



Exploring the Potential of Citizen Social Science for Environmental and Sustainability Research: Experiences of and with Community-Based Researchers

CITIZEN SCIENCE:
THEORY AND PRACTICE

RESEARCH PAPER

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ABSTRACT

Citizen social science has been developing in meaning and prevalence over the past few years, building on experiences with both citizen (natural) science and established social science methods such as participatory action research. However, most of the debate is still at the conceptual level, with strong calls for more empirical insight. Here, we critically examine the promises and challenges of citizen social science, based on two small-scale, co-created and locally embedded projects on people's relationships with urban greenspaces and community food growing, conducted as a collaboration between professional and citizen social scientists. Our findings illustrate the complexity of such research in practice and identify five dilemmas that arise from tensions between the aspirations and hopes associated with co-created citizen social science, and the pragmatic and procedural realities of citizen research in practice. We argue that citizen social science projects will have to actively engage with these in order to be successful.

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INTRODUCTION

Embedded in discourses of citizen science, open science, and transdisciplinarity, citizen social science has been developing in meaning and prevalence over the past few years. However, much of the debate is still at the conceptual level, with repeated calls for more empirical insight (Heiss and Matthes 2017; Kythreotis et al. 2019; Pykett et al. 2020). Here, we critically examine the opportunities and challenges of citizen social science approaches applied to environmental and sustainability issues, on the basis of two projects conducted as a collaboration between social scientists working in a research institute (hereafter professional researchers) and citizen social scientists in Scotland.

We understand citizen social science as an approach “where volunteers collaborate in a formal social research project” (Purdam 2014, p. 375) in a “partnership between professional researchers and volunteers in which the volunteers implement tasks which have been traditionally implemented by scientists” (Heiss and Matthes 2017, p. 22). We argue here that rather than simply considering volunteers as unpaid hobby researchers, the crucial characteristics of these volunteers may be their background in contexts other than social science academia, and their embedding in existing communities of place or interest that are of relevance to the research.

The literature on citizen social science has recently been rapidly growing and includes work that self-identifies as citizen social science (e.g., Tauginienė et al. 2020) as well as citizen research that addresses social scientific questions but does not use this label (e.g., on parenting, Collins et al. 2020). In addition, we also draw on experiences with other relevant approaches that have developed in parallel and are rarely considered in the wider citizen science literature, including participatory action research (PAR, e.g., Baum et al. 2006) and peer research (e.g., Lushey and Munro 2014). Both bodies of literature provide us with reflections on the active role of the non-academic partners in the research process (Braye and McDonnell 2012); from the PAR literature, we use their definition of PAR as an approach “to understand and improve the world by changing it” (Baum et al. 2006, p. 854) which “embraces the concerns experienced by a group, community or organization” (Wimpenny 2010: 89). We distinguish here between PAR, which has an activist motivation—the desire to change a situation that is of personal importance—and citizen social science, which, like most mainstream conventional social science, does not have an activist motivation as its starting point and at its core.

Different models of engaging citizens in science have been discussed extensively (Haklay 2013; Schäfer and Kieslinger 2016). Here we focus exclusively on so-called co-created projects, which involve citizen researchers in all stages of

the scientific process, from identification of the research questions and research design through to sharing and disseminating the findings (Heiss and Matthes 2017). This approach is often seen as positive but is less often put into practice, including in social scientific contexts (Tauginienė et al. 2020). We raise two broad questions. First, we ask what the promise and potential of citizen social science may be if we define it as distinct from PAR. Second, we examine to which extent this promise holds when applied to concrete research contexts. To do so, we draw on empirical material derived from two distinct research projects, one of them dealing with people’s use of (peri)urban greenspace, the other one addressing issues around community food growing.

CITIZEN SOCIAL SCIENCE—A NEW WAY OF DOING SOCIAL RESEARCH?

Two main merits are recurrently put forward for citizen science in both natural and social sciences. First, there is the hope that the involvement of citizens enables access to more data, or to data and knowledge that is difficult to access by conventional scientific means. Second, the approach is meant to bring science closer to the public, to raise awareness and understanding of the sciences in wider society, and, ideally, to democratise knowledge production (Lushey and Munro 2014; Resnik et al. 2015; Kythreotis et al. 2019). The literature on citizen social science (Purdam 2012; Heiss and Matthes 2017) has so far largely focused on research with large sample sizes (high-n), which tends to use citizen social scientists as contributors of data rather than as partners throughout the entire process. However, we contend that citizen social science can offer more than this when we include citizen researchers in the research process right from the start. Such co-created citizen social science tends to (but does not necessarily have to) be in-depth, small-n research rather than research that aims to crowdsource a large number of observations as described above. Here, we draw on the existing literature on PAR and other, related approaches to elucidate the nature of such citizen social science.

