Spokespeople: Exploring Routes to Action through Citizen-Generated Data

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ABSTRACT

This paper presents insights from a collaboration with cycling advocates and local authorities to consider how HCI can open productive spaces for citizens to contribute to the realization of social goals. We worked with members of a walking and cycling advocacy organization to explore the potential for technology-mediated data collection to support advocacy and action taking. Based on our initial findings, we developed and deployed Spokespeople—a system to enable people who cycle to collect, curate and make visible their everyday journeys and experiences. We then worked with participants, cycling advocates and local authority transport planners to explore how citizens can contribute beyond data collection, by curating and prioritizing their experiences and exploring possible routes to action. We identify future directions for technology design to support citizens to make meaningful contributions to changes in the city through *annotated routes*, prioritization and community commissioning processes.

Author Keywords

Digital Civics; Collaboration; Cycling; Data; Transportation Planning

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION

Digital technology offers the potential to break down traditional barriers to participation and collaboration. Meanwhile, the *deluge of data* [40] in modern life continues to gather pace and movements such as crowdsourcing and citizen science have seen increased citizen participation in data collection [29,30,36,45]. Previous research projects have explored the way citizens collect and use data to advocate for social change [4,5,14,15,43]. While any data citizens collect may potentially lead to meaningful change, citizens' roles in influencing how these processes play out tends to be limited to their allotted role of collecting data. We

believe there is the potential for citizens to play a continuing role in change processes beyond simply providing data for scientists, advocates or local authorities to take action [9].

In the field of cycling and transportation planning, crowdsourced data has been used to democratize the collection of route traces [29]. It has also enabled the collection of data about accidents that would otherwise be invisible [32]. These citizen-generated data have been used both to inform researchers and to influence transportation planning processes, not only widening public participation but also potentially leading to lasting changes to the built environment. With this in mind, we explore how technology might support citizens to collaborate not only by collecting data but also by actively using it to create meaningful social change [21]. Specifically, we explore the role that cyclists can play in advocating for changes to the city's transport infrastructure in order to improve safety and enable more people to cycle.

Working with cycling advocacy organizations and local authority transport teams, we held initial meetings to explore their attitudes to using digital technology to enable citizens to generate their own data. Building on these discussions, we held a workshop with walking and cycling advocacy groups to delve deeper into how they might use such data to campaign and take action. The outcomes of the workshop informed the development of Spokespeople, a mobile platform to enable cyclists to collect, curate and share their everyday cycling journeys and experiences [44].

We then carried out a two-week, in-the-wild deployment of Spokespeople to enable local cyclists to capture their cycling journeys and experiences. Finally, we held a workshop with Spokespeople participants, walking and cycling advocacy groups and local authority transport planners to understand how they could make sense of the data and use it to inform future steps towards meaningful action.

With this research, we contribute: 1) Spokespeople, a platform to enable cyclists to collect and curate situated journey *and* experiential data; 2) through Spokespeople, we introduce and explore the concept of *annotated routes*, whereby cyclists experiences are understood within the context of an overall journey; 3) an exploration of design challenges and opportunities for technologies to support

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citizen participation in processes leading to action and change that go beyond data collection.

CIVICS, DATA AND CHANGE

Digital Civics explores the potential for digital technology to empower citizens [9] and enable them to *“take a more active role in shaping agendas, make decisions about service provision and play a more central role in making such provisions sustainable and resilient.”* [35]. One way that previous research in this space has explored these issues is by considering the role data can play in driving this change [13,41,43]. This civic angle has led to a conception of data that differs from that presented in several other domains where technology and data are in widespread use. Citizen science, for example, is concerned with how it can make *“non-experts an integral part of the scientific process”* [39]. This has led to big increases in citizen participation in scientific research as well as educational benefits for those involved. Despite this, citizen science has been criticized for limiting the involvement of citizens to providing *“the data that scientists needed to do their own, ‘real’ science”* [28], calling into question how meaningful this participation might be [3]. Digital Civics [35] instead prompts us to ask how technology might support citizens to contribute directly to meaningful change in society. Researchers working in this area might consider how citizens can use data to influence planning processes for place-making, advocacy, or to make people happier [14,29,38,43] rather than for scientific research alone.

Researchers have also considered how citizen-generated data might be used in a more meaningful and impactful way. Koeman et al. [27] looked at how low tech tools might help to take this data out into the community, giving data a wider reach and inspiring broader engagement. With PosterVote [43] meanwhile, Vlachokyriakos et al. explored how technology can support citizens to ask their own questions of their communities. Where big data promises a deluge of passively collected, supposedly objective data to answer a wide range of questions, the approach of digital civics has often been something approaching the opposite – relatively small amounts of data, explicitly biased and inextricably linked to a place, a group of people or a purpose [41].

