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RESEARCH ARTICLE

Grassroots Infrastructure for Disability Cycling in London and São Paulo: Exemplary Precedents Affording Motility and Wellbeing

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Although standardised infrastructure—such as cycle lanes or bike share systems—provides necessary foundations for more just and sustainable mobility and leverages economies of scale, it fails to recognise the diversity of mobility needs, as well as non-mobility needs that are related to transport, such as those stemming from variation in mental and physical human characteristics. It is also often assumed that transport infrastructure interventions are the exclusive domain of government, and increasingly the private sector, whereas civil society is thought to contribute only through voting and campaigning.

This paper presents discoveries drawn from interviews with citizen-led organisations working on grassroots innovations in social and physical cycling infrastructure for people with disabilities in London and São Paulo. It finds that (a) the affordances of the physical infrastructure are actuated by social infrastructure, i.e. networks of collective practice; and (b) the diversity of assemblages of this infrastructure, in the aggregate, measurably develops these disabled people's mobility and capacity to move, provides them with sensorial and psychological benefits, increases their independence and personal security, and boosts inclusive sociality for both them and their carers. It thus argues that these grassroots innovations can provide exemplary precedents of responsive infrastructural assemblages that increase disability affordances and through that support more equitable motility and wellbeing. Besides the immediate benefits of these infrastructural innovations, their experimental and demonstrative nature may also guide larger scale efforts to achieve just and sustainable mobility transitions, and thus, should be better supported by funding agencies.

keywords: social infrastructure; grassroots innovations; inclusive cycling; infrastructural assemblages; just transitions; sustainable mobility

1.0 Introduction

It is now widely acknowledged that an urban mobility transition is a necessary ingredient to realise a more just and sustainable society (Geels, 2012; Newell and Mulvaney, 2013;

Schwanen, 2015; Swilling and Annecke, 2012; Temenos *et al.*, 2017). However, most of the efforts to achieve this transition focus on standardised infrastructural 'hardware' such as electric vehicle charging infrastructure, bike lanes and paths, or bike sharing schemes. Although these provide helpful foundations for sustainable transport that leverage economies of scale, they may fail to recognise the diversity of mobility needs, as well as non-mobility needs related to transport, within a city or region. This diversity of requirements stems from not only context/situation, such as place of residence and current income, but also the varied minds and bodies that make up populations of people. In short, the heterogeneity of people in our societies demands differentiated mobility infrastructure rather than "one size fits all" provision.

Also, there exists an assumption among transport decision makers, researchers, and the public at large, that responsibility for transport infrastructure rests in the hands of local and national government, and increasingly the private sector, who may bid to build or operate the systems. The role of civil society is seen as limited to voting and campaigning; in other words, motivating the responsible actors to offer additional and improved physical infrastructure. However, civil society's involvement may be broader and more important than recognised (Amin, 2014; Tonkiss, 2015).

This paper introduces ways that civil society may create more diverse and needs-sensitive mobility infrastructure and discusses narratives provided by three grassroots organisations that offer infrastructural innovations for differently abled (or disabled) people in London and São Paulo. It argues that citizen-led organisations working on grassroots innovations (GIs) in just and sustainable mobility can provide exemplary precedents of infrastructural assemblages that support more equitable mobility. In other words, in the process of supporting and improving the motility (the potential or capacity to move) of their beneficiaries, these organisations are constantly improving "experimental prototypes" for larger mobility transitions. The demonstrative nature of these precedents is inherently political in its exposure of extant infrastructure insufficiencies and explication of preferable alternatives. They should thus be more substantially supported by governments through better subsidies and regulatory support.

The paper first reviews contemporary literature on grassroots innovations, recent interrogations of the concept of infrastructure and disabled mobility studies, and shows how these bodies of work are ripe for synthesis. Presented next are the methods and an overview of the social and physical infrastructure delivered by several dozen London and São Paulo grassroots initiatives and the needs of the communities they address. This is followed by a more detailed exploration of three initiatives that attend to the mobility needs, and beyond, of disabled people so as to cultivate alternative understandings of forms and origins of infrastructure, and to show how these grassroots efforts provide precedents for the provision of infrastructure that is both sustainable and just. Finally, the wider implications of these GIs for desirable mobility transitions is discussed.

This paper follows Kay Inckle's position on terminology (see Inckle, 2020: p. 417, f.n. 1), whereby both "disabled people" and "people with disabilities" are used for the sake of respectful inclusion across (often geographically differing) individual and institutionally formalised preferences, and the journal's international readership. Although not disabled, the author sympathises with Inckle's "jadedness" regarding terminological posturing, which now seems omnipresent across the social sciences, activism, and politics. This seems to the author reminiscent of Confucianism's preoccupation with the "Rectification of Names" (正名, zhèngmíng), an approach to social harmony not held by the other traditional Chinese philosophies such as Daoism and Buddhism. That said, the author recognises that semantics are

dynamic and words carry emotional baggage; they thus feel strongly about the importance of both minimising perceived disrespect and of changing the public's understanding of things through more "illuminating" use of terms. Therefore, the author hopes that the varied terms employed here are experienced as thought provoking rather than disrespectful, as no disrespect is intended.

