



Children breathe their own air: Reflections on children's geographies, the urban political ecology of air pollution, and ongoing participatory action research with undergraduates near an east London primary school

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Children are uniquely socially and biophysically exposed to the toxic and illegal air pollution plaguing many cities around the world. Scholars working in urban political ecology (UPE) and in children's geographies have a significant opportunity to research these toxic metabolic flows and responses to them, though scholarship at the intersection of UPE and children's geographies is scarce and falls behind the growing social movements involved in activism regarding air pollution in children's urban spaces. Additionally, the intersection of children's geographies and UPE presents a chance for significant pedagogical reflection in UPE, which, to date, has been nearly absent. To address these issues, this paper details a multi-method and participatory action research project with undergraduates to locate and intervene in uneven and unequal urban metabolism of air pollution near a primary school in east London. It argues for the increasing relevance of air pollution for UPE scholarship, for further interdisciplinary work at the intersection of UPE and children's geographies, and for the greater participation of undergraduates in urban environmental politics beyond the classroom.

KEYWORDS

air pollution, children's geographies, London, participatory action research, urban political ecology

1 | INTRODUCTION

In just the first 31 days of 2018, London's air pollution levels exceeded the EU statutory limit of annual exposure to nitrogen dioxide, a common pollutant from road traffic. In 2017, London's air breached the same annual limit by 5 January – in only five days – continuing a trend since 2004 in which the annual limit was breached within the first week of every year (London Air Quality Network, 2018). Events like the infamous Great Smog of 1952 and these egregious recent infractions demonstrate that harmful air pollution has been a regular part of life in London for generations. In London and beyond, the air pollution death toll is staggering. Air pollution kills roughly 800,000 people annually in Europe alone – and this figure might be a significant underestimate (Lelieveld et al., 2019; Loxham et al., 2019). Globally, air pollution is even more acute as weak regulation, polluting vehicles, and toxic industry expose various publics to greater levels of polluted air.

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Beyond increased mortality, air pollution also exacerbates health conditions as diverse as septicaemia, Parkinson's disease, and even urinary tract infections (Davis, 2019; Lelieveld et al., 2019).

Depending on the city, social variables like race, class, and socio-economic status factor significantly into uneven exposure to urban air pollution (Hajat et al., 2015; Sexton et al., 1993). Across London, social movements ranging from neighbourhood groups to issue-specific policy organisations have tactically responded to the uneven and extreme exposure via public pressure on politicians, citizen science campaigns, and direct action. The vulnerability of children in particular has come to the fore as a critical issue in air pollution campaigning. Groups like Mums for Lungs and news stories like those highlighting that London children face five times the exposure to air pollution during the school run compared to midday levels (Varaden, 2019) have strategically emphasised the vulnerable position of London's children.

Relatedly, the knotty entanglement of biophysical impact, urban politics, and environmental governance of air pollution is ripe material for university students learning about complex and urgent urban environmental problems and politics. Urban political ecology (UPE), with its emphasis on the uneven burdens of urban environmental conditions, is an especially well-positioned subfield for teaching critical perspectives on urban air pollution. Yet there exists limited explicit reflection in the UPE literature on its own pedagogical implications for how undergraduates might intervene and participate in the reworking of urban environments.

This paper, then, addresses the intersection of children's geographies and UPE using the issue of air pollution, examining and detailing a participatory action research (PAR) project with third-year undergraduates. As part of an undergraduate module titled 'Urban Political Ecology', the project is also a university–primary school partnership that attempts to locate and intervene in uneven flows of air pollution in children's breathing spaces near a primary school. The paper unfolds in several sections. First, it extends the currently small intersection of children's geographies and UPE using the issue of air pollution. Next, it draws on the UPE–children's geography nexus and public health literature to locate children both politically and biophysically in flows of air pollution, using the project to situate and understand these flows in east London. Lastly, the paper concludes after a reflection on the project and a discussion of UPE, pedagogy, and the urgent politics of urban air pollution.