Cycling and Civics

In 2015, Aldred et al. published a study looking into the phenomenon of non-injury cycling incidents, known as near misses. Participants submitted a one-day online diary of their bicycle journeys, and any near miss incidents encountered. Findings suggested that the average commuter cyclist in the UK experiences a frightening near miss incident every week with women and slower cyclists disproportionately affected. This research revealed the extent of a previously little studied phenomenon that has a significant impact on cycling levels and was an inspiration for our research. However, we believed we could build on this work by using technology to support citizens to capture their own near miss data offered the chance to build on it. This would not only enable the

collection of detailed, live near miss data over a longer period, but might also provide open access for civic actors such as citizens, advocacy groups and local authorities to use the data as they saw fit.

There are also a number of existing technologies that enable citizens to generate data from their cycle journeys. These generally fall into one of two categories; firstly, there are technologies that enable users to record GPS traces of routes they cycle. These require low levels of user input, and typically collect information during the cycle journey. Examples include Cycle Atlanta [15,29] and Strava, [24] a well-known commercial route tracking application. The resulting data can tell us where people cycle but not why they cycle there or what they experienced during the ride. The lack of context for the aggregated data may make understanding the significance of this type of data challenging. For example with Cycle Atlanta, Le Dantec et al. described how *“the ambivalence of the recorded ride data grew out of its decoupling from the context of production—the people and their intentions”* [15].

In the second category there are technologies that enable users to record information about noteworthy incidents such as safety concerns that happen while they are cycling [2]. These systems typically require users to manually enter the details of what happened through an app or website after the journey has finished. Collideoscope [31] and BikeMaps [32] are examples of this type of system. These technologies generally capture significantly less data than those that record GPS traces. Two interrelated factors are likely to be responsible for this scarcity of data. Firstly, there is a greater level of effort required to submit descriptive information about incidents. Secondly, it is not practical to log this information during a ride when motivation to act is likely to be highest [19], since attention must be given to cycling safely.

The Give a Beep campaign [23] suggested a potential means to address these concerns. Cyclists were given a Bluetooth button and asked to press it when they felt unsafe. A paired smartphone recorded the location of the incident and sent an automated email to the Mayor of London. The campaign collected an enormous number of incidents, however, there was no additional information or context to help us understand what these pins might really mean.

We wanted to explore how we could build on Aldred’s research and on existing cycling technologies, not only collecting data about journeys but also about incidents and doing so in a way that enabled citizens to generate large quantities of context rich data. Beyond this, we wanted to situate this data within the Digital Civics agenda asking how it might be used to promote understanding of an important civic issue, and inspire meaningful action as a result.

We initially conceived of a system to enable collection of near miss data using a Bluetooth button alongside a smartphone application to make it easy for cyclists to collect

and map near miss incidents in the city. The system required two separate interactions; a button press during the ride would enable cyclists to log the time and location of a near miss, a notification would later prompt the user to reflect on the experience and add more detail. This proposed system was used to prompt discussion in our early engagements. Our conception of the system evolved based on our research, ultimately leading to the development of the Spokespeople system detailed later in the paper.

STUDY CONTEXT

Newcastle Upon Tyne is a city of close to 300,000 inhabitants and the most populous city in the North East of England. The city has relatively low levels of cycling with under 2% of residents cycling to work. However, the national and local policy environment is increasingly conducive to cycling, as exemplified by the city's successful bid for the Department for Transport's Cycle City Ambition Fund [33]. According to a high profile recent survey of attitudes to cycling in the city [34], eight out of ten residents support improving the safety of riding a bike in Newcastle. There are a small and increasing number of walking and cycling advocacy organizations in the city, including a citywide cycling campaign group, and local groups that promote walking and cycling in specific areas of the city.

Initial Views of Advocates and Transport Planners

During the early stages of our exploration we spoke with representatives of a local council's transport and public health departments and committee members of the above advocacy organizations to understand their attitudes to citizen-generated cycling data. The council's attitude was somewhat ambivalent. On the one hand, they could see the value of the data and believed that it could help them to understand the experience of cycling in the city. At the same time, there was concern that the council would not have the necessary resources to respond to the issues raised.

For the cycling campaign group, there were deeper concerns about the value of citizen-generated data. They were worried that the data might distract from the group's core message, about the primary importance of safe, convenient, coherent strategic routes [11,18,37]. Beyond this, the campaign was worried that any data generated might be misleading. For example, if only "assertive cyclists" are involved it might paint an overly positive or misrepresentative picture. Alternatively, places that are truly dangerous and which should be a priority, might not feature in the data simply because they are so dangerous that nobody cycles there. This attitude echoes Le Dantec et al.'s [15] findings about the potential ambivalence of data generated without sufficient context. Finally, a leading member of the group said that the campaign did not have a "special relationship with the Council" and appealed for future work in this area to focus on improving communication with and developing a better relationship between relevant actors such as walking and cycling advocacy groups, the Council and the University. This suggested the potential value of following Le Dantec's

approach of framing the diverse stakeholders involved as a "public"[17] and "working toward a common end to overcome or re- solve [an] issue" [16].