Participatory action research is a well-established approach, and overlaps with a number of similar approaches, such as co-operative inquiry (Heron and Reason 2001) and community-based participatory research (Durham Community Research Team 2011). Apart from health research, in which PAR has probably been used most widely (Baum et al. 2006), it has also been applied to environmental and natural resource management issues (e.g., Pain et al. 2012), which sometimes include or even focus on social aspects. PAR’s main aim is to enable action, through an iterative reflective cycle of research and subsequent action

(Baum et al. 2006), to change or improve the real-world issue that is being researched (Pain et al. 2012). The participating researchers are usually understood to have a stake in the issues being investigated (Jordan 2003), and are characterised as “mavericks/heretics,” “optimistic, believing in the possibility of change,” and “concerned with achieving real outcomes with real people” (Kindon et al. 2007, p. 14), thereby highlighting both the desire to directly work towards change and a break with traditional forms of science.

PAR can thus be seen as a necessary alternative to conventional social science, with a higher potential to achieve real-world impact (Banks et al. 2017), which can help us to reflect on wider social scientific practice. However, it can also be criticised as privileging those actors who have a clear stake in an issue, thus potentially reinforcing existing power imbalances (Cooke and Kothari 2001; Kindon et al. 2007), as it amplifies the voices of those already engaged with an issue. The focus on research for change, and the researchers’ desire for a process and outcome that is useful for them, can also impede more exploratory, open-ended approaches. By contrast, we take citizen social science to be primarily driven by an interest in improving a collective understanding of an issue, which then might or might not lead to ideas for an improvement of the situation—and this improvement might eventually be implemented by very different actors than the citizen researchers.

Based on these considerations, we hold three main (and interrelated) expectations of citizen social science, which arise from our reading of the literature as well as from our own experience with traditional forms of social science. First, we hope that citizen researchers will enrich and invigorate social research by contributing perspectives and (types of) knowledge that are different from those of professional social scientists. While this expectation tends to be well articulated in parts of citizen natural science (Andrews et al. 2019), it has so far not received a lot of attention in the emerging citizen social science debate. We suggest here that as citizen researchers have different life experiences and worldviews than professional researchers, and—in cases where they are members of the study community—because of their experiential knowledge and understanding of the research context, they are able to ask questions that might not occur to professional social scientists. They might also choose methods and approaches that lead to different or deeper insights than those that external researchers would have chosen.

Second, citizen social scientists might—where they have connections with relevant communities of place or interest—be able to draw on their social and cultural capital to access and interact with very different research participants than external researchers (Teedon et al. 2015). Ideally, this means that voices and perspectives

that are usually underrepresented in social research can be heard and better understood (Creaney et al. in press), and that historical marginalisation can thus gradually be addressed (Fiske et al. 2019). Conventional research tends to frame questions from an academic perspective, and this framing then speaks to those who can best relate to it (Fischer and Marshall 2010), while potentially excluding others. The involvement of embedded citizen social scientists could thus help to overcome this perennial problem of much social science, namely that the educated middle-class as well as people with a strong pre-existing interest in the topic area of study (self-selection bias) tend to be overrepresented as research participants (Lienhoop and Fischer 2009), leading to research that is potentially self-perpetuating and -reinforcing, thus limiting novel interpretations. Combined with the fresh perspectives and different types of knowledge that citizen scientists might offer (see previous point), this might lead to research findings that are more socially robust (Prainsack 2014).

Third, making it distinct from PAR, citizen social science can explore issues of interest in an open-ended manner, with flexibility in relation to the nature and direction of the findings. It is neither bound by the need to arrive at actionable conclusions, nor by a strong activist interest that might obscure alternative ways of making sense of the issue or limit access to a wider range of participants whose views might diverge from the activist’s.

These three hopes and expectations—fresh perspectives, access to different voices, and openness in approach—are undoubtedly idealistic, and many caveats and criticisms formulated elsewhere—for example, concerns about data quality, ethical aspects, and power relationships (Frankham 2009; Purdam 2014; Resnik et al. 2015)—apply here, too. However, in this paper, we take Bonney et al.’s (2016, p.10) statement “for much of the field [citizen science], the promise is presently greater than the reality” as a starting point and explore the extent to which these three hopes were met through two citizen social science projects conducted in 2018. We first describe our approach and the trajectories of the two projects, and then examine the ways in which they did, and did not, realise their potential in relation to these three expectations. To conclude, we discuss the implications for citizen social scientific approaches going forward.

TWO CONTEXTS, TWO APPROACHES, TWO VERY DIFFERENT TRAJECTORIES: OUR CASE STUDIES PROJECT DESIGN

We set up citizen social science projects in two different contexts in Scotland (see Supplemental File 1: Appendix).