2 | LITERATURE REVIEW

2.1 | Air pollution, UPE, and children's geographies

Reviews and stock-taking of UPE's scholarly trajectory chart its evolution from a subfield rooted in Marxian political economy to encompassing a broader range of theoretical and methodological approaches and contributing to debates across geography and other disciplines (see Heynen, 2014; Zimmer, 2010). Even so, one social variable often overlooked by UPE is age. In particular, UPE's interface with children's geographies was, until recently, nearly non-existent. Though fleeting traces of the geographies of children do appear in the UPE literature – for instance, in examinations of Black Panther anti-hunger alleviation programmes (Heynen, 2009); social identity in squatter settlements (Moffat & Finnis, 2005); exposure to improperly treated wastewater (Karpouzoglou & Zimmer, 2016); and access to drinking water (Truelove, 2011) – children and their geographies nevertheless remain peripheral.

In their identification of this gap, Shillington and Murnaghan (2016) question why and how the interests of UPE and children's geographies might mutually inform one another, noting the “simplification and romanticization of nature in children's geographies and the lack of children and their spaces in urban political ecology” (2016, p. 1018). A hallmark of UPE is to understand nature as a constantly reconfigured set of flows and connections made possible through the processes of urbanisation, rather than an enduringly romantic realm of the world untouched by human labour or culture. For Shillington and Murnaghan, the contribution of children's geographies for UPE is that children are not simply subjects of the city and of urbanisation, but instead are also active participants in its life, function, and structure. Similarly, Bosco and Joassart-Marcelli's (2015) approach to understanding children's labour in participatory urban planning, Rupprecht et al.'s (2016) analysis of young people's use and making of informal urban green space, and von Benzon's (2018) study of how children 'do nature' in the city are examples of how scholars of children's geographies conceptualise children's making of urban environments. In contrast, the contention that children are active participants in the city is largely ignored by UPE scholars, often treating children as vulnerable urban subjects, but not as central to research or as active participants in remaking urban metabolic flows.

2.2 | Locating children in metabolic flows of pollution

Urban political ecology's strength, though, is in understanding these metabolic flows and their differentially experienced and uneven outcomes. Alongside broader recent interest in geography in the theorisation and investigation of air (e.g., Adey, 2014; Nieuwenhuis, 2016; Simpson, 2019; Škof & Berndtson, 2018; Whitehead, 2011), UPE also has a small literature focused on air pollution. Graham's (2015) wide-ranging account of technologies, infrastructures, and other themes establishes a broad theoretical framework for a political ecology of urban air pollution. Véron's (2006) study in Delhi examines air pollution policy as a function of attempts to beautify the city that further entrenches and complicates existing socio-ecological inequalities. Buzzelli (2008) notes the scalar politics and disjunctures between techniques of measuring air pollutants versus the instruments of governing air pollution in Vancouver, while Monstadt (2009) names air pollution as a symptom of infrastructural deficit in his examination of the political ecology of urban infrastructures.

These studies, along with the rich and related scholarship in environmental justice on air pollution, incinerators, and more (e.g., Buzzelli & Jerrett, 2004; Morello-Frosch et al., 2001; Pearce et al., 2006; Su et al., 2010), demonstrate that varied exposure to air pollution often falls along lines of race and class. There is, then, an intersection of these variables and identities in children's exposure to air pollution. Not all children, of course, are equally exposed and it is often those children and their families already experiencing environmental injustice who face further exposure. An urgent opening exists in UPE to locate children in metabolic flows of pollution given that they are relatively understudied and overlooked.

To take advantage of this opening, biophysical and public health research on children's exposure to air pollution can help scholars in UPE articulate these uneven bodily geographies of air pollution and their consequences for children. Metabolism insists on the biophysical nature of breathing and the uniqueness of children's bodies, which are more vulnerable to air pollution firstly because the ratio of breathed air to body mass is higher for children than it is for adults. Children thus receive higher relative doses of airborne toxicants than adults do, as infants have triple the volume of breathed air per kilogram of body weight compared to adults and a six-year-old has double an adult's volume (WHO Regional Office for Europe, 2005). Furthermore, children, because of their physical stature, breathe air positioned vertically lower than air adults breathe. Guzelian et al. (1992) found that a common indoor pesticide applied on baseboards evaporated in quantities up to four times higher in children's breathing zones than adult breathing zones higher from the floor.