These interactions highlighted three main principles that informed our work: 1) Local authority doubts regarding capacity to act meant that we should consider the agency of citizens and how technology might support them to act. 2) Presenting citizen-generated data without sufficient context has the potential to be misleading and suggested a cautious approach was necessary when framing and interpreting data. 3) Technology and citizen-generated data might play a valuable role in and bringing together civic actors together to form a public around shared issues of concern. These principles helped to situate future work in a collaborative space, aiming to involve all parties and create technology for sustainable change [6,7,21].

ENGAGEMENTS AND ANALYSIS

We adopted an action research approach to our research, a methodology that is flexible and well suited to collaborative work [22]. The action research cycles of planning, acting and reflecting provided a framework for an iterative approach enabling us to respond to the needs of the various actors in this complex context. This paper covers three distinct stages of research. In *Stage 1: Beyond Pins on a Map Workshop*, we worked with local advocacy organizations, holding a workshop to explore their attitudes to citizen-generated data and to using it to advocate for walking and cycling. Our findings fed into *Stage 2: Spokespeople Design and Deployment*. Finally, in *Stage 3: Exploring Routes To Action* we held a workshop with participants, cycling advocates and transport planners to understand how we might use this data to inform further steps towards meaningful action.

All data collected in the following stages was analyzed following a thematic analysis approach as outlined by Braun and Clarke [10]. The workshop recordings and audio data from the deployment were transcribed. This data was reviewed alongside written materials from the workshops and deployment, and coded by the first author. Codes and candidate themes were iteratively discussed with two other members of the research team to verify their validity.

STAGE 1: BEYOND PINS ON A MAP WORKSHOP

A workshop was held with members of two local walking and cycling advocacy groups and other interested parties. Recruitment was carried out by email through the organizations' contact lists, and through social media. 22 participants attended. The workshop had two aims: 1) to explore attitudes towards citizens generating and making sense of data about their everyday journeys 2) to explore how citizens might work together, using this data to campaign for better conditions for walking and cycling. The workshop was titled *Beyond Pins on a Map* to stress that data collection was only the starting point, with the ultimate aim being to use the data for a civic purpose. To provide context and inspiration for participants, the workshop began with a presentation outlining two proposed projects using citizen-generated data

related to air pollution and the proposed system for capturing cycling near misses outlined earlier.

In small groups, participants were presented with three scenarios that each problematized particular aspects of the collection, interpretation and use of citizen-generated data. Participants were asked to discuss the challenges and opportunities posed by these scenarios. In the second half of the workshop, participants identified potential tactics for collaboratively campaigning using citizen-generated data. For inspiration, each group was provided with a set of examples projects that had either campaigned for walking and cycling or had used data creatively, as well as a set of campaign principles inspired by Beautiful Trouble [8]. Participants were asked to brainstorm tactics for using data to encourage walking and cycling before selecting and expanding on one or two tactics that they believed would be particularly effective.

Findings

Inclusivity Is Key For Advocacy

There were repeated calls to include as many people as possible in the proposed projects. In particular, there were several appeals to consider adapting the proposed cycling near miss system to involve pedestrians as well as cyclists. This was seen as important for engaging with a wider number of people due to the low numbers of people who currently cycle. *“That’s what I’m thinking, walking. For cyclists, by and large you’ve got a slightly narrower demographic than people who walk.”* Other participants felt that involving car drivers in particular was necessary in order to influence behavior and encourage more people to walk and cycle. *“I think it’s that comparison between people who cycle, walk, drive cars, take the bus and the ability to talk to each other and understand.”* and *“Building that conscious awareness, that partly is what [group name] is all about... it’s actually how do you reach that group?”*

For use in advocacy work there was a clear preference for work based on air pollution rather than cycling near misses. Air pollution affected people no matter how they travelled and so could unite people irrespective of their mode of transport. For work that focused only on cyclists on the other hand, the potential for direct advocacy was seen to be limited. *“But it’s a closed group of cyclists and pedestrians and it’s not including people who are driving whether they be truck drivers, bus drivers or car drivers.”*

Widening Scope and Functionality

Another theme that emerged was the value of widening the scope of the proposed cycling near miss project. One way in which participants suggested that we do this was by enabling citizens to collect positive, and neutral experiences as well as negative ones. *“Personally, if I was doing it I’d like something that recorded both. I mean most of the time it’ll be neutral, it won’t be good or bad.”* Collecting a wider range of experiences was seen as having a number of advantages. *“You can highlight where good infrastructure*

exists... You could find out what people like best.” and *“You can understand the factors that are encouraging people to ride can’t you?”*

Another issue raised echoed the concerns of the cycling advocacy organization who foresaw that any near miss incidents recorded would highlight the areas where people cycle, rather than the areas that are necessarily the most dangerous. *“The other issue is of course that there might be areas that don’t have any clicks that are so bad because they don’t have anyone that would go to them in the first place... You wouldn’t survive long enough to press the button!”* Following this exchange one participant suggested a method to mitigate this concern. *“It needs to be overlaid with a holistic map of the journeys that people have done so that you can see where they don’t go so you sort of identify those places. But you need to record all the GPS data.”*

