in the city centre, not least because it was the pilot city in a national innovation project (Danish Ministry of Social Affairs, 2010). Meanwhile, radical urban transformations of public spaces have taken place in the city centre, where a huge construction work to bury a major street has boarded up a large part of the city centre for several years, disturbing marginalised citizens’ use of existing daily paths and public spaces, as well as establishing new patterns of both.

On this basis, the city’s planning authorities foresaw two overlapping challenges. First, they expected the new patterns of the use of public space by marginalised citizens to densely populate public spaces they previously

only rarely used, which were predicted to cause complaints from other citizen groups about noisy and disturbing behaviour. Second, new barriers, both geographical and temporal, to marginalised citizens’ access to social and health services were expected to follow the new patterns of spatial behaviour. Hence, the main task for the municipal planners was to find a way to approach these predicted challenges to marginalised citizens’ new patterns of public life.

Until then, the city had focused its work on providing inclusive public spaces in the inner city, and in doing so had acquired a solid knowledge base on marginalised citizens’ use of and preferences for central public space (Danish Ministry of Social Affairs, 2010). However, the city lacked knowledge about this citizen group’s wider patterns of space use and movements that would have allowed it to establish a better background for the location and provisioning of an efficient health service, and of urban spaces aligned with marginalised citizens’ need for both protection and shelter and proximity to a “normal” urban life. The latter would enable planning to ensure conflict-neutral co-existence in public spaces for the various citizen groups by reducing the crowding of marginalised citizens into shared public spaces, for instance, by striving for a balanced spatial distribution of marginalised citizens’ preferred spaces.

In order to meet these requirements, the city decided to test GPS tracking as a method of collecting evidence on spatial behaviour with the additional expectation that the representation of marginalised citizens by means of their direct involvement would be improved. The city’s main motivation for the application of new digital techniques was to test how such data could support the city’s strategy of achieving an inclusive and smart city (City of Odense, 2015a, 2015b). Two technical reports were produced (Carstensen et al., 2017; Skov-Petersen et al., 2017). The rationale for the city’s choice of GPS technology relied on an expectation that this could produce knowledge about spatial behaviour that was considered hard to access by other means. It was expected that making the marginalised citizen’s spatial behaviour and needs visible on maps would improve their representation in stakeholder discussions. Specifically, it was expected that the data would reveal the spatiotemporal dynamics of the group so that they could be related to the effects of the closure of public spaces that were popular with this group due to urban renewal and be useful in locating services relevant to the group.

The GPS project started in 2014. At the time GPS-based tracking was still in its infancy where the involvement of marginalised citizens was concerned. Thus, there was a need to develop and adjust the methodology to test and evaluate its potential as regards the technical, governmental, and ethical aspects. To meet these needs, the city authorities approached the University of Copenhagen for assistance, and a research project was defined based on the existing data inventory and collected through the City of Odense’s GPS project.

This article explores the potential and challenges of using GPS-based data in planning an inclusive city, as is underway in the City of Odense. It evaluates processes of analysing and displaying GPS-based tracking data and explores how such data are perceived to be relevant and applicable to urban planning and policy from the perspectives of three core stakeholder groups: marginalised citizens, their representatives, and municipal planners and professionals. The article starts by outlining the form the smart city discourse takes in the City of Odense and especially how it resonates with “smart engagement” and “smart governance.” Then the study’s methodological approach is presented. In the analytical sections, we first describe our efforts to produce non-person sensitive maps of the urban life patterns of marginalised citizens by means of GPS-based tracking and revealing the resulting maps. Second, the article analyses the validity, relevance, and potential applicability of such data from the perspectives of the three stakeholder groups respectively. Then follows a discussion of the different technical, ethical, and governance potentials and challenges related to collecting and applying GPS-based data in planning assessed from the distinct stakeholder groups’ perspectives. The article concludes by outlining how these findings relate to current debates around smart cities and smart governance.

2. Background

2.1. The Smart City

The concept of the smart city has grown rapidly until it has reached the point where it has become “a favoured response to the 21st-century urbanisation challenges” (Praharaj & Han, 2019, p. 1). To reduce the somewhat confusing application of the term, many attempts have been made to formalise the concept and to assess its conceptual and discursive evolution (Kummitha & Crutzen, 2017; Toli & Murtagh, 2020). Cohen (2015) divides the evolution of the smart city concept into three distinct phases or periods. It is acknowledged that the idea for smart cities initially grew out of digital technologies, including sensor systems, networks based on the Internet of Things, and centralised dashboards targeting a city’s sector-specific efficiency in terms of, for example, its use of energy, resources, and transport systems. From this internal management perspective, applications to support the provision of public and private services to citizens, institutions, and private companies were added. Thus, the first phases of smart cities focused on the use of technical infrastructure to make cities more responsive, efficient, sustainable, and intelligent. More recently, collaborative democratic approaches that permit participatory citizen-centric urban innovation have become prominent features of the smart city concept (Fernandez-Anez et al., 2018; Lee & Lee, 2014; O’Grady & O’Hare, 2012).