Our funding was intended to support the exploration of citizen social science methodologies. This meant that the citizen researchers were free to genuinely steer their research in the direction of their interest. It also allowed the professional researchers to conceptualise the overall work from the start as a qualitative exploration of approaches to citizen social science. Based on this, the professional researchers developed a guiding structure for the working process and a procedure for ongoing reflection and discussion.

Both applications of citizen social science (hereafter: projects) arose within larger and longer-term research settings in which the professional researchers were engaged. The first one revolved around human-nature relationships and the management of peri-urban greenspaces in deprived areas of a mid-sized town in Scotland's Central Belt (i.e., the relatively densely populated area between Edinburgh and Glasgow). The second one explored issues related to community food growing in Aberdeen, and was embedded in a larger research programme addressing household food insecurity. These broad topic areas were also used to recruit the citizen researchers through local community contacts and word-of-mouth (see Supplemental File 1: Appendix). However, beyond this we did not further delineate the scope of the research.

PROFESSIONAL AND CITIZEN RESEARCHERS: TEAMS AND ROLES

In both contexts, the citizen researchers received fixed-term contracts at the James Hutton Institute, with a planned budget of 12 hours per month, which could be increased if needed. The hourly rate was significantly above the UK minimum wage for ages 25 and over, and the citizen researchers were encouraged to claim travel and other expenses. We opted to offer employment contracts, considering that exploitation of volunteers has been an ethical concern in the citizen science literature (Resnik et al. 2015). We also did not want to limit our recruitment to those who could afford to volunteer or who had a personal interest in the research topic.

Two teams of citizen researchers—one in Aberdeen, one in the Central Belt—worked together with the four professional researchers. The two teams differed in various respects, including their levels of prior educational attainment, their interest in the research topic, and their relationships to each other (Supplemental File 1: Appendix). We will explore the potential implications of these differences in our analysis.

In both projects, we adopted an approach that could be termed collegial (Schäfer and Kieslinger 2016) or “extreme citizen science” (Haklay 2013), as the professional researchers' main role was to facilitate the process. They

provided bespoke training and arranged and structured meetings to encourage collaborative planning of the research, to reflect on the work, and to discuss analysis and dissemination activities. They also shared summary notes from the meetings. Training materials consisted of power point slides that introduced basic concepts underpinning social scientific research, and material such as interview excerpts that were used for illustration and for practical exercises. These were the same for both projects but were adapted to the groups' interests and methodological emphases. The citizen researchers shaped the process through their ideas, their research interests, and their needs, and in the Aberdeen case, conducted the fieldwork and developed their own analyses and outputs. Two of them are co-authors of this paper (all Aberdeen citizen researchers were invited to be co-authors, but two declined; the Central Belt team was no longer in contact with the professional researchers so could not meaningfully be invited).

CITIZEN SOCIAL SCIENCE IN PRACTICE

Figure 1 highlights how differently the two projects evolved. In the Central Belt, the citizen researchers were initially very enthusiastic and engaged, working on one joint project. However, after the first pilot interviews and the compilation of a list of potential interviewees, the work essentially ceased. After two months, during which the citizen researchers struggled to continue their research as other demands on their time took over and interviewing proved more difficult than expected, they chose to stop their research activities (*Figure 1*).

In Aberdeen, the four citizen researchers decided to develop three stand-alone sub-projects that all contributed to an overarching research question (Supplemental File 1: Appendix). The sub-projects reflected diverging interests in the overall topic area. However, this greater independence seemed to allow the citizen researchers to work in a proactive and self-motivated way, seeing their sub-projects through to the dissemination stage and identifying opportunities to share their findings with a range of audiences both academic and nonacademic.

To understand the dynamics within the two teams, two aspects are notable: First, the citizen researchers found themselves in very different life situations, with all of them initially having some level of flexibility, either because they were in college education, or were self- or part-time employed. As one of the Aberdeen researchers put it, the project seemed interesting and fitted into their life at the time. However, over time their circumstances changed: two citizen researchers (one in each location) took up full-time employment, and the college students applied for and started new courses away from their