Citizen Engagement is hard to sustain

Participants talked about the difficulty of getting people involved and keeping them involved in volunteer led advocacy. One active member of the advocacy organization commented *“That scenario is a daily occurrence in [group name]. How do you get people involved? There’s a group of nine of us that drive 85% of the output despite the fact there’s 2-300 people as members.”*

Another participant speculated on how long involvement might be sustained in projects that relied on citizen-generated data. *“There is perhaps a lesson here that if you’re going to collect data on a voluntary basis then it’s great for short term projects, but it’s really not good for longer term studies.”* Several committed advocates suggested that sustaining the involvement of volunteers in advocacy is difficult. This suggested that configuring participation [42] to provide the option of short term commitments is a potential way to involve relatively large numbers of people without creating an unrealistic expectation of ongoing work.

When discussing how meaningful involvement in the project might be sustained, the level of feedback provided to those who collected the data was thought to be important. *“How many websites do you keep using? Hardly any of them!... You need to see some action, something that carries on. Having something that consistently alerts people.”*

Implications for design

We used findings from the Stage 1: *Beyond Pins on a Map Workshop* to develop the Spokespeople system. The themes above illustrate ways in which the design and implementation of the system was influenced. Specifically, 1) The concept was widened from the collection of near misses to the collection of any experiences, positive or negative, that citizens found meaningful during their journey. 2) Wider participation was encouraged by opening up the discussion of issues to anyone, including non-cyclists. 3) The importance of GPS data to complement and provide context for incident data was better understood. This led to the development of ideas for *annotated routes* explored in

our discussion. 4) The importance of feedback led into the facility for peer discussion and up voting of experiences.

STAGE 2: SPOKESPEOPLE DESIGN AND DEPLOYMENT

Responding to this context and to the engagements in *Stage 1: Beyond Pins on a Map Workshop*, we developed the technology for Spokespeople. Spokespeople is a system that makes it easy for citizens to record information about their bicycle journeys, including if they wish, both the route they took and any experiences that occur during their journey. Spokespeople is comprised of an Android (versions 5.0 and later) smartphone application that can work as a standalone app or, most effectively, alongside a Bluetooth button mounted on bicycle handlebars and paired with the app. The button makes recording journeys and experiences extremely simple while the presence of the device provides a visual reminder of the possibility of logging an experience. The button permits three distinct gestures. A long button press starts or stops recording a journey, while a short tap logs an experience and creates a notification to reflect on the incident and provide further details at a later time. Double tapping the button enables a user to record audio information about an experience immediately by speaking into their phone. Audio responses are framed as an optional a way for participants to record brief notes about an experience on the fly. These can be reviewed, re-recorded or deleted during the later reflection stage. One participant dubbed this the “rant feature”.

Figure 1. Screenshots from Spokespeople app. (Left) journey reflection overview showing any events captured en route. (Centre) incident category selection menu. (Right) incident reflection screen.

When a journey or experience has been recorded, a notification appears on the user’s phone prompting them to reflect on it. Reflection includes the following process: 1) Rating the overall experience of the journey, from one to five stars 2) Choosing a category for any experiences logged from the following: *Infrastructure*, *Near Miss*, *Positive Experience*, *It Felt Unsafe*, *Air Pollution*, *Noise*, *Other*. (Near miss incidents have a sub-set of categories such as *Problem pass*, or *Way blocked* to provide more detail and align with existing studies [1].) 3) Adding a short description of any experience logged – this could be typed or recorded as audio.

Finally, journeys and experiences are uploaded to the Spokespeople website and displayed alongside other users’ data. Only experiences that contained at least one of an incident type or description could be uploaded. The Spokespeople website enables people to browse submitted journeys and experiences and to comment and up-vote the collected journeys and experiences.

Spokespeople Deployment

Participants were recruited by convenience sampling for a two-week deployment. To be included prospective participants needed to cycle regularly in Newcastle (at least one journey per week). 39 participants were recruited, of which 35 installed the app and submitted at least one journey or experience.

Complete demographic records exist for 26 participants, which show that participants were largely male 81% (21). The mean age was 37 (median 36, min 24, max 60). Participants generally self-identified as being *Experienced* cyclists 81% (21) with 19% identifying as *Intermediate* and 0 *Novice* cyclists. The most common reason for cycling was *Commuting* 65% (17) followed by *Multiple* 31% (8), and *Leisure* 4% (1).

Usage and Behaviors

Participants recorded a total of 297 experiences during the two-week deployment, equivalent to 21 experiences per day and 8.5 experiences per participant. One participant recorded 65 experiences (22% of the total). Without this outlier, the average is 6.8 per participant, or one incident every two days. 91% (269) of experiences were described using a written description while 16% (44) had audio recordings. Less than half of these recordings (20) had discernible audio. This suggests that the double-tap interaction for instant audio recording was frequently pressed accidentally. Audio recordings were transcribed and have been coded along with other incidents below. The vast majority of experiences were logged during the working week 96% (286) with slight peaks discernible during commuting times.