2.2. Smart Engagement

Cities labelled as smart have been criticised for being overly technocratic and instrumental and as high-tech variations on the notion of the “entrepreneurial city” (Hollands, 2008). As a reaction, some cities have reframed their initiatives as “citizen-centric.” However, as Cardullo and Kitchin (2019) have pointed out, what “citizen-centric” means in practice is rarely specified. Smart cities tend to frame citizens as smart, and they measure their inclusion, participation, and empowerment in diverse ways. Analyses have shown that “citizen-centric” smart-city initiatives are often rooted in a neoliberal conception of citizenship that prioritises market-led solutions to urban issues, rather than being grounded in civil, social, and political rights and the common good. Thus, research is required if smart cities are to be refashioned to become truly “citizen-centric.”

In this respect, theory and practice are both dominated by ambivalence about the very idea of participation and direct involvement. The conflicts between individual and collective interests, or between the ideal of democracy and the reality that many voices are never heard, produce dilemmas that are hard to solve. An emerging set of practices of collaborative public engagement from around the world demonstrates how alternative methods can better meet the goals of public participation (Innes & Booher, 2004).

A new repertoire of techniques that provide alternatives to traditional methods of involvement has been developed, for example, urban laboratories, art interventions, foresighting, web-based participation, charrettes, and a variety of location-based digital media. These techniques of involvement are considered fruitful for engaging specific citizen groups, for instance, young people (Townley et al., 2016). Not least, smart-city initiatives have shed new light on novel means of enabling citizen engagement and participation in urban planning. To increase citizens’ social integration, spatial inclusion, and democratic engagement, new methods, practices, and tools that enable smart engagement have a lot of potential for urban governance and planning (Aasi & Lee, 2020). For instance, they could contribute to reframing smart cities as sites where citizens are actively engaged in the design and planning of urban space. Moreover, they might be very useful for handling different but related public interventions that aim to be coordinated and integrated.

2.3. GPS Tracking for Understanding the Spatial Behaviour of Marginalised Citizens

So far, studies of marginalised citizens using GPS techniques have been applied in a limited number of cases (North et al., 2016; Šimon et al., 2019). In general, it is recognised that individuals within marginalised groups can be hard to reach out to and maintain contact with (Snow & Mulcahy, 2001). Accordingly, information about

the spatial behaviour of such individuals is hard to obtain and verify. In the present study, the intention was to assess behaviour on the city scale over an extended period (a week) as comprehensively as possible. GPS tracking provides the required spatial and temporal coverage and degree of detail feasible for the purpose. Assessments based on direct personal contact, including interviews and in-person questionnaires, would in many cases suffer from having a lower temporal coverage since respondents rarely can recall every trip they made a week back in time (Snow & Mulcahy, 2001). Sketch mapping, as part of interviews, is often challenged by a lack of accuracy—in space and time—during the depiction of routes and locations. Although GPS registration is regarded as being a feasible option, the need for direct contact with the respondents when collecting qualitative data by means of interpretative approaches is regarded as imperative, both as a means of verification and to add further semantic information to the data (Gasson et al., 2010).

To assess the optimal location of shelters in Texas (US), North et al. (2016) studied the spatial behaviour of 18 marginalised citizens by means of GPS. The main strategy of the study was to involve respondents in assessing the variation between self-reported and recorded travelling distances and durations. The study reported by Šimon et al. (2019) combines week-long GPS tracking of marginalised citizens in the Czech Republic, combined with post-deployment interviews. The main motivation was to assess the size of respondents' activity spaces and how they were influenced by city size, age, gender, housing situation, and education. In a study not aimed specifically at marginalised citizens, Martini (2020) applies a "spatial transcript technique" to GPS tracking to add spatial and temporal semantics to walk-along interviews. In all three studies, interviews with the respondents were conducted to complement the recorded data. However, such studies do not include the involvement of marginalised citizens in data collection/interpretation or urban planning/design.

Townley et al. (2016) investigated the activity spaces of homeless youth by means of participatory mapping and GIS to involve the respondents in the research process and thereby "grant a voice" to them during knowledge generation. In this case, the involvement and the openness of the resulting dialogue are regarded as just as important as the resulting maps per se.

3. Methods and Data

3.1. Collection of GPS Data

The collection of the GPS data was initiated and conducted by the City of Odense in collaboration with the Danish charity DanChurchSocial, which runs a local shelter for marginalised citizens in Odense.

The service and support places for marginalised citizens in Odense are mapped in Figure 1. The health ser-

vice is run by the municipality and includes health clinics and drug dispensaries. The care service is mostly run by private organisations and consists of day or night shelters, one of which is for women only. Some have a religious dimension (Christian), while others are non-religious. The shelter run by DanChurchSocial is the biggest of its kind in Odense.

The shelter staff recruited all the participants (partly by means of a flyer entitled "Where to Situate New Refuges in Odense?") and handled the GPS equipment. The respondents received three meal tickets for participating in the experiment. The GPS units, which consisted of a GPS tracker/logger and access to the mobile GSM network, enabled reminders to be sent to recharge the unit, for example. The shelter staff kept track of the relationship between the respondent and the units. The authors (the research team) conducted the data analysis and the subsequent workshops, assisted by a facilitator. As also noted by Townley et al. (2016), recruitment of respondents at the shelter might introduce a selection bias for those who socially can afford such interaction.

