Enhancing community resilience through dialogical participatory mapping

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ABSTRACT

Citizen generated data can play an important role in enhancing community resilience. However, the relationship between data and community resilience has only been partly addressed in existing resilience scholarship, predominantly from the perspective of data utilisation in response to unfolding crises. Yet, in this study we attempt to highlight a different pathway for data-enabled contributions to community resilience, focusing on the process of data generation and its capacity to constitute a transformative moment itself. By exploring the case of the marginalized flood-prone community of M'Boi Mirim in São Paulo, Brazil, we introduce the concept of dialogical participatory mapping, and we argue that the process of generating geospatial data can empower local communities and assist in nourishing a resilience spirit among community members.

Keywords

Community resilience, dialogical approach, participatory mapping, marginalized communities

INTRODUCTION

Community resilience as a term has dynamically entered the human geography, sociology, planning and disaster scholarship during the last two decades, following an ontological evolution of the root term -resilience- across different disciplinary fields and an eventual 'social turn' in resilience conceptualisation (Brown, 2014; Coaffee & Lee, 2016). In parallel with this continuously accentuated role of civil societies and local communities in resilience scholarship, the increased utilisation of digital technologies and the development of knowledge infrastructures has facilitated an advanced capacity to respond to unforeseeable events, rendering data as a key component of modern practices to enhance community resilience (Kaufmann, 2016). Practices such as risk mapping, scenario planning (Fresco & Timm, 2016; Rickards et al., 2014), forecasting and early warning and alert systems are among the prevalent methods of knowing and preparing for events that can never be fully anticipated. Such methods are predominantly targeted at transforming resilience management by taking advantage of the continuous interconnectedness and overabundance of data in urban environments and the amplified importance of concepts like 'Big Data' and 'Internet of Things' in contemporary urbanization processes (Batty, 2013). This gradual digitization of urban life has elevated the importance of digital information for modern urban operations, giving birth to novel urban concepts such as 'urban science' (Michael Batty, 2015; Kitchin, 2020), 'neogeography' (Haklay, 2013; Turner, 2006) and 'smart urbanism' (Kitchin, 2014). In practice, the abundance and ubiquity of data has encouraged many local authorities to adopt and implement smart, data-driven approaches that take advantage of the new infrastructure of sensing, data collection and analysis (Bibri, 2018; Viale Pereira et al., 2017).

Citizen generated data hold a central position among such approaches as it physically demonstrates this shift from top-down command-and-control approaches to emergency management towards a more bottom-up collaborative approach that is sensitive different socio-spatial particularities and vulnerabilities and assists in not only making

marginalized voices visible but also in ensuring that such voices are fed in to emergency response policies (Krüger & Albris, 2020). In this context, participatory mapping has acquired a central position among common citizen generated data methods, primarily for humanitarian response, through the establishment of collaborative online platforms such as 'Open Street Map' (OpenStreetMap, 2021) and 'Ushahidi' (Ushahidi, 2021), which '*leverage mobile platforms, geospatial technologies, and visual analytics to map emergent challenges and resilience initiatives in order to accelerate response*' (Kaufmann, 2016: p.110).

While community resilience scholarship has a distinct and continuously emerging literature (Camponeschi, 2021; Norris et al., 2008; Wisner & Kelman, 2015), the emerging role of data as a vital mode of enhancing community resilience has only partially been addressed in existing resilience scholarship, rendering a more thorough investigation of the relationship between data and community resilience both timely and essential. Therefore, in this study we attempt to rethink the relationship between data and community resilience by shifting the focus from data utilisation to data generation, essentially viewing the process of data generation as a transformative moment that is capable of enhancing community resilience (Porto de Albuquerque et al., 2021). We explore this hypothesis through dialogical participatory mapping, a collaborative co-productive approach for data generation inspired by the Brazilian educator Paulo Freire and his dialogic engagement approach (Coaffee et al., 2021; Freire, 1970; Porto de Albuquerque & de Almeida, 2020), presenting the initial application of the approach in the marginalized community of M'Boi Mirim in the city of São Paulo, Brazil.