There was a notable drop off in the number of experiences recorded in the second week – 206 vs 91. This is likely to be due factors, such as novelty or technical problems with the button. It also backs up findings about the difficulty of sustaining volunteer involvement from our first workshop. There was also a change in the categories of incidents logged between weeks. In the first week 40.8% (84) experiences were infrastructure related with 16% (33) near miss incidents, while in the second week infrastructure was down to 28.6% (26) experiences while near misses levels remained more stable in terms of overall numbers and rose as a proportion of all experiences 29.7% (27) incidents. The likelihood here is that participants were initially logging infrastructure issues that they noticed on their regular routes and, with these experiences already logged new infrastructure experiences were less likely to be encountered in the second week. This suggests that with a longer-term study infrastructure issues would be likely to account for a

lower overall number of incidents than shown below in Figure 2.

The data shows that participants were willing to contribute a large number of experiences. For context, in its first two months, BikeMaps received 14,000 hits and only 356 incidents meaning that just 2.5% of visits to the site resulted in a logged experience.

Findings

The proportion of incidents in each category is shown in figure 2 and findings from the three largest categories are discussed below.

Figure 2 Proportion of experiences recorded by category

Infrastructure Experiences

The most common type of experience registered was in the infrastructure category. This included statements about the quality of the existing provision: *“Poor track surface”, “Cycle lane is not continuous, annoying.”* and direct appeals to the local authority to improve things. *“Really important cut-through... but it's not officially a bike route, has no drop kerb or marking. An easy win for Council here!”*

The second most common type of experience in this category was a cyclist finding his/her way blocked. Many of the obstructions were motor vehicles, which were involved in 24% (20) of infrastructure experiences recorded. For example, *“Car stopped in bike box at lights”*. Other common experiences in this category included temporary hazards such as *“overhanging vegetation”* or *“lots of broken glass to avoid”*. A small number of experiences in this category also praised existing cycling infrastructure *“new infrastructure, very good separated from traffic, felt very safe”*.

Near Miss Experiences

In line with previous findings [1], the majority of near miss experiences, 66% (37) involved interactions with motor vehicles. These ranged from relatively minor incidents such as *“van parked in cycle path”* to potentially quite frightening and dangerous ones such as *“Car coming from behind blasted horn before deliberately passing too close. Driver shouted abuse through open window.”* A further 14% (8) involved interactions with pedestrians such as *“Pedestrian*

looking at a phone stepped in to the road without looking.” The most common sub-category was *Way blocked* 39% (22) – often with cars in cycle lanes but also other obstructions such as vegetation. *Problem passes*, such as the incident above where a motor vehicle passes a cyclist dangerously closely, made up 27% (15) of near miss experiences while *Other Vehicle Pulls In / Out* accounted for 21% (12). *“Car overtook and immediately turned left”* is a typical example of this type of incident.

Positive Experiences

The most common type of positive experience logged was *courteous driving*, 57% (30). While it is good to see so many positive interactions between bicycles and motor vehicles, many of these incidents seem to describe mundane, unexceptional driver behavior such as *“car waited at traffic calming”*. That these incidents were viewed as noteworthy, positive experiences could be interpreted as a reflection of some participants’ low expectations of car drivers’ behavior.

The next most common positive experience was related to perceived good cycling infrastructure. For example, *“Fantastic segregated cycleway!”* and *“Recent improvements have made it very easy to get from the road on to the cycle path through the park.”* This type of experience raises the possibility of using citizen-generated data to create positive engagement with councils about successful improvements to the cycling network. The next most common code for positive experiences was *overall positive experience* this type of incident contained comments about riding, making it home, good weather or enjoying a ride such as *“a lovely evening cycle home after watching the cricket”*. These positive experiences offer the potential to be used in user-curated stories about cycle trips. We refer to these as *annotated routes* and expand on their potential application in the discussion.

STAGE 3: EXPLORING ROUTES TO ACTION

Following on from the two-week deployment, we held a workshop with eight people including six participants from *Stage 2: Spokespeople Design and Deployment*. Four participants were members of local walking and cycling organizations and were two transport planners from a local authority. As suggested by the name, the purpose of this workshop was to see how participants might make sense of the data from our deployment, prioritize the issues identified and plan some feasible actions to tackle them.

Prior to the workshop the first author curated a set of user-generated experiences such that they varied by location, experience type and potential solution. Each experience showed the category of incident and the description of what happened, along with a map and street level image of the location. Participants had access to the internet and were encouraged to browse for further data sources if required. Participants were put into groups of 2 or 3 people.

In the first part of the workshop each group was presented with a curated set of three Spokespeople experiences. They

were then asked to choose the “most important” of these experiences and to explain their decision. Participants were free to choose the criteria for prioritization.