An initial set of GPS-tracking campaigns was conducted between December 2014 and October 2016. A total of 70,176 points were collected. No scientific documentation exists, but the ideas and early endeavours were presented in a Ted Talk by the project leader (Rønning, 2014). The time lap between the points was more than 20 minutes on average. Accordingly, since the analysis of respondents' routes and resting points were focal issues, the data sets from the initial campaigns were considered inadequate and were set aside. To compensate for this, three additional campaigns with a higher temporal resolution were conducted during weeks eight, nine, and 17 of 2017, resulting in a total of 596,715 recorded points.

The 64 respondents each carried the GPS unit for an entire week. The respondents comprised 14 women, 49 men, and one individual whose gender was not recorded. The gender imbalance of the sample—approximately a quarter female and three-quarters male—corresponds with the national average for shelter and care-home users in Denmark (Statistics Denmark, 2023). All respondents were more than 30 years of age. The national statistics for shelter and care-home users reveal that 25% are younger than 30 years. A main reason for the lack of young users in our sample is expected to be due to the inclusion of "care homes" in the statistics, which can be expected to cover a younger user type than targeted by the present sampling site. Accordingly, the number of respondents above 50 years of age is high compared to the national statistics.

Nine (14%) out of the 64 respondents reported not having a permanent dwelling, without any further specification of whether their situations were "roofless," "houseless," "insecure," or "inadequate" (cf. the ETHOS typology; Amore et al., 2011). Further information was unavailable due to the researchers' lack of options for direct access to the respondents.

With respect to data handling and privacy, a protocol for a code of conduct was drawn up:

- Data collection: Only the employees of the shelter know the respondents' identities. Anonymised age, gender, and access to a dwelling of the respondents are to be known to the researchers and the city authorities.
- Analysis and visualisation: Only the research team have access to the raw data. No data transfer, by whatever means, is to be permitted to anyone outside the team.
- Handling and management: In cartographic communications between the research team and the city authorities, the addresses of individual respondents must not be identifiable.
- Dissemination and publishing: All locations of stopping points or movements must be aggregated and obscured before being published. Stopping points used by only a single person are to be deleted.

3.2. Analyses of GPS Data

The raw data generated an anonymised identification of the respondent, locations, and times of recording. Of the originally recorded 596,715 data points, 404,603 data points (68%) of poor or irrelevant positioning were set aside due to (a) horizontal dilution of precision above 10, (b) positions at latitude/longitude equal to 0.0 (i.e., location lacking), (c) locations left over in data-loggers from previous registrations, or (d) locations appearing to be "spikes" (technical faults resulting in sudden, unmotivated shifts in coordinates). The main reason for the inferior quality of locations was the occasional indoor recordings.

After filtering, the points were divided into *stops* and *movements*. Sequences of points constituting a stop were defined and identified as being within a maximum radius of 250 m (about 820.21 ft) for periods of over 30 minutes. The method was adapted from the software V-Analytics (Andrienko & Andrienko, 2013, 2017). The location of a stop point was revealed as the average of the *x* and *y* coordinates of the points involved. Similarly, the start, stop, and duration of each stop were calculated based on the constituent points. Stops consisting of fewer than five recorded points were omitted from further assessment. To further distinguish stops during daily activities (which were the main interest of the study) from stops at home (which were removed from further assessment or communication), a "home stop" was defined as lasting longer than eight hours and/or starting or ending between 8:00 p.m. and 7:00 a.m. Points between stop sequences, defined as "movements," were collected into polylines and further classified according to average speed: walking < 6 km/h (3.72 mi/h), cycling/running 6–18 km/h (3.73–11.18 mi/h), driving or riding on public transport > 18 km/h (11.18 mi/h). To generate maps where an indi-

vidual's behaviour could not be identified, both stops and movements were "blurred" as "kernel distributions." A similar technique has previously been applied to the analysis and visualisation of cluster patterns of disease transmission, injuries, and drug use among homeless citizens (Ahasan et al., 2022).

3.3. Workshops

Three workshops to assess the GPS data's precision, relevance, and applicability were carried out from 30 May to 14 June 2017, and each had a duration of two hours. In order to enable comparison and cross-assessment of the GPS-tracking technique, the same maps were applied to all three workshops. If the workshops had been conducted separately, the methodological approach could have been adjusted to suit one of the three stakeholder groups more specifically. However, the participants at the first two workshops dismissed the map's ability to provide insights into spatial dynamics. Hence, it was the wider outcomes of the GPS project that came into focus at the last workshop with the municipal planners and professionals.

3.3.1. Workshop 1: Marginalised Citizens

The first workshop was attended by marginalised citizens who enrolled as respondents and "GPS carriers." The shelter staff announced the workshop and its aims to the potential attendees. The aim was to validate the GPS-based spatial patterns displayed on A1 wall maps and to explore the participants' experiences as GPS carriers. The workshop consisted of individual interviews ($N = 12$) and map-based group dialogues ($N = 8$). Potential participants were contacted on-site by the shelter staff ahead of the workshops. The individual interviews focused on the data collection experience. These were conducted around tables in the shelter's courtyard using an interview guide and took 10 minutes each on average. The map-based group dialogues took place inside the shelter in front of the wall maps (see Figures 1–3) and focused on validating the precision, relevance, and collection of further semantics and storytelling.