Scholarly understanding of GIs in sustainable and just mobility infrastructure is in its infancy. This paper advances both the GI and critical infrastructure literatures by charting new syntheses of theories from the two bodies of work as well as providing concrete examples of the social benefits of civil society's infrastructural creations "on the ground". The latter may also be of interest to policy makers and other public servants seeking ways to reach sustainability and social welfare (for all) objectives.

2.0 Theoretical frameworks

2.1 Grassroots innovations

Grassroots innovations are a relatively new cousin of the Strategic Niche Management (SNM) and Multi-Level Perspective (MLP) analytical frameworks for theorising low-carbon transitions. They are most often defined as, "a network of activists and organisations generating novel, bottom-up solutions for sustainable development and sustainable consumption" (Hossain, 2016; Seyfang and Smith, 2007: p. 585). GIs are different from conventional low-carbon innovations in several distinct ways.

First, they aim to service local social needs (Blake and Garzon, 2012; Hossain, 2016; Reinsberger *et al.*, 2015) and support broad social change (Hess, 2007), rather than generate profit. In this way GIs are strongly value driven (Bradbury and Middlemiss, 2015; Gupta *et al.*, 2003; Haxeltine and Seyfang, 2009; Hielscher, Seyfang and Smith, 2011; Martin, Upham and Budd, 2015; Pansera and Sarkar, 2016; Ross, Mitchell and May, 2012; Seyfang, 2009; Seyfang and Haxeltine, 2012; Seyfang and Smith, 2007; Smith, 2006; Smith *et al.*, 2016), with social, cultural, and ethical values different from mainstream sources of innovation (Monaghan, 2009). These broader social values not only drive the innovations but are themselves said to be extemporaneously and iteratively negotiated through the process of innovation (de Vries, Boon and Peine, 2016; Grabs *et al.*, 2016; Nixon and Schwanen, 2018; Wolfram, 2018). For example, new residents from an ethnically unfamiliar background may prompt the expansion of the geographic and demographic extent of an organisation's domain of concern (Nixon and Schwanen, 2018). The values held by grassroots leaders and beneficiaries may be diverse, even tacitly conflicting, yet still overlap well enough for productive collaborations, such as with co-existing members of free re-use groups who may range from radical anti-capitalists to frugal conservatives (Martin and Upham, 2016; Seyfang and Longhurst, 2013; White and Sterling, 2013; Wolfram, 2018). The process of negotiation towards mutual understandings itself may beneficially challenge and alter normative values (Grabs *et al.*, 2016).

Second, and borne of these values, those involved in GIs often take an inclusive stance in both the process of creating, and subsequent use of, an innovation. They thus often focus on marginalised groups. Some initiatives also include people from these groups among the participants and/or leadership (Amin, 2005; Geels, 2012; Gupta, 2012; Kirwan *et al.*, 2013; Pansera and Sarkar, 2016; Seyfang and Smith, 2007; White and Stirling, 2013).

Third, they involve locally responsive experimentation to produce novel bottom-up solutions to environmental and social problems, and communal efforts that often demand volunteerism, grants, and exchanges (Hossain, 2016; Nixon and Schwanen, 2018; Seyfang and Longhurst, 2016; Seyfang and Smith, 2007). Strong understanding of need is not akin to knowledge of how to proceed, so these initiatives are often "living experiments" that do much

of the trial and error work too onerous or unprofitable for larger organisations. They could thus be seen as "path finders" of socially just and sustainable transport (Aiken, 2015), developing promising praxiologies (Kotarbinski, 1965) for transitions.

Grassroots innovations may sometimes overlay but should not be considered synonymous with mainstream activism. As suggested above, participation in GIs is not exclusively dependent upon pro-social values (Martin and Upham, 2016), though they are often involved, and some innovators intentionally avoid the overt politics of mainstream activism. But as Chen, Lune and Queen (2013) argue, organisations reflect and propagate values, and GI initiators could be said to "lead by example" in enacting their values through concrete projects. Chatterton and Pickerill (2010) describe a "prefigurative politics" as one in which the means actively shape the ends, rather than traditional political consequentialism where the ends justify the means. This may also reveal existing deficiencies in a mainstream system, such as automobility. As Smith *et al.* (2014: p. 122) argue, "by trying to do things very differently, and in coming from or engaging with the excluded, GI movements make very visible the institutional, political and economic injustices of conventional innovation systems" (see also Smith and Seyfang, 2013). In this way grassroot innovations could be said to intentionally or unintentionally exemplify, or provide a "prototype" for, alternative practices and politics that support diversity and inclusion.

There is an arguable paucity of studies of mobilities-related grassroots innovations (