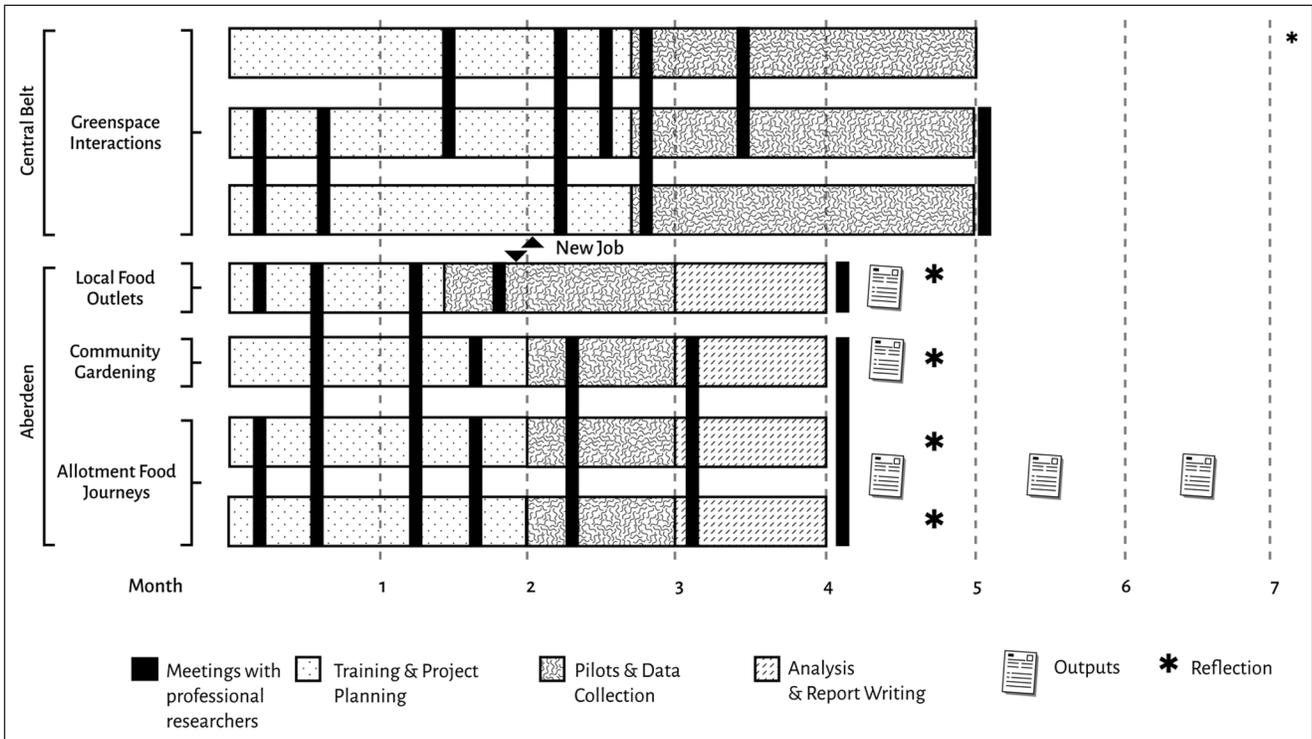


Figure 1 Trajectories of the two citizen social science projects in the Central Belt (*above*) and Aberdeen (*below*). Rows denote individual citizen researchers.

hometown. This meant (a) less mental energy available to focus on the projects, especially in the Central Belt case, (b) less available time, and (c) less predictable schedules, resulting in some citizen researchers having to cancel or arrive late at project meetings on short notice. In the Central Belt, the intermittent attendance of one team member posed challenges that ultimately compromised the work. In Aberdeen, we arranged separate meetings when schedules could not be aligned (*Figure 1*), an approach that was not feasible in the Central Belt where the citizen researchers had opted to work as a team, on a shared project.

Second, the two teams differed in their levels of internal cohesion. In the Central Belt, their close relationship meant that the citizen researchers could discuss their work between meetings and brief a team member who had missed a meeting. They enjoyed working together and seemed more confident working as a team than they would have been on their own. However, when the oldest team member took up a full-time job and became less engaged in the project, the two younger researchers seemed to miss their support and enthusiasm. By contrast, the Aberdeen citizen researchers decided to pursue three different sub-projects, focusing on (a) social cohesion in a specific Aberdeen neighbourhood, (b) sharing of produce from allotment gardens (food journeys), and (c) local food markets, respectively.

THE PRESENT STUDY: ETHICS, DATA COLLECTION, AND ANALYSIS

Ethical considerations and good practice in social science were an integral part of the training and research planning sessions. We obtained formal ethics approval from the James Hutton Institute’s Research Ethics Committee, first for the work with citizen researchers overall (#117/2017), and then for the specific projects carried out in the two different contexts (#128/2018; #146/2018). As part of this, the citizen researchers were free to withdraw from the project and their contract at any time.

Throughout the process, the professional researchers took technical as well as reflective notes, and some of the citizen researchers also shared brief written reflections. Each meeting included time to discuss the process to date, and to hear how everyone felt about the work. Apart from these notes, the interview guides, and materials and outputs produced by the citizen researchers, we also draw here on reflective debriefing discussions with the Aberdeen team. An extensive, 4-month Facebook group chat thread of the professional researchers and the Central Belt team (this was the Central Belt citizen researchers’ preferred way of communication between face-to-face meetings) complements the dataset. The Central Belt team was also invited to provide us with their final reflections in whatever format they preferred but offered only a relatively short comment via Facebook messenger.