3.3.2. Workshop 2: Representatives of the Marginalised Citizens

The second workshop was held with members of Odense's Council of Marginalised Citizens, considered as marginalised citizens' representatives, and included private and public care providers ($N = 6$), who possess a high level of knowledge about the group's daily living conditions and could accordingly provide supplementary information. The aim was to validate the mapped GPS-based patterns and to assess the applicability of such data. The participants were asked to sketch their anticipation of the spatial behaviour of the marginalised citizens

(places and routes) on “blank” city maps. Afterwards, the maps were assessed in two subgroups and the potentials, pitfalls, and barriers of the GPS tracking technique were discussed.

3.3.3. Workshop 3: Municipal Professionals and Planners

The third workshop was carried out with the city’s professionals and planners from two departments: Labour and Social and City and Culture ($N = 12$). The aim was to facilitate a broader discussion of the derived effects of the GPS test and of the potentials of and barriers to using similar evidence-based information in intersectoral (strategic) collaboration. Data collection consisted of joint meetings and sub-group discussions around the themes of “evidence-based knowledge for strengthening professional collaboration around the vision of the inclusive city” and “the potential use and applicability of

GPS.” Data consisted of written inputs and outcomes that were analysed.

4. Results

4.1. GPS Data

Tables 1 and 2 and Figures 1, 2, and 3 show the number and distributions of stops “in town” and moves. For further details of the methods used, see the previous sections.

A series of four A1 (594 × 841 mm, 23.4 × 33.1 in) posters were produced to support the dialogues in the workshops. Two maps are included as Figures 1 and 3. All maps are available in full resolution online (legends in Danish):

1. Stops “in town” for the entire City of Odense (Figure 1): <http://joom.ag/af0L>

Table 1. Respondents’ stops during weeks 8, 9, and 17 of 2017.

Total	Number of stops		
	More than five points	“At home”	“In town”
919	707	393	314