BACKGROUND OF THE STUDY

Community resilience definitions

Community resilience as a term, largely reflects the gradual upgrade of the role of civil societies (and communities in particular) in reducing vulnerability and managing disaster impact. From this standpoint, it also echoes evolutionary understandings of resilience (Davoudi et al., 2012) as the process of developing *adaptive capacity* to deal with complexity and uncertainty (Beilin & Wilkinson, 2015) in local communities, instead of merely the ability to increase the capacity for learning and adaptation. The notion of adaptive capacity is inherently embedded in the understanding of resilience as a process, since it connects the idea of 'bouncing forwards' following a disturbance to the mobilisation of resources to prepare for confronting a range of known and unknown future risks and challenges. Many scholars have also referred to the concept of 'adaptive resilience' as a fundamental quality of sustainable social systems. Others have extended this understanding to urban environments by underlining the contribution of community planning in the revitalisation of communities affected by destabilising shocks (Goldstein et al., 2012). Furthermore, in the context of environmental risk and disaster recovery, the potential of communities and individuals to mobilise and create social networks and reframe the traditional pathways of local risk management from a top-down to a bottom up approach, has been extensively emphasised by several researchers (Aldrich, 2012). Such work has illuminated how civil society has played a key role in post-disaster recovery on several occasions, especially through efforts concentrated at the neighbourhood scale.

In contrast with traditional approaches to disaster risk, which advocated a top-down mechanism for disaster risk management, relying on a narrow range of stakeholders (Coaffee et al., 2018), community-oriented resilience approaches aspire to leverage a network of professional and community groups at a range of spatial scales, in preparing for and responding to (un)expected perturbations. In the context of disasters, Wisner and Kelman (2015), argue that '*community resilience, [...], involves interactions among individuals, groups, and institutions that usually result in collective action to enhance the capacities for recovering from a disaster (p.355)*, emphasising once more the importance of collective action and active citizenship in order to enhance community resilience. Similarly, Bosher and Chmutina (2017, p.32) define community resilience as '*a measure of the sustained ability of a community to utilize available resources to respond to, withstand and recover from adverse situations*', although pointing out that determining actual risk awareness in the first place is a complex matter requiring contextual understanding of cultural, social and spiritual norms and perceptions.

More recent definitions of community/social resilience reflect the community-based transition in disaster studies as well as the 'social turn' of resilience studies (Coaffee & Lee, 2016). Some of them are quite broad and attempt to reflect the ontological fermentations on different understandings of the term (Imperiale & Vanclay, 2021) while others emphasise human-environment interactions, following the ascent of discussions climate change in academic and global policy agendas (Fazey et al., 2021).

Citizen Generated Data and community resilience

Citizen generated data and digital participation as a means for enabling the empowerment of local communities

and enhancing community resilience towards external shocks has been widely acknowledged in GIS and human geography scholarship as well as disaster risk management (Wehn et al., 2015) and humanitarian action (Haworth et al., 2018). In more detail, the collective production of geospatial data for humanitarian response, usually encapsulated in the term 'neogeography' (Turner, 2006), has been identified as an alternative source of real-time data for hazard-prone and disaster-impacted communities, especially in data-scarce urban environments, such as the Global South. With local authorities in need of continuously updated, real-time datasets, crowdsourced-produced citizen generated data in different forms, such as Volunteered Geographic Information (VGI), is becoming an increasingly more reliable source of information, and combined with existing authoritative datasets, can inform disaster risk management and ultimately enhance community resilience through improving disaster risk governance. Although there are key challenges restricting the utility of citizen generated data in resilience practice, mostly related to data quality, accuracy, veracity, reliability and compatibility with existing authoritative datasets and improvement of tools to facilitate data production (Camponovo & Freundschuh, 2014; Haklay et al., 2010), 'neogeography' constitutes a significant alternative source of updated and often real-time data for emergency response in times of crisis.