The epidemiological literature on air pollution's detrimental impact on children's health is vast, with thousands of studies examining different physiological consequences of air pollution on children in cities worldwide. Three central concerns at the core of this literature help to illuminate some of the embodied metabolic pathways of interest to UPE scholars. First, cardiopulmonary and respiratory issues are key in epidemiological studies of air pollution and children. Asthma is of primary importance, with dozens of studies demonstrating children's asthma is exacerbated by increased exposure to air pollution. A significant relationship exists between household air pollution and worse pulmonary function in infants (Lee et al., 2019). Second, studies examining neurological damage in children because of air pollution exposure are newly prominent. Calderón-Garcidueñas et al. (2016), for example, note that neuro-inflammation and neurodegeneration, key underlying risk factors for the onset of Alzheimer's disease, multiple sclerosis, and Parkinson's disease, are present in children due to air pollution and that long-term exposure to air pollution is a global neurological health issue. Similarly, traffic-pollution exposure adversely affects the brain maturation of 8–12-year-olds (Pujol et al., 2016). Lastly, air pollution as detrimental to foetal and newborn health is also a common theme. Foetal and early postnatal infants are especially damaged by exposure to air pollution during organ development and periods of rapid lung growth (Goldizen et al., 2016). Furthermore, common traffic air pollutants contribute to low birth weight (Olkhanud et al., 2018) and pre-term birth and exposure to air pollution are linked (Ritz et al., 2000). Even uterine spaces – the only space in which all children grow and have inhabited at some point – are shown to be affected by air pollution (Bové et al., 2019).

3 | METHODS

3.1 | Participatory action research and air pollution

For UPE, material flows like those identified above from the epidemiological and public health literatures are grounds for political action and thereby add another dimension to the study of urban metabolism. Methodologically, PAR has been one response from UPE scholars to partake in political interventions in similar uneven flows (see Burke & Heynen, 2014; Radonic & Kelly-Richards, 2015; Yates & Gutberlet, 2011), all of which shaped the initial conception of this project. PAR covers a wide spectrum of methods, actions, and contexts, but, broadly speaking, it pursues the involvement of non-academic stakeholders and a commitment to social change in its research design and execution (cf. Anyon et al., 2018;

Chevalier & Buckles, 2019). The social and biophysical production of unjust and uneven urban environments is the subject of study for UPE scholarship, and PAR allows this work to develop research with stakeholders committed to changing these conditions. Below, I recount the ongoing PAR with undergraduates in Silvertown as a way of understanding and intervening in the metabolism of toxic air.

3.2 | Context and data collection

Working in Silvertown and connecting with community groups is important from both a UPE and a PAR perspective for two reasons. First, Silvertown is in Newham, a borough whose neighbourhoods are highly uneven in their deprivation (Somerville, 2019) and which was one of the three most deprived boroughs in London and in the top 10% most deprived in the UK (London Councils, 2019). Second, Silvertown is sandwiched between an overwhelming array of noise and air pollution sources: London City Airport; a sugar refinery; several scrapyards serviced by hundreds of lorries weekly; a construction hub for Crossrail, an extensive underground rail construction project; and a main road whose traffic emissions greatly exceed legal limits on air pollution. Despite publicly touting air pollution mitigation measures, Mayor of London Sadiq Khan approved plans in November 2019 for a new £1 billion vehicle tunnel under the Thames connecting Silvertown with south-east London and a multi-storey lorry park in Silvertown to accommodate the new traffic. Inadequate green space in the area and residential tower construction further compound these problems.

Long before selecting Silvertown as a project site, the idea for air pollution monitoring as an undergraduate out-of-class activity originated from conversations with physical geography colleagues about how to link human and physical geography ideas, methods, and pedagogical practices in the undergraduate curriculum. Air pollution monitoring, given its ability to be studied from a range of social and physical science perspectives and techniques, was the most obvious issue to use in these discussions. Our discussions also noted that diffusion tubes are relatively cheap and that installing them with students would also make for an interesting walking field trip in the city. After these conversations and when planning my teaching, I relied on a local sustainability network to connect me with an activist neighbourhood organisation in east London, which led to a partnership with a local primary school.