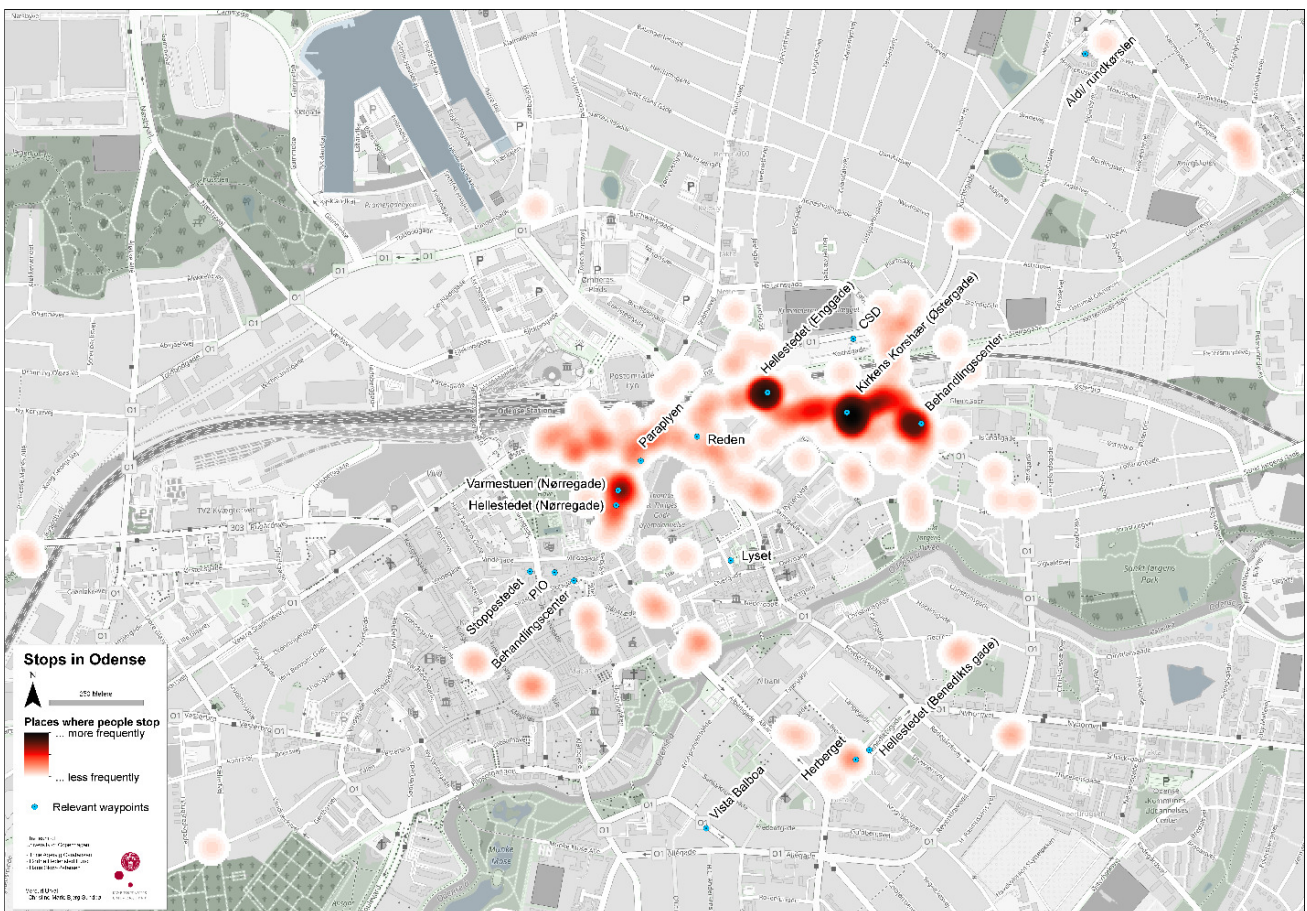


Figure 1. Stops “in town” (not “at home”) in downtown Odense.

2. Stops “in town” in downtown Odense: <http://joom.ag/ef0L>
3. Walking through the whole of Odense (Figure 3): <http://joom.ag/df0L>
4. Walking to downtown Odense: <http://joom.ag/zf0L>

The maps were deliberately designed in a large size (A1) to foster dialogue between the participants of the workshops. Furthermore, several relevant and generally well-known locations (waypoints) have been added to the maps.

4.2. Workshop 1: Marginalised Citizens

The respondents explained that they were motivated to participate by shelter staff and by the meal vouchers they received from participating. They wanted to assist the DanChurch Shelter and the municipality in improving their understanding of the group’s behaviour and needs. They thought it was an exciting project that could contribute to urban planning focused on marginalised citizens. They expected that the outcome of the GPS project would be to identify locations for new refuge(s).

The participants felt safe about the project, and they did not feel they were being surveyed. One respondent stated that, in the beginning, it felt a bit weird knowing that the municipality could follow one’s behaviour. Another respondent talked about the relationship between surveillance cameras and safety. When a favoured spot in a square with an overhead surveillance camera was moved elsewhere due to urban redesign, the camera remained in place. Thus, the spot-users

soon asked the authorities to move the camera too, as it provided them with a feeling of security and comfort, presumably in relation to local criminal gangs and mobs. Conversely, surveillance was an issue for those shelter users who did not want to become part of the data collection.

The shelter users who participated in the group dialogues found that the map revealed a precise and relevant picture. However, they also pointed out that a handful of important places were missing. One respondent explained that a group of GPS carriers had deliberately enrolled with the intention of going frequently to a preferred location to actively enhance its activity level, and thus raise the site’s candidacy as the location for a new refuge. This shows that the participants were aware of the technology as a potentially new or added option in “being heard” in a public planning process by being recorded, thus choosing to “vote with your feet.”

In examining the mapped spatial patterns, the respondents immediately started to explain how these were reasoned, for example, how a lack of safety led to the dominant choices of the route being along the major roads, where they felt less threatened by local criminal gangs and mobs, and avoiding minor ill-lit roads.

The workshop participants also provided additional information on preferred urban spaces and spatial qualities. Dedicated spaces, such as the refuge near the shelter, were important. They also stressed a preference for public spaces that were not too isolated and that provided them with a feeling of belonging to the city and of being part of the urban spectacle. However, some segregation was also valued, as it created a feeling of not disturbing the public order. They reflected on how the group’s behaviour with crowding and creating noise and

Table 2. Respondents’ movements during weeks 8, 9, and 17 of 2017.

Means of mobility	Number	%	Average		
			Distance (km)	Duration (minutes)	Average speed (km/h)
Walking	200	48%	1.4	42.8	3.0
Cycling	208	49%	3.3	44.5	10.1
Car/bus	13	3%	7.4	42.1	21.8
Total	421	100%			

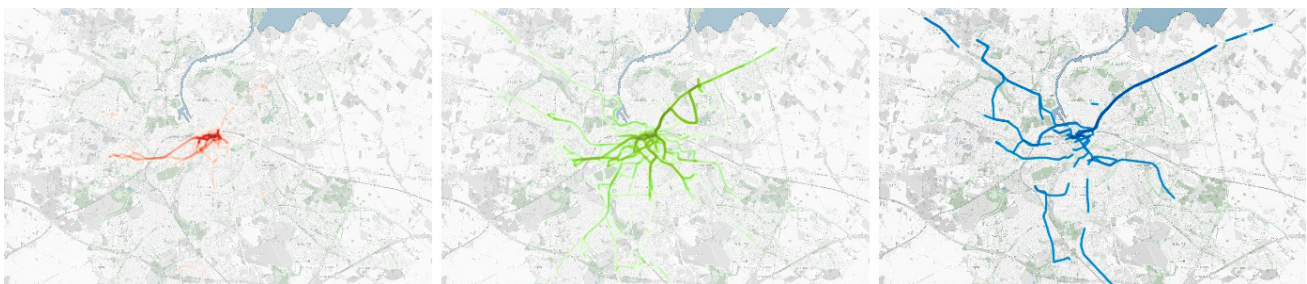


Figure 2. Maps of density/kernel distribution of points on the move. Notes: From left to right, we have, in red, walking (see details in Figure 3); in green, cycling/running; and, in blue, car/public transport.