From this perspective, the relationship between citizen generated data and community resilience is apparent. Here, the mobilisation of local communities in generating locally relevant data for emergency response is a crucial activity which assists the emergency response apparatus ultimately contributing to enhancing community resilience through the utilisation of the newly produced datasets. Examples of such local mobilisations have been identified in several areas across the world (particularly in the Global South), most notably after the Haiti earthquake in 2010 (Yates & Paquette, 2011) and numerous other humanitarian crises. The emergence and continuous expansion of groups such as the Humanitarian OpenStreetMap (HOT, 2022) and its Tasking Manager Platform have also assisted in the wider involvement of individuals across the world in the process of geospatial data generation.

DATA GENERATION AS A COMMUNITY RESILIENCE BUILDING PROCESS

However, here we propose a different pathway for enhancing community resilience through citizen generated data, one that focuses on the process of data production and its transformative potential rather the utilisation of the data per se. In accordance with the ascent of citizen-generated data and digital participation as an instrument for enabling the empowerment of local communities, as it has been manifested through 'neogeography', instead of focusing on the applicability of citizen-generated data as essential digital information for supporting disaster risk management and response, we take a step back and consider the data generation process as a transformative moment itself (Porto de Albuquerque et al., 2021). In our view, the process of data generation is capable of gradually establishing a culture of community resilience through social learning, the establishment of mutual trust, the empowerment of alienated urban stakeholders and the development of 'critical consciousness'[1] (Porto de Albuquerque & de Almeida, 2020; Souza et al., 2019). This endeavour to progressively nourish a sense of community resilience through the production of locally relevant data is focused on individuals and social groups, commonly alienated from decision-making processes. Here, geospatial information -more commonly referred to as VGI- are more relevant in the majority of the cases.

Viewing data generation as a resilience building process is, however, not always, de facto transformative. More critical opinions on digital participation for humanitarian action focus on the inherent dangers involved in the process digital engagement arguing that inappropriate engagement methods are often incapable of unveiling tacit local knowledge and can create a 'delusion of democratisation' (Haklay, 2013), instead of equitably promoting urban resilience principles, such as holistic vision (Hynes et al., 2013), mutual trust (Bourgon, 2009), co-production (Turnhout et al., 2020) or participatory and adaptive methods (Healey, 1998). As community engagement through data generation being inextricably connected to the processes of community engagement employed, we propose dialogical participatory mapping approach, inspired by the Brazilian educator Paulo Freire and his iconic work *'Pedagogy of the Oppressed'* (Coaffee et al., 2021; Freire, 1970; Porto de Albuquerque & de Almeida, 2020).

Dialogical participatory mapping as a method for building community resilience

Our dialogical participatory mapping method is constructed upon the production of citizen-generated data from a critical pedagogical lens. The dialogical approach commences with the exploration of 'generative themes', which can be conceptualised as *'meaningful existential themes that are part of the everyday life of social groups and which are filled with emotional content that constitutes experiences and shared values'* (Souza et al., 2019 p.

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[1] Critical consciousness is a term coined by the Brazilian educator Paulo Freire (Freire, 1970) and frequently used in the context of the critical pedagogical process he proposed in illiterate marginalized communities across Brazil.

1169). By exploring generative themes, we attempt to comprehend the reality of community groups and individuals and activate a dialogical process for community engagement. Our ultimate goal is to document local perceptions of risk and understandings of the physical and built environment and allow community members to frame their understanding of sustainability transformations while mobilising local communities to produce change in their local conditions (Coaffee et al., 2021). This is based on the Freirean concept of 'conscientização' or conscientisation, a concept targeting at establishing a new critical consciousness to local citizens through, with which they will *'learn how to perceive social, political, and economic contradictions, and to take action'* (Freire, 1970 p.17). Through this process, citizens are becoming transformative agents and commit to co-creating their ambient physical and built environment (Souza et al., 2019). Citizen engagement in this case is not merely a means to gather data, but an opportunity for social learning for citizens and researchers, through which both can acquire a new critical consciousness of the components undergoing socio-spatial processes in their communities.