In the second part of the workshop, each group was asked to set themselves a “feasible goal” for addressing the issue they prioritized earlier. To support them in this participants were asked to complete a plan to detail how they would achieve their goal, setting out the stages, people, resources and technologies that they would need to achieve it. Participants were encouraged to think of a feasible goal that they could realistically work together to achieve. The potential solution “Get the council to build a new cycle path” was explicitly banned to focus discussions on what citizens could do for themselves over and above simply referring issues on to other agencies.

Findings

You Need More Context To Prioritize

Even when working from a curated set of just three experiences, deciding which was the “most important” was an extremely challenging activity. Participants’ discussions around prioritization reveal it as a messy process with no single correct answer. Participants considered a wide range of factors that might influence their way they prioritized issues, including: the number of people affected by an issue, the importance of the issue, the feasibility of a solution, the potential impact of a solution, the contribution to a wider cause (such as encouraging more people to cycle or improving safety), and the wider benefits of a solution, for example to pedestrians or car drivers as well as cyclists.

Another aspect that complicated prioritization was that participants did not feel comfortable making a judgement with the limited data presented to them. *“You would need more context to make a judgement”*. Some groups turned to official sources of information including statistics on cycling levels based on UK government Census data to check the validity of their choices. This suggested the value of making it easy for citizens to view the data they generated in the context of other existing and relevant data sources.

However, context wasn’t only thought of as official data sources. Personal experience of an area or issue was also thought to be important. *“I certainly don’t cycle it regularly... unless you go through an area, you are not in a... position to make a decision.”* People spoke about offline processes feeding into this, one potential strategy was knocking on doors and asking people about the issues raised. This could help to get opinions of all local people, not just project participants or other cyclists. But participants also saw the potential for technology to help drive people to engage with the data. For example one participant wanted to encourage people with local knowledge of a given location to encourage them to give their opinions and help provide more context. *“It’s a really good suggestion about... engaging with people through Spokespeople who actually*

are affected by that area.... from the data in Spokespeople... getting a message back to them... to get their input on it.”

This idea of encouraging people who live near or cycle through a particular area to engage with existing data rather than simply contributing new experiences has the potential to encourage local experts to provide context for the issues revealed through Spokespeople. It also offers a way to extend functionality beyond simply logging experiences by keeping people engaged in conversations about the areas that they live in or move through.

Feasible Goals vs. Impactful Goals

Participants’ discussions highlighted the importance to them of coming up with a proposed course of action that would have a positive impact on other cyclists and the wider community. *“Yes, there’s pros and cons for each of them but this one is the most promising... It can have the biggest impact.”* Two out of the three groups opted to plan work that meant making changes to the built environment. With experienced advocates and local authority transport planners involved in the workshop, participants were well aware of what a difficult undertaking it can be to influence this process. *“When we put infrastructure in, you have a big battle”*. There was a conflict here between picking a “feasible goal”, something that a group of committed citizens could easily do something about, and picking a goal that participants felt was likely to have a big impact.

For example, one group’s experiences included a problem that was relatively easy to do something about, involving overgrowing vegetation on a cycle route. One participant suggested *“you could just focus on cutting down trees and keeping things trim.”* He suggested that this would not only be relatively easy to tackle, but also meaningful for those who use it. *“It’s just sort of commutable into the city, people could have been using it for years therefore they might be very deserving”*. However, when it came to deciding on what action they wanted to take this group chose an extremely ambitious goal of *“increasing the number of people cycling into town”* by improving the infrastructure at a pinch point where a large number of cyclists come into conflict with pedestrians.

Another group noticed that the goal they were considering was extremely difficult to achieve, requiring several interventions to join up existing bits of the cycle network with busy routes into the city centre. Despite this, they proceeded with the goal and planned out ways in which they could tackle it. *“So, the, what is it? feasible goal, it is more of an ambitious goal, is to join up a few different bits of the pre-existing network.”* And later, *“Yes, but does anyone benefit from a proposal? Who benefits from us submitting a proposal, if it doesn’t have a...?”* This suggests that the potential impact of goals, even if they are extremely ambitious, is a stronger motivational pull for citizens than identifying more modest goals that are easy to do something about yet offer the promise of less impact.

Participants recognised that there are potential limitations of what citizens can achieve alone when it comes to making changes to the built environment and that often it's impossible to act alone in the context of the built environment. *"They are the Highway Authority, it's their highway"*. To address this, the plans that our groups put together involved building a public by gaining support from local people and involving other parties such as local politicians, and transport teams. Participants tended to conceive of the process as an exercise in convincing other people. *"We're convinced but I guess you've got to plan some goals and some milestones to convince other people, really."* This suggests a view of citizens as catalysts for change, working to engage others and inspiring them to jointly work towards changes that will have a large impact together where it is not feasible for them to reach their goals by working alone.

Technologies to Support Citizen Action

Participants identified several distinct stages they needed to go through to meet their goals. These including *goal setting, forming and maintaining a public, data collection, developing a proposal, trailing an intervention*, and finally *making changes to the built environment*. Technology was seen as having a role to play in several of these stages.