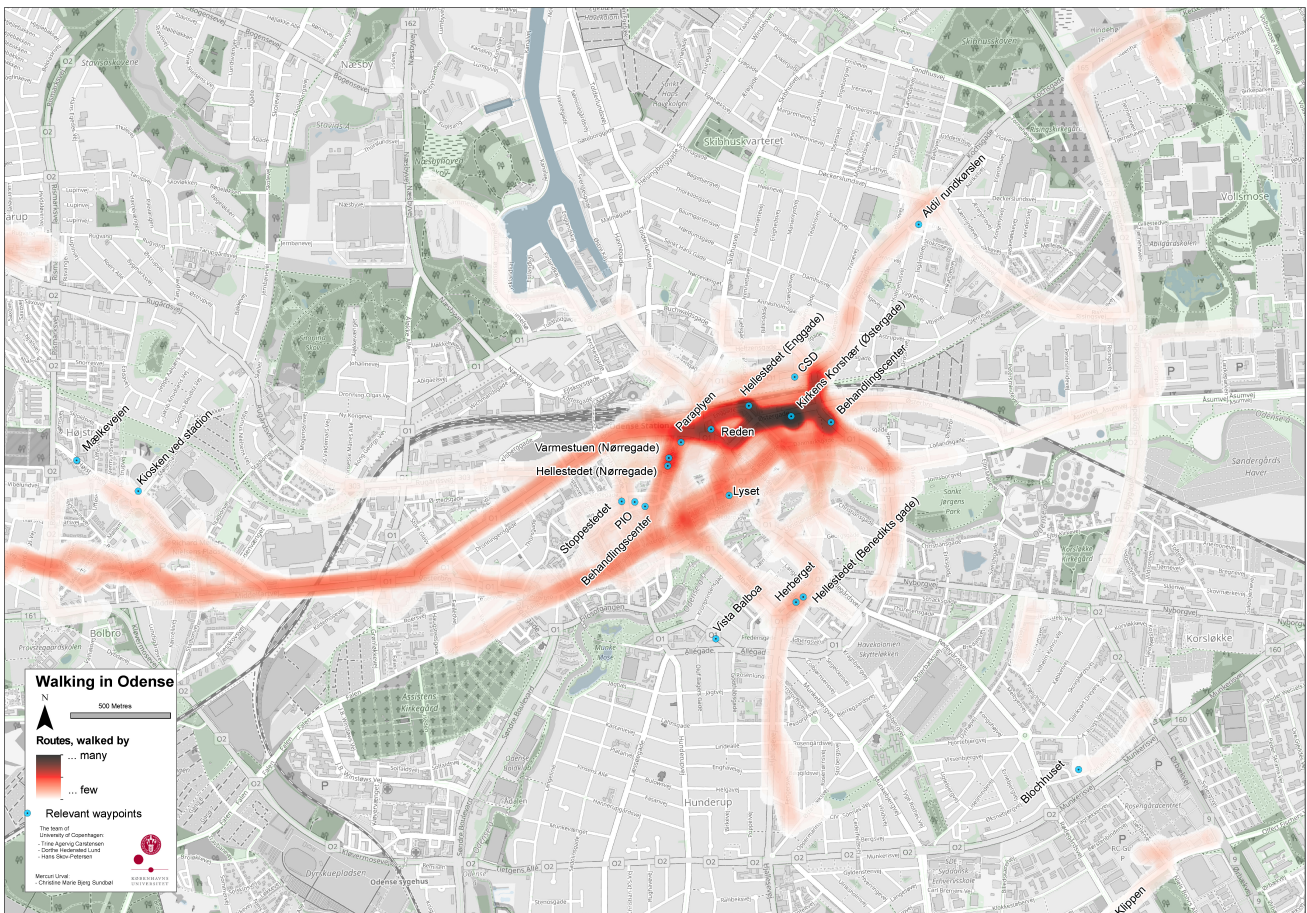


Figure 3. Stops “in town” (not “at home”) in Odense: Entire area of recording.

litter negatively impacts their harmonious cohabitation with other citizen groups.

One of the lessons of this workshop was that GPS tracking has the potential to make the social visible by revealing spatial patterns, as well as empowering the “muted” citizen groups, but also that it cannot stand alone. The GPS-based tracking and the resulting maps were experienced as a valuable communicative platform for and contribution to the dialogue with the marginalised citizens and thereby improved insights into the patterns and spatial needs and preferences of this group.

4.3. Workshop 2: Marginalised Citizens’ Representatives

The workshop started with the representatives drawing their own maps of how they saw the marginalised citizens’ spatial behaviour. These mappings were almost identical to the GPS-based maps, which showed that the representatives already possessed much of the knowledge on spatial behaviour that the GPS project was striving to uncover.

In addition, the representatives found that a lot of behaviour was missing from the map and that it only represented a narrow section of the marginalised citizens, namely citizens over 30 years of age and mostly

men with alcohol problems. This was the result of the sampling strategy, as a lot of Odense’s marginalised citizens do not use the DanChurch Shelter. When discussing how to collect data that would represent the entire group of marginalised citizens, they saw more challenges than solutions.