We then analysed the data in two steps. These included, first, an exploration of the material described above, guided by the authors' collective interest to better understand the trajectories of the two projects, identifying common themes and patterns. Initial themes that emerged from the exploration included the citizen researchers' different motivations, the insights generated through citizen research as opposed to conventional research, the implications of the approaches taken by the different teams, and the different dimensions of what constitutes success in citizen research. We interrogated these themes and the material in an iterative and in-depth way, critically challenging the roles, actions, and interpretations of the professional researchers, exploring multiple perspectives to make sense of the data. On this basis, in a second step, we then conducted a detailed in-depth analysis of the data, and in an iterative approach that related our emerging findings to the literature, organised our insights according to three expectations that can be formulated in relation to citizen social science (see above). In the following section, we present our findings according to these three expectations, examining if and how the two projects held their promise of (a) fresh perspectives, (b) access to different voices, and (c) openness in approach.

FINDINGS: CITIZEN SOCIAL SCIENCE — DOES IT HOLD ITS PROMISE? CITIZEN SOCIAL SCIENTISTS—OFFERING A FRESH PERSPECTIVE?

In both Aberdeen and the Central Belt, the research questions chosen were grounded in the citizen researchers' lived experiences. However, the character and complexity of the chosen research questions varied greatly. The Central Belt team decided to focus on issues of vandalism and antisocial behaviours, and how these affected people's perceived safety when accessing local greenspaces. Although concerns over littering, dog waste, and vandalism of benches had been highlighted by visitor surveys and very much reflected the experience of the local manager of the greenspaces, the citizen researchers gave these issues a very different conceptualisation and framing, as they connected these to broader community-scale issues of social cohesion and inter-generational alienation. Thus, their initial interest in misuse of greenspace was extended in scope to consider people's "respect for their environment," "respect for each other," and "community spirit." Moreover, the research evolved to include an interest in perceptions of antisocial behaviour as they might be shaped by the extent to which different age and other social groups felt they were familiar with each other. Importantly, the Central

Belt researchers' normative concepts of ideal greenspace, favouring highly managed, short lawns with paved paths, diverged significantly from that of the professional researchers and local NGO staff who, influenced by nature conservation discourses, valued more biodiverse and wilder greenspaces. This difference in perspective on the ecological materiality of the greenspaces could be seen as one of the ways in which the citizen researchers' very own view on the research context manifested itself.

The approaches chosen by the Aberdeen team were characterised by well-defined, pragmatic research questions, inspired by their own activities and interests, which led, in two of the sub-projects, to tangible outputs, namely an annotated map of local food outlets, and a diagram of the journey of local produce from "soil to stomach." The third sub-project, focusing on the role of community gardening in fostering social cohesion in an Aberdeen neighbourhood, was, albeit similar to a standard social scientific piece of research in its conceptual foundations and systematic approach, motivated by the citizen researcher's own, long-standing experience of the place:

I think the data...the findings I've got...have very much drawn on my existing knowledge, interests, place if you like and might not have been so easy to obtain just by someone from James Hutton thinking 'we must research this'. [...] Well, in a way that's the point [of citizen social science] - it has been drawing on questions that have been in my head for a long time and I would say in a way that's the value of the approach both for me and for you, and for science. That in a way is what makes it citizen science... [AB-CR1-db, code indicates location (AB: Aberdeen, CB: Central Belt), role (CR: community researcher, PR: professional researcher) and unique identifier, and data source (db: reflective debriefing discussion at end of project; rd: reflective diary; ff: final feedback by Facebook messenger)]

The citizen researchers identified and explored research questions based on their interests and needs for a better understanding that was relevant in the context of their lived experiences. By creating the space and openness for these explorations, the professional researchers handed the control over the framing of the research to the citizen researchers. In our study, this resulted in very different types of research foci, ranging from pragmatic and narrowly defined questions on local food outlets to large and complex questions on social cohesion and intergenerational relationships.