Under this prism, in our approach participatory mapping is utilised as the transformative method for enacting this dialogical approach and is divided into three phases. The **first phase (diagnostic phase)** focuses on identifying local perceptions and understandings of risk through performing a risk perception and mapping exercise. Starting with an exploration of different *'generative themes'* sensitive to the particular realities of different local communities, and through developing and applying a dialogical community engagement approach, the goal here is to record bottom-up voices and needs of community members and document them on existing maps of the areas. Later, the **second phase (data-production phase)** attempts to transform the outcomes of the diagnostic phase into geospatial data through participatory mapping. In more detail, local citizens and community members, with the initial support and guidance of more experienced mappers, start generating new context-related and locally relevant geospatial data, as identified through the generative themes presented in the risk perception maps. This newly-produced data is then added to the OpenStreetMap (OSM) platform (OpenStreetMap, 2021), a free online geospatial platform used by thousands of mappers around the world and enable the generation of detailed community maps, openly available to everyone and are subjected to an initial digital validation process. Here, the dialogical participatory mapping method is expected to not only create a sense of collective ownership to local citizens (Liu et al., 2018) but also to instigate a process of consciously and critically exploring their ambient environment and gradually cultivate a community resilience spirit. The **third phase** of our dialogical participatory mapping approach **(ground-truthing phase)** involves field visits in the mapped areas with printed maps by local citizens involved in the data-production phase including the newly-produced geospatial data from the previous phase, in order to confirm their spatial accuracy and validity. Finally, the **fourth phase** of our approach involves the presentation of the mapping results to the community members and a detailed documenting of reflections to the dialogical participatory mapping process not only by the community members but also by external actors.

In the following example we present some preliminary outcomes of our dialogical participatory mapping approach in the community of M'Boi Mirim, São Paulo.

Building community resilience to floods through dialogical participatory mapping in M'Boi Mirim

The first endeavour to operationalize our dialogical participatory took place in M'Boi Mirim, a marginalized flood-prone urban district located within the metropolitan area of São Paulo, Brazil. The fundamental driving force for our method was the fact that existent geospatial and flood risk data for M'Boi Mirim was not comprehensive or granular enough to facilitate effective disaster risk management, while it also lacked personalised and locally relevant information. Therefore, the diagnostic phase commenced with the sharing of memories by older residents and community members about previous flooding events and the sharing of perceptions and understandings of risk in the neighbourhood. Later, 60 dwellers of M'Boi Mirim were approached and provided with physical copies of maps of their neighbourhood and were subsequently asked to draw the most flood-prone zones within M'Boi Mirim based on *their* perceptions of flood risk (Klonner et al., 2021) (Figure 1). These newly created 'Sketch Maps' (Klonner et al., 2018) were subsequently digitized and compared with official flood risk maps and models to examine if local perception is adequately depicted on authoritative datasets[2]. It should be mentioned here that whilst conventional community engagement approaches recognise the value of citizen participation in filling the gaps of existing urban data, they often instrumentalize the role of citizens, framing them as sensors confined to capturing pre-defined environmental signals. Thus, the main purpose of risk perception mapping here was to unveil flood risk knowledge that might be undetected and not accounted for by conventional risk monitoring approaches.

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[2] While the majority of flooding areas within M'Boi Mirim were identified as such in official flood risk maps, the coarseness of the maps led to many irregularities with the risk perception maps.

Figure 1: Risk perception mapping with residents in M'boi Mirim

The data-production phase begun with the introduction of the mapping tools to the students of four local schools through a series of workshops and participatory mapping sessions (Figure 2). Later, and following a discussion with representatives of the local communities, local residents and local Civil Protection units, students were actively involved in mapping buildings and streets across M'Boi Mirim in the OpenStreetMap platform, adding features and information to the newly-created data based on their local knowledge of the area. The geometrical accuracy of the data was later digitally validated by more experienced mappers, and common patterns of mapping mistakes were categorized and presented back to the students with the aspirations of such issues being avoided in future mapping efforts. The geospatial data generated by the students was aimed towards assisting local authorities in improving the spatial and temporal coverage of existing databases, thus enabling more precise flood forecasting, whilst simultaneously empowering citizens and school students in M'Boi Mirim and encouraging them to adopt a more anticipatory and resilient behaviour towards flood-related events.