The project has been running for three years and occurs in three major events throughout the year. First, the undergraduates and I install 12 diffusion tubes, simple devices that over a period of weeks measure exposure to air pollutants. We measure NO₂ because of that chemical's visibility in smog, ease of measurement, and clearly regulated status. Early in the term for a regularly scheduled class meeting, we take a field trip to install the diffusion tubes on lampposts or bus stops in the neighbourhood. At the school's advice and request, we installed them along students' common walking routes to school, also taking one diffusion tube into the school to collect indoor data because some studies show that indoor air pollution equals or exceeds outdoor levels.

Ideally during this installation, we meet a representative from the primary school or from a local neighbourhood organisation to understand more about the local area and the struggle for pollution mitigation. For instance, one year we met a representative from a local neighbourhood organisation for a seminar on the streets of Silvertown, during which the representative spoke with students about asthma rates, activism, upcoming neighbourhood meetings, and more. The site visit proved important in illustrating the metabolic flows we were studying: the thunderous jets from City Airport paused our conversation every few minutes because of their volume and the smells and sounds of passing lorries made clear just how polluted Silvertown Road could be.

Second, after roughly four weeks, I collect the tubes and send them to the lab for analysis. About two weeks later, the results return. In lecture, we then discuss and map the results using GIS software, highlighting the points at which we installed the diffusion tubes and the NO₂ values at each point. We then share the map, results, and brief interpretation with the school. One year, for example, 11 of the 12 tubes stayed in place for the duration of the monitoring period and at five of those sites NO₂ pollution exceeded the EU legal limit of 40 µg/m³, including two in popular parks for children, one at a transit stop, and one just outside of a school's front gates.

Third, we attempt to schedule a presentation for the school's club for environmentally aware and enthusiastic students. For instance, for one co-planned session in 2018, we decided on a mix of activities for our session, highlighting what students think of and experience as air pollution, in addition to political changes that might address the problem. We taught students some basic air pollution principles using visual aids and asked the students what they themselves could do to combat air pollution. What we found more interesting, though, were the two activities we asked them to do next: first, to imagine and draw a picture of the kind of neighbourhood you would like to live in and second, to write a letter to Mayor Khan about what changes to the city might improve air quality. After the lesson, the school sent the letters and pictures to the mayor's office. We did not intend to use these letters and pictures as qualitative data and therefore we did not go through

our university's institutional research ethics process to use them as such. Thus, offering specific details on those pictures and letters is not possible here. Collectively, though, their pictures and letters were impressive: colourful, interesting, and detailed drawings of imaginative neighbourhoods of the future accompanied funny, witty, thoughtful, and incisive letters to the mayor.

The module will continue to run in future years, though with adjustments and modifications along the way, especially seeking institutional ethics approval to work more closely with children. Planned improvements include collaborating with a community group specifically interested in air quality. We will also continue to monitor the same points of the neighbourhood for comparison's sake and to provide a multi-year data set. There are also other plans for connecting our activities to other groups: there is a UK-wide data set collecting air pollution data from citizen science projects similar to ours and I plan to share our module's data with this database. Additionally, colleagues in the chemistry and engineering departments at our institution are also doing projects with their undergraduates regarding air pollution and building a cross-department project with them is possible.

4 | DISCUSSION: UPE, PEDAGOGY, AND AIR POLLUTION RESEARCH

4.1 | Methods for understanding children's urban metabolisms

While deepening the project's participatory elements and connecting the project to other initiatives beyond geography and UPE are essential, one aim of the project is to encourage pedagogical reflection within UPE, currently uncommon in the literature (though see Boggs, 2011, and the Athens Urban Food Collective). Undergraduate content on urban environments, environmental politics, and other similar and overlapping themes to UPE are present throughout undergraduate curricula, but key questions remain: what in particular can UPE bring to undergraduate classrooms? How should UPE be taught in terms of method, aims, and theory? What successful pedagogical methods exist for not only explaining but also intervening in the production of uneven urban environments with undergraduates? Clearly here the pedagogical literature on service learning, environmental justice, critical food studies, and more will be relevant, but an extended conversation about what UPE specifically brings to an undergraduate curriculum is overdue.