However, our most important finding in relation to the citizen researchers' choice of a research angle and research

question lies in the process of making this choice. In both locations, the first part of the project, where the citizen researchers explored different options and then decided on the research approach (framing, research questions, and methods) was experienced as challenging, as their ex-post reflections suggest. In Aberdeen, this process was considered time-consuming, inefficient, and sometimes frustrating, as a range of ideas and possible approaches had to be “whittled down to one fairly small thing,” as the community researchers put it:

...for quite a long time I was thinking this is really not an efficient way of getting results. Taking non-scientists and going through all this and then only having time to do a tiny little bit of actual data gathering... [AB-CR1-db]

Ultimately however, the Aberdeen citizen researchers found the process important and useful:

I think it's quite valuable to go through that process to discover what it is you want to...you want to discover, and it's important to get a good question otherwise you get...information of less value. [...] I was thinking about would it have been different if we had been given more of a research topic, that would have saved some time but might have made it less interesting. [AB-CR2-db]

In the Central Belt, feedback was still positive in month 4 of the process:

I found today's meeting very interesting and exciting I liked all the potential ideas we came up with in regard to the interview. [CB-CR5-rd]

By contrast, the final comments of one of the citizen researchers indicate that the lack of direction from the professional researchers was seen as a shortcoming rather than an opportunity: “the project was not well planned out” [CB-CR6-ff].

Ultimately, the extent to which the citizen researchers brought new and unexpected perspectives to the process varied, and manifested themselves in a range from focused, pragmatic knowledge needs to rather large and complex questions. Yet the time and effort required to articulate these questions and objectives was substantial, suggesting that such fresh perspectives were not just there, fully formed and waiting to be uncovered, but rather emerged through deliberation and exchange of ideas, a process that the citizen researchers experienced as demanding.

ACCESS TO MORE THAN THE USUAL SUSPECTS?

We had also hoped that, through their embeddedness in local contexts and framing of the research problem, citizen researchers would be able to access people who would be less likely to participate in conventional academic research. In the Central Belt, we were interested in communities of place, such as residents of the areas around the peri-urban greenspaces. In Aberdeen, the subproject focusing on a specific neighbourhood was looking at a specific community of place, while the other two sub-projects addressed communities of interest, such as allotment gardeners and buyers of local produce.

In the Central Belt, beyond the three pilot interviews, no further interviews were conducted (**Figure 1**), but the citizen researchers had compiled a list of potential interviewees and places to approach people, such as local corner shops, their own neighbourhoods, and a community centre. The characteristics of the pilot interviewees and the content of this list suggested that, had the research project been completed, it would have indeed included many people who would be considered hard-to-reach in conventional social research. However, the seemingly low barrier between citizen researchers and their potential interviewees did not result in the improved access to local perspectives and knowledge hoped for by the professional researchers. Two aspects are worth mentioning in this respect.

First, the pilot interviews suggested that the fact that the citizen researcher came from the same locale allowed the interviewee to take for granted a shared understanding of that place. In one interview, the participant did not feel the need to spell out his thoughts to a fellow local, whom he believed to share his views without having to verbalise these, and only did so for the sake of the professional (i.e., non-local) researcher (who was present for training purposes). As one of the citizen researchers reflects: “[The interviewee] *did go on to say that myself would know a lot about this area, [but] as a [local] resident myself I didn't know nearly as much as he did*” [CB-CR5-rd]. This suggests that the Central Belt citizen researchers would have had to work hard to overcome the assumption of a shared local understanding, and elicit explicit views, insights, and experiences from their interviewees.

Second, the Central Belt team, instead of capitalising on their familiarity with the place and the people, sought to position themselves as externally accredited researchers, giving, for example, much weight to their wearing lanyards and staff identification cards from a research institute they had never been to, located 130 miles away. Although we might have thought of the citizen researchers as community-based, they appeared to resist this idea, and did not mobilise their local-ness at the data collection stage.

This was different in the Aberdeen case, where all three sub-projects managed to access relevant target populations: The two interview-based projects approached their participants in situ, at the allotment stall and in local food outlets, respectively. The neighbourhood survey, circulated through a neighbourhood Facebook page, attracted 53 completed questionnaires. It is difficult to say whether professional researchers—with the support of community gatekeepers—would not have been able to access a similar set of participants. Perhaps the most notable advantage for the citizen researchers was in the casual access they had to research participants, and the already existing rapport and trust they had with some of them, which may have expanded the coverage of their data collection.

OPENNESS IN PROCESS AND OUTCOMES?

Our third hope for our projects was that citizen researchers would not feel pressure to produce findings that necessarily lead to actionable outcomes, and could therefore adopt an open-ended, curiosity-driven approach. The Aberdeen and Central Belt cases differed significantly in this respect. While in the Central Belt, citizen researchers were indeed personally not overly concerned about nature conservation and greenspace issues, the Aberdeen team were all motivated by their interest in and engagement with (community) gardening, and/or locally produced food. This engagement varied in its intensity, but even for the more activist citizen researchers, the potential applied value of their work never dominated their engagement, as this extract from the debriefing discussion illustrates:

PR2: *... when the opportunity arose to become a citizen social scientist [...] what was it that kind of triggered your interest and thought 'yeah I'd like to do that'?*

CR2: *Well, I had the time available, and it was a bit vague but it sounded like it might be interesting and it was connected to what I was doing, so I thought it would feed in quite nicely. And I'm quite willing to try something new and it might even lead to something else. So...all of those reasons. [...] And I did think it would help with...promoting the TAMS [the Allotment Market Stall] project a bit. [AB-CR2-db]*

This substantive interest might have been indeed crucial to help the Aberdeen citizen researchers overcome obstacles they encountered during their work.