These workshop participants did not find that the GPS method revealed relevant information. For them, what was important was to grant a voice to marginalised citizens. They found that the method had many limitations, as the maps only revealed spatial patterns. They also discovered that the maps had the potential to show how the locations of existing health services and public spaces determine marginalised citizens’ daily life patterns and living conditions. They were also critical of how the data would be applied in the future. They asked whether the revealed routes to a suburban neighbourhood, where 30% of the marginalised citizens live, should be interpreted as a wish to have a refuge (a dedicated public space) located in this part of the city. It was concluded that GPS tracking is not enough to include socially marginalised citizens in the planning for an inclusive city. Other sources of explanation are important too.

The representatives were sceptical about whether the GPS tracking provided any necessary knowledge at all. First, this was because they already possessed that

knowledge themselves. Second, as gatekeepers and protectors of the group, they felt that the project's outcomes did not legitimise the GPS method. In their opinion, the direct engagement of marginalised citizens as GPS carriers had intervened unnecessarily in their lives, both when deciding to enrol and when waiting for the results. The GPS project had been running for almost three years before its results were presented, by which time the marginalised citizens' patience was exhausted.

4.4. Workshop 3: Municipal Professionals' and Planners

In the workshop with the municipal professionals and planners, the mapped behaviour was discussed indirectly. The workshop focused on a broader discussion of the derived effects of the GPS project and of the potentials of and barriers to applying such evidence-based data in intersectoral strategic collaboration within the municipality.

The GPS project had been running for three years, during which time many meetings across the different municipal sectors and professions were held, which facilitated discussions and decisions around the implementation of the inclusive city. Thus, GPS tracking had been contributing to the establishment of an internal common narrative and anchoring of the vision of the inclusive city.

The workshop participants found that the knowledge base prior to the GPS test was influenced to a high degree by the gut feelings and assumptions of the various actors and that the main motivation for the evidence-based approach would be to add to such individually based interpretations. Hence, the provision of a better, more factual, and representative foundation for decision-making was assessed, being needed in a setting where actors with diverse agendas must plan for communal and public intervention and service.

The participants saw huge potential in GPS tracking producing evidence for pre- and post-assessments of public investments. The data could ensure a common point of departure for cross-sectoral collaborating actors, promote health and prevent marginalisation, ensure continual contact with target citizens' groups, ensure a focus on establishing urban spaces and services for marginalised citizens who do not benefit from existing services, increase the security of all citizens, and establish specific spatial improvements, such as squares, shelters, and parks. They found that data could also improve marginalised citizens' everyday lives by enhancing the coherence of daily life, reducing mobility needs, and providing accessible health services and protected public spaces.

5. Discussion

The GPS project's validity, relevance, and applicability were assessed differently at the workshops with the three stakeholder groups. The maps were seen as the main outcome of the project in the first two work-

shops. However, it was soon realised that these maps only gave a time-limited snapshot and did not meet the expectation of providing insights into spatial behaviour dynamics within the citizen group applicable to identifying new dedicated public spaces in alignment with marginalised citizens' changed spatial patterns as a result of urban renewal.

At the first workshop with the marginalised citizens, assessments were made on whether the maps succeeded in revealing valid spatial patterns of the group. The workshop participants saw potential in the displayed patterns, which they validated as non-person sensitive. They also saw challenges regarding the partiality of the mapped behaviour and added more information to increase the maps' representativity of the group, as perceived by the participants. The practice of adding was already brought into play when the data was produced. Here, some of the GPS carriers had sought to align the data's applicability with their own preferences for urban spaces by staying in such spaces deliberately. This practice clearly indicates that some of the marginalised citizens had already foreseen the vulnerability due to the data quality and saw an opportunity to influence the results. Apparently, they had low expectations that the project would be able to identify potential locations for a new dedicated public space. Despite the shortcomings of the data inventory and the maps, the participants found that the GPS project had the potential for increasing the citizen group's empowerment, involvement, and representation in planning and policy. Allowing for the digital participation of marginalised citizens was considered meaningful by some of the participants. They stressed the productive aspects of surveillance as a means of creating safety and felt empowered when they were made "visible." The aspects of visibility were assessed differently within the group. Whereas those who had participated in the GPS project as GPS carriers found that increased visibility ensured safety, another group of shelter users did not want to carry the GPS. This group had no trust in the project and feared the consequences of having their spatial behaviour made too visible in relation to previous experiences with policy authorities and other urban space users.

The second workshop with the marginalised citizens' representatives also centred around the maps as a core outcome of the GPS project, which they approved as being non-person-sensitive. As they already possessed much knowledge about the spatial behaviour of the marginalised citizens, they stressed that the maps mostly displayed the spatial behaviour of what they characterised as "middle-aged to older alcohol-drinking men," with very little representation of other gender and age groups. These shortcomings would have been evened out if the GPS tracking had included a greater variety of the city's health and service landscape. The GPS tracking was considered a unique method of increasing the evidence base for urban planning, but they raised the question of whether the project was adding new knowledge

applicable to urban planning and policy. Still, this workshop's participants were concerned about whether the GPS project's limited mappings would be taken as representing marginalised citizens' use of urban spaces in the future.