For this project, one pedagogical and methodological tool from UPE is its emphasis on flows, which means that children's spaces in addition to children's words, art, or other elements can be the source of data. Such an approach emphasises children's *geographies* by looking at the flows in which children abide, which can be examined alongside ethnographic or other methods of children's geography. Doing participatory research with community groups on children's urban metabolic space is another methodological way forward at the UPE–children's geography nexus. Methodological conversations in children's geographies are rich and continuously developing (see Aitken, 2018; Brown, 2014; Kesby, 2007; Kraftl & Horton, 2018) and are essential for further conversations, greater integration, and innovative research methods at the intersection of UPE and children's geographies.

4.2 | UPE and the interdisciplinary, public, and pedagogical usefulness of data

Another important pedagogical element raised by participatory work in UPE is the politics and purpose of data collection. The air pollution data we gather for NO₂ using the diffusion tubes are not methodologically robust enough to demonstrate the transgression of legal air pollution limits. A central question for students, then, is: what is the point of collecting these data? Undergraduates, of course, should learn how to critically incorporate broad sources of qualitative and quantitative data in their research and, to this end, this project exposes mostly human geography students to the epidemiological literature on air pollution and conveys the importance of biophysical science and data. Indeed, without the epidemiological literature above, this project's understanding of children's spaces of air pollution would be significantly weakened. Similarly, collecting quantitative data has several pedagogical advantages: when we map the data in class, it exposes students to the political potential of GIS methodologies; when we attempt to narrate the unjust and uneven geographies of air pollution, it adds another layer to the narrative; and when we share the data with our research partners, it raises questions of data access and who should benefit from academic research.

Furthermore, though UPE scholarship relies primarily on qualitative data and methods, there is still tremendous scope and political benefit for the addition of quantitative methods, biophysical data, and transdisciplinary collaboration. Because metabolism is both a social and a biophysical process, UPE scholars ought to be open to including all kinds of data to narrate and intervene in uneven urban flows. This is especially true for participatory action researchers in UPE and beyond. The quantitative data we collect in this project, for instance, are valuable to our research partners and sharing that data is

an essential step in working to relieve the uneven burdens of air pollution. Ultimately, collecting scientific data has use far beyond its narrow application in legal and institutional contexts: it opens doors, communicates trends, provides grounds for further investigation and collaboration, feeds into larger projects, connects otherwise unconnected people and groups, and, from a UPE perspective, helps to illustrate the metabolic flows constitutive of urban life and the participatory grounds for new urban environmental politics.

5 | CONCLUSION

With these urban flows and politics in mind, the project has contributed to an ongoing development of a framework for scholars and for undergraduates to understand and discuss the intersection of air pollution, children's geographies, and UPE. The project continues to be possible because of a mutually beneficial university–primary school partnership. The school serves as an important locus for undergraduates to think through issues relevant to module lectures and readings. This primary school also has a relatively high proportion of students whose parents have not attended university. Having university staff and students engage with primary school students communicates that university is a place for them and that their own interests can be pursued through further study.

Working at the intersection of UPE and children's geographies means teaching that the lives and life courses of children open a window onto new kinds of political action for schools, children, and undergraduates. If UPE's strength is in understanding the differentially experienced and highly uneven outcomes of urban metabolic flows, it partners well with children's geographies to locate young bodies in these flows. In a time when youth are leading political conversations on issues as diverse as climate change and gun control, the increasingly powerful and persuasive political action and voices of the relatively young – whether children or, at least in this particular classroom, undergraduates – are important context for this project. Children inhabit the city and breathe its air in ways and places that adults do not and therefore their position in the politics and flows of air pollution ought to be carefully considered in UPE pedagogy and scholarship.

That children breathe their own chemically and spatially varied air compared with that of adults is the key initial observation and motivation for research at the intersection of UPE, children's geographies, and air pollution. Rooted in this variance, though, is the notion that children's subjective and embodied position in these materially distinct urban flows is both the reason for their physical vulnerability and the development of their own political agency. Working at the intersection of UPE and children's geographies, scholars can further highlight the (vulner)abilities of children in relation to air pollution and other urban metabolic flows.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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