With regard to *forming and maintaining a public* Spokespeople was viewed as a way of finding people who would be interested in becoming involved in any issues identified. As one participant said *"You have got a network of people who are cyclists and you know from the cycle there, who is in that area, or would likely be in that area. ... So what you need then is an announcement on this [Spokespeople], that goes out to anyone who is roughly in that area, and that is how we maybe, target them."* This suggests the value in using technology to help recruit people at a hyper-local level for *micro-tasks*.

Echoing Taylor et al.'s findings [41], Data was frequently viewed as evidence, and valued for its role in *"building up a business case"*. While existing sources of official data and statistics were seen as important, participants saw informal, citizen-generated data collected using digital technology as just as impactful. One local authority transport planner agreed with this viewpoint: *"Informal traffic counts where people are tracking routes before and after... can, actually, be as useful as anecdotal evidence, it can be as powerful as hard data. I'm not saying one should replace the other... both can work together very well."*

There was a discussion in one group about how citizens might move forward from data collection to *developing proposals* about what action to take. Again, it was thought that technology could have a role to play here, by facilitating crowdsourced feedback about proposals from people who live in or move through the area in question. *"Here is proposal one, here is proposal two, here is proposal three. Pull them apart, because you are the people who have been through that area."* This idea of using technology to support citizens to create and publish proposals, and to crowdsource

informed, local critiques of proposals for next steps towards action is a promising area for further research with implications for any technologies aiming to enable citizen led change to move beyond data collection.

Organising Collective Action

Participants saw themselves as part of a collective group that could work together to meet shared goals. *"There are 40 users, a lot of them are probably fairly keen, you know, committed to make things happen."* and *"Oh, you mean like a mechanism to develop the proposal. There is a number of different ways you could do it. You could do it in community collective."* While others saw a potential way to direct citizens to carry out tasks that had already been decided on. One example of this was data collection, *"Is there any way of flagging areas on Spokespeople, requesting more feedback about this area?" ... "If you are going to verify it, it's not just looking at what it is that's here and if it's a hotspot or not. Is this a genuine hotspot well let's send this anonymous group of people along to see if they have the same experience."* Here participants imagined putting out a request to fellow Spokespeople users to commission them to undertake new journeys and data collection within specific areas of the city.

One group discussed who might create the tasks in the first place to be distributed to the community. *"I guess, in reality, there would be someone managing the whole project from start to finish but getting other people to do specific tasks". ... "Yes, yes. So, it's more of a case to self-organize and to give out different jobs to share the workload a little."* Moreover, the groups were confident that much of the work could be carried out within the community, without always needing the involvement for professionals or experts. *"They just need to be committed and willing to sift through this data and do something with it."*

This way of conceptualizing the process, with a person or small group of people organizing at the center suggesting ad hoc tasks that the *"community collective"* can carry out offers a potential way of for people to choose their level and type of involvement. It also begins to address the concerns of the campaigner from our *Stage 1: Beyond Pins on a Map Workshop* who wondered *"How do you get people involved? There's a group of 9 of us that drive 85% of the output despite the fact there's 2-300 people as members."*

DISCUSSION

Annotated Routes

Previous civic cycling technologies have enabled users to collect either experience data [32] (usually accidents or near misses only) or a GPS route traces [15]. With Spokespeople users were able to collect any type of experience along with the trace of the route cycled. The result was a curated set of experiences that were situated within the context of a journey. We call this *annotated routes*.

Annotated routes offer citizens the opportunity to collect and share stories, based around their journeys. One participant

summed up the potential value of this when he observed that “the power is that it’s a real-life story”. Previous work has shown the importance of understanding data in the context of the experiences and realities people live with [14] and the value of engaging people in what have been described by anthropologists as “non-places” [12]. *Annotated routes* extends these ideas by enabling people to highlight and document important issues throughout their journeys and while they are on the move. One of the advantages of annotated routes is that they provide users with the ability to associate experiences to their routes alongside the traces of their journeys.

Yet, *annotated routes* might be also understood as a way to show not only where cyclists have been but also where they have *not* been. This begins to address the concerns raised by cycle campaigners during our initial exploratory engagements, where they suggested that any incidents collected may be more an indication of where people cycle than of where there are specific issues. As we also have the GPS trace of where people have cycled, we are able to see whether or not this is the case. Indeed, it shows that there are large sections of Newcastle that have no incidents not because they are particularly safe but because our participants simply did not cycle in these areas.

Finally, because we are able to see incidents within the context of a journey, we can look at exposure to certain parameters and how that correlates with any incidents. For example, by reverse geocoding our GPS coordinates, we might discover what proportion of near misses took place in areas with high speed limits or near to certain types of junction. This type of data is not readily available elsewhere. While we have not explored this angle on the data in this study we believe it can offer real possibilities for future research as well as for advocacy work.

While Spokespeople has been specifically designed for and deployed with cyclists, neither the technology itself, nor the application of *annotated routes* is limited to those travelling by bike. They are equally applicable to other types of transport including walking, public transport and driving. The potential value of this work also extends to wheelchair users, who might for example report and curate experiences about inaccessibility in the built environment [26]. Using Spokespeople with groups of citizens travelling by more than one mode of transport also opens up the opportunity to use *annotated routes* data to promote dialogue between different groups. This opens a potential space for communication between different groups whose practices would otherwise remain hidden from each other, and suggests the value of *annotated routes* for advocacy work around transportation and place making issues.