The maps' lacking ability to provide insights into spatial dynamics had already been established in the discussions at the two previous workshops. Hence, they played a marginal role in the last workshop with the municipal planners and professionals. At this workshop, the validity, relevance, and applicability of the data inventory behind the maps were framed as a purely technical challenge that could be improved in the future. Instead, they focused on the derived outcomes of the GPS project. They found that the GPS project had the potential to provide a platform for interdisciplinary and cross-sectoral collaboration around the vision of "the inclusive city." They stressed the amount of knowledge of the citizen group they had shared and generated together in the group and how that is being integrated into the work of the individual municipal sectors supporting the engagement in how to enhance the living conditions and welfare of the city's marginalised citizens. Furthermore, they underlined how the GPS project has had derived effects on the city's external branding as an inclusive and innovative city by attracting attention from the outside world, for example, due to a Ted Talk and EU-based city-level collaborations.

6. Conclusion

This article has explored and evaluated the potential and challenges of applying GPS-based data in planning an inclusive city in Odense, Denmark. It has focused on the city's GPS project and the extent to which its maps of spatial patterns were perceived as valid, relevant, and applicable to urban planning and policy from the perspectives of marginalised citizens, their representatives, and municipal planners and professionals. From these three perspectives, various technical, ethical, and governmental challenges and potentials of the GPS project are stressed.

At the time the GPS-based tracking method was applied in the Odense, the method was still new in relation to marginalised citizens. Thus, the GPS project was largely an innovation project and not, as such, clearly defined. The collected GPS data inventory was widely expected to be applicable for understanding how urban transformation impacts spatial behaviour and for optimising the location of public spaces and healthcare services for marginalised citizens. Hence, the aim of the project was both broad and ambitious.

First, the article has developed an analytical framework for revealing group-based and non-person-sensitive maps of spatial patterns based on individual GPS-based data. From the perspectives of the marginalised citizens and their representatives, the procedures for processing the GPS data into maps, out-

lined here, succeeded in revealing non-person-sensitive spatial patterns. However, due to the data collection period being restricted to one week per person, it was not possible to create a comprehensive picture of the groups' spatial behaviour over all the seasons of the year. Moreover, the data inventory's representativity of the city's marginalised citizens is poor, with the maps only giving a partial snapshot of a limited sample of this group. This representational gap was pointed out by both the marginalised citizens and their representatives in the map-based workshops.

Regardless of the shortcomings of the data inventory and the maps, the municipality decided to locate a new dedicated public space in a suburban neighbourhood undergoing urban renewal. This could be interpreted as a pragmatic solution to meet the expectations of the GPS project, as well as being a way to give the marginalised citizens something in return for spending their time and effort on the project. On the other hand, the marginalised citizens' representatives interpreted the decision as a misuse of data that might harm the marginalised citizens' confidence in the local authorities. They were especially critical of the suburban location, as they saw a need to be in the city centre, where the existing facilities were under high pressure, not at least due to the urban renewal process, that had closed off some of the group's most preferred public spaces.

The workshops also revealed a range of perceived and derived potentials of the GPS project. The maps themselves proved to have the potential to empower the marginalised citizens. First, they made the groups' spatial patterns visible and thus established their citizenship as genuine. Second, they provided them with an opportunity to talk about their living conditions and preferences for urban life. Cartography is a form of knowledge which creates a common platform for reflections and interpretations. Such dialogues are important in re-contextualising behaviour and reminding us that the people behind the data points are flesh and blood with rich experience and expertise. The value of having dialogues about tailor-made maps with spatial data about the group behaviour of citizens has shown much potential compared to what a standard city map could facilitate.

In conclusion, the GPS project in Odense has provided important insights into the potential and challenges of applying GPS-based data to urban governance and planning. The article has revealed how complex it is to provide evidence for spatial patterns of a marginalised citizens group useful to localise services. Despite immature methodologies and technical challenges, the GPS project has produced important side benefits ranging from marginalised citizens' sense of empowerment to fruitful collaborations about the project among municipal planners and the marginalised citizens' representatives. Hence, building on the lessons learnt in the crucible of Odense, we find the approach relevant for further exploration and testing in other cities and future studies.

It would be crucial to apply a more systematic approach to sampling strategies and order to ensure a better representation of the group's spatial behaviour. Although distrust would be hard to overcome when making the social visible, the project has shown that non-person-sensitive spatial patterns can be made visible and have productive effects on the urban governance of more inclusive cities.

As Goodman et al. (2020) have argued, many municipal governments see public participation as a top-down tool, despite sincere attempts to become citizen-centric. To some extent, this was also the case in the Odense project, and it relates to the GPS project's objectives, which did not include the marginalised citizens' needs and preferences at its point of departure. Some important methodological insights have been gained, potentially making future projects more citizen-centric. This study has taken its point of departure in GPS-based maps, which allow the social to be made "visible." Such maps provide important platforms for communication and inclusion. They can increase civic, professional, and political awareness about marginalised citizens' living conditions and well-being, and they can work as consultancy tools enabling marginalised citizens to increase the knowledge base for their urban space preferences and use, thereby making urban planning more citizen-centric.

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Conflict of Interests

The authors declare no conflict of interests.

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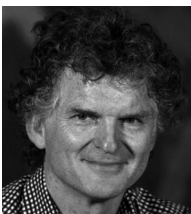
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