A key characteristic of our approach was to involve the citizen researchers from the beginning of the process, so that they could identify the focus of their research and

develop suitable methods (*Figure 1*). From the professional researchers' perspective, this process was intended to allow citizen researchers to take ownership. In hindsight, this worked well in Aberdeen, as all four citizen researchers saw their projects through to the dissemination stage, dealing with the challenges resulting from changes in employment and family situations as well as with the frustration arising from the perceived inefficiencies of the research process (as described above). However, it failed in the Central Belt, where final feedback from one of the young team members highlights a fundamental misunderstanding between professional and citizen researchers:

... firstly the project was not well planned out and we were not given the freedom required to collect the information successfully. [...] I also think that the meetings were extremely repetitive, and they weren't going anywhere. [CB-CR6-ff]

For the professional researchers, this negative feedback came as a surprise, as relations until then had been positive, even despite the lack of progress in data collection. During project meetings, the citizen researchers had indeed proposed additional activities, such as large consultation events and public information days, which would have required extensive planning and institutional approvals. In these instances, the professional researchers highlighted these constraints and encouraged the citizen researchers to pursue their original plans, which the citizen researchers seemed to fully agree with. Reflecting on the process, we believe that the experience of setbacks (e.g., interviewees asking to postpone a scheduled interview), together with changes in personal circumstances and availability of time, and the absence of strong engagement with the research topic, worked together in a way that protracted the process and led the Central Belt team to gradually withdraw. What the community researchers viewed as a lack of freedom was possibly rooted in their encounter with the practical and methodological challenges of doing research—and of being part of a research organisation with institutional responsibilities. The formal employment contract and the foregone salary were not strong enough to compensate for the factors that ultimately resulted in the team's disengagement. As one of the Aberdeen citizen researchers reflects:

And I don't know if I was less interested in my question whether then it would have been easier because I could just treat it more like it's a job. Yeah. Or harder because I just wouldn't really have had the interest in it at all. Um...yeah...can't really answer that one... [AB-CR1-db]

In summary, while it initially appeared advantageous that the Central Belt team did not have any personal stakes in the wider research topic of people's use of greenspaces (as many conservation activists would have had), this lack of prior engagement with and direct interest in the research topic might have played an important role in their withdrawal. By contrast, the Aberdeen citizen researchers, while generally potentially better equipped for the research work because of their education and experience, might have benefitted from their personal engagement with the research topic, particularly in the face of the inevitable setbacks and obstacles that characterise research processes more generally.

SYNTHESIS AND CONCLUSION

Across our two projects, we found that citizen social science indeed had the potential to (a) develop valuable research perspectives on real-world issues that were grounded in lived experience and, especially in the Central Belt case, (b) access research participants that would likely not have been interested if approached by somebody unknown to them, or from outside the community. However, this potential was not fully realised. For example, the expertise offered by the Central Belt team shaped the research focus and design, but as the project was abandoned this did not come to fruition. Our findings identify and illustrate the complexity of some of the factors that compromised our initial expectations. Our analysis also highlights a number of dilemmas, and we argue that to be successful, citizen social science projects will have to actively engage with these.

First, there is a tension between the time the newly formed team of professional and citizen researchers needs to build relationships with each other and co-develop a robust approach, and the risk that citizen researchers' circumstances change and/or momentum is lost if the process takes too long or is too onerous. While a project duration of, say, six months or more might seem advantageous to develop a truly shared approach, it might be too long for citizen researchers whose situations may change (see also Braye and McDonnell, 2012), and as such, a longer-term commitment to an open-ended process might be daunting, uncomfortable, or simply impractical.

Second, although the initial lack of direction and inefficiencies of the process can be experienced as burdensome and frustrating, it is crucial for the citizen researchers to play a strong role in the project from the start to allow genuine co-production of knowledge. Ultimately, the more responsibility for the design of the project lies with the citizen researchers, the greater the demand placed on

their time and level of interest in the research process. In some contexts, it might therefore be worth considering an approach that enables the citizen researchers to explicitly opt in or out of the different stages, so that although citizens are involved throughout, not every individual has to necessarily go through the entire process, depending on their interests, time, and energy (see example in Collins et al. 2020).