Supporting Prioritization Processes

While most previous studies of technology and cycling have looked at citizen involvement in data collection as the outcome of their participation, with this work we supported citizens to work together to make sense of the issues raised

by their data collection and to consider how they might go on to address them.

Prioritization was an aspect of the process that proved to be crucial in supporting citizens to achieve both these aims. Identifying which issues were the most important encouraged them to engage critically, and politically, with the issues. Beyond sense making, prioritization also played a foundational role in supporting citizens to consider appropriate next steps and actions. It enabled them to work with a small number of important issues and to focus their attention into developing detailed proposals and actions to resolve them. Our research therefore frames prioritization processes as a key step in enabling citizens to move beyond data collection and begin formulating what is important and why, thus developing strong bases for action. Next, we suggest several ways that HCI researchers might support this work and its related challenges.

One challenge researchers face when designing to support prioritization processes is how to enable citizens to meaningfully limit the data they have to review and prioritize. This is particularly important when asking citizens to work with larger data sets. In *Stage 3: Exploring Routes to Action* of our study, we artificially limited the data to just three experiences. Without our selection, the amount of data would have been simply overwhelming. Filtering by incident type, location and time are possible ways to enable citizens to limit the data they see. The crux of this challenge though is enabling citizens to limit data in a way that is not arbitrary or that is likely to exclude issues of importance.

Our work with Spokespeople suggested that crowdsourced commenting or voting might also play a part here. Comments and up-votes on experiences might indicate which experiences users collectively believe are the most important. There are some clear issues for technology designers to consider here such as how to govern these crowdsourced processes and prevent any voting from turning into a popularity contest. In addition, prioritization processes requires significant levels of citizen engagement with existing data. For example, the amount of votes we received on our citizen-generated data were insufficient to provide any meaningful insight into their relative importance.

Our participants suggested some potential methods to drive engagement with data collected by other citizens, for example by prompting users who pass by the place where a particular experience was logged to engage with the issue by notifying that person through the Spokespeople app and requesting their feedback. This technique also offers the potential to shift the emphasis away from citizens simply generating data towards engaging with and making sense of it, which in turn may feed into prioritization processes.

From Data Collection to Community Commissioning

As Taylor et al. found in their work on Data-In-Place, data may reflect the community that collects and uses it [41]. Our engagements with cyclists, advocates and planners have

shown that as a community, our participants were interested in moving beyond data collection and using it to inspire collective and collaborative action, and meaningful change. During *Stage 3: Exploring Routes to Action*, participants suggested that they might take control over the future direction by setting tasks for other members of the community to carry out.

Participants suggested, for example, that they might create and share requests for other users to record a journey and experiences in a location with little existing data, or alternatively, to comment and vote on proposals to address a particular issue raised by existing citizen-generated data. The tasks they suggested were generally small discrete pieces of work which we refer to as *micro-tasks*. While on one level these *micro-tasks* may seem somewhat limited or even mundane, they represent a significant transfer of power from the research team to the citizen. This idea of using technology to facilitate community commissioning of *micro-tasks* echoes processes explored by Garbett et al. with App Movement [20].

There are undoubtedly design challenges for technologies that seek to enable users to set *micro-tasks* for each other such as moderation of comments and tasks, and facilitating the allocation of work to relevant people. However, larger questions are raised here about ownership of the research agenda and the agency of citizens. Rather than simply generating data to respond to an agenda set by a research team, technologically supported processes of community commissioning might offers citizens the ability to set the agenda themselves, organically, *micro-task* by *micro-task*. In this respect, enabling citizens to set the future direction of their work is an important step for research into technologies that seek to support citizens developing the organizational capacities necessary to push for change.

The key challenge here for HCI researchers is not simply about facilitating the collection of citizen data to be handed over to local authorities or to feed into solutions that someone else might develop like in Fix My Street [25], but rather to remove the technical barriers to citizens forming a “sense of virtual community” [25] and collectively working together and taking control over the agenda. As such, technologies must seek to build community capacity, and enable communities to self-organize to set, as well as carry out, actions that can lead to meaningful change [4].

CONCLUSION

This paper covers three stages of our research working with cyclists, cycling advocacy organizations and local councils to explore how citizens can not only generate data but go on to use data to create meaningful change. We have presented Spokespeople, a platform to enable cyclists to collect and curate situated journey *and* experiential data. We have also identified future directions for technology design to support

citizens to make meaningful contributions to changes in the city. We introduce the idea of *annotated routes* that provide affordances for data curation, storytelling and data analysis. Finally, we also explore design challenges and opportunities for technologies to support citizen participation in processes leading to action and change that go beyond data collection. We highlight supporting issue prioritization and community commissioning processes as promising areas for further research.

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