Figure 2: Participatory mapping with students from the Vicente Leporace school in M'boi Mirim

Unfortunately, pandemic-imposed restrictions posed significant hurdles related to the completion of the ground-truthing phase of this dialogical participatory mapping approach. Covid-19 had a significant impact on the country of Brazil, and eventually on the citizens of M'Boi Mirim rendering physical contact and visiting of the mapped areas rather complicated. However, as the restrictions are progressively being lifted, this very important phase of the proposed method is progressively being planned. However, despite the lack of implementation of its third phase, preliminary results of our dialogical participatory mapping method show that the high-quality locally-relevant geospatial data produced by the citizens can be a useful supplementary source of information for the local civil defence and disaster response authorities, while simultaneously the dialogical community engagement can increase awareness on flood risks, empower local communities, establish new and strengthen existing solidarity networks and stimulate social mobilization.

Currently, we are in the process of rethinking the dialogical participatory mapping process through reapplying it in three different neighbourhoods across three Brazilian cities: Cai Cai in São Paulo, Guarani Kaiowá in Belo Horizonte and Seis de Agosto in Rio Branco. As contextual characteristics of communities vary across our case studies, we are ready to accommodate potential alterations in our approach, following however, the framework

WiP Paper – Data and resilience: opportunities and challenges
Proceedings of the 19th ISCRAM Conference – Tarbes, France May 2022

499

presented above and emphasizing more on the importance of critical reflections in a given space from the co-production of geospatial data through mapping, and the involvement of internal and external agents.

CONCLUSIONS

The goal of our approach is to highlight a different pathway for data to contribute and ultimately enhance community resilience, particularly in marginalized and data-scarce areas of the Global South. Here, instead of harnessing citizen generated data as information to enhance community resilience, we focus on the process of mapping as a transformative moment that can contribute to the cultivation of a resilience spirit among community members. While acknowledging the significance of citizen generated data to improve and inform disaster risk management and eventually enhance community resilience, we conceptualize data generation as a community resilience building process itself. Hence, without disregarding the necessity to produce timely and accurate data, particularly in data-scarce urban environments, or in areas with ongoing humanitarian crises, we argue that engaging local citizens in the data generation process is a crucial transformative moment capable of mobilizing existing social capital, empowering underrepresented citizen groups and cultivating a spirit of awareness through data ownership.

As the example of collaborative mapping in M'Boi Mirim demonstrates, the introduction of participatory mapping to local schools has not only enabled school communities to familiarize themselves with flood risk in their neighbourhood, but also provided them with the opportunity to break existing knowledge barriers by conveying their territorial wisdom through geospatial citizen generated data, simultaneously building a sense of data ownership and risk awareness. Similarly, risk perception mapping endeavoured to transform citizen memories, experiences and tacit knowledge into tangible representations of flood risk. Regardless of the practical utilization of the newly created datasets[3], the process of data generation creates a pathway to mainstreaming a spirit of community resilience, not only in data-scarce communities of the global south, but also in the context of more data-rich contexts. Hence, in parallel with the expanded application of our approach across Brazil, we are currently adopting the dialogical participatory mapping approach aspiring to enrich our initials insights from M'Boi Mirim and provide a more comprehensive and inclusive version of our method in seven case studies across Europe through the HORIZON 2020-funded project *'RiskPACC – Integrating Risk Perception and Action to enhance Civil protection and Citizen interaction'*, expanding the perceived array of risks to include wildfires, earthquakes and urban security beyond flooding.

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[3] It should be mentioned here that some of the newly-produced datasets are being used by the local civil defence in M'Boi Mirim. Such datasets are mostly referential base-maps of the local community, including local roads, pathways and buildings.

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503