At the same time, our example shows that giving citizen researchers control over the definition of the research questions and project design confers both opportunities and risks, as it gives space for a reframing and rethinking of perspectives and meanings, but also implies that research foci can end up either too overwhelming or very descriptive. However, in this respect, citizen social science might not be very different from any other forms of science, where these risks might exist as well. Looking at citizen social science as "bricolage," a cumulative process of furthering our collective understanding, might be helpful here, where each citizen researcher contributes as much as they feel able to, building on each other's work over time. The approach taken in Aberdeen, where the three sub-projects worked independently of each other but all contributed to an overarching theme, is an illustration of what such a cumulative process could look like. While admittedly less collaborative, it offered more flexibility and resilience to disturbances.

Third, our work highlights an aspect of citizen social science that has so far been neglected, namely the ways in which the type of citizen social science we describe here relies on competencies and the background of the citizen scientists. Our citizen researchers varied with respect to the level of their formal and informal education and the depth of their previous engagement with the issues addressed in their research projects. If we expect citizen researchers to bring in perspectives and knowledges that are different from those of the professional researchers (e.g., Andrews et al. 2019) to facilitate difference and diversity (Kindon et al. 2007), we might want them to have educational backgrounds and competencies that are different from those of the professional researchers. Yet our experience also indicated that higher levels of formal education and greater familiarity with the scientific method and with research processes seemed to enable citizen researchers to deal better with emerging obstacles and frustrations, as seen in the Aberdeen case. However, if citizen researchers are more successful when they rely on competencies and experience from their educational or professional backgrounds, this challenges the inclusivity of citizen social science and limits the potential of the approach to include a broad range of perspectives. Such questions of inclusiveness and diversity in perspectives in citizen social science will require more consideration,

analysis, and critical debate, especially if educational background may preclude those who may have the most pertinent contributions to make to the societal challenges we face. It may be necessary to consider more carefully the types of competencies that are privileged through citizen social science, and to explore approaches that facilitate the successful participation of citizen researchers with other competencies and ways of knowing.

Fourth, we had originally imagined citizen social science as not driven by an immediate activist interest, not directly working towards change, and thus as distinct from PAR. However, we found that personal interest was a crucial ingredient in the research process that helped citizen researchers to see their projects through uncomfortable and challenging periods. The Aberdeen project showed that such a personal interest did not have to be an activist interest and did not necessarily have to compromise the adoption of an open-ended approach to the research. This means that in practice, citizen social science might not be as different from PAR as we originally considered it to be.

Fifth, citizen science is often critically interrogated in relation to its potential to redress traditional power imbalances between professional scientists and other participants in research (Braye and McDonnell 2012; Janes 2016; Fiske et al. 2019). Our experiences suggest that power relationships in a citizen social science project such as ours, where professional and citizen researchers are working closely together in a carefully negotiated partnership, might be much more complex and multi-layered than often assumed (see also Creaney et al. in press). In such “extreme” (Haklay 2013) citizen science, in which professional researchers largely act as facilitators of the research process, the outcomes of the project are crucially dependent on the contributions of the citizen researchers, at procedural, relational, and substantive levels. Seemingly small acts, such as short-notice cancellations of meetings or the failure to make progress against one’s own research plan, can, if cumulative, seriously jeopardise the work—and thus also the investment of the professional researchers, as we can see in the Central Belt case. The complexities of such relationships certainly merit more research.

These dilemmas arise from tensions between the aspirations and hopes associated with citizen social science and the pragmatic and procedural realities of citizen research in practice, and each project will have to navigate its own way through the different trade-offs to be made. While some of the challenges outlined here are found in many types of citizen science, for example, issues related to trust and team-building (Lakeman-Fraser et al. 2016), others are potentially more specific to co-created citizen social science, such as the role of citizen researchers’ competencies and interests. Our research

shows that all three hopes we articulated for citizen social science—fresh perspectives, access to different voices and openness in approach—deserve more empirical exploration and investigation, as well as juxtaposition with the existing theoretical literature beyond citizen science. Practical measures, such as clear communication of the research process, the opportunity to opt in and out of certain components (Collins et al. 2020), and overall a more flexible and cumulative approach that makes the research more resilient to e.g., changes in the citizen researchers’ availability, might go a long way in addressing some of the challenges we encountered. However, although our three hopes might continue to be important ideals to strive for, our analysis also shows that there are limits to how they can be achieved in practice.

DATA ACCESSIBILITY STATEMENT

This research involves human participants. To maintain anonymity and confidentiality, in accordance with the informed consent obtained from the study participants, the data cannot be made publicly accessible.

SUPPLEMENTARY FILE

The Supplementary File for this article can be found as follows:

- **Supplemental File 1:** Appendix: Overview of the two citizen social science projects. DOI: <https://doi.org/10.5334/cstp.389.s1>

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COMPETING INTERESTS

The authors have no competing interests to declare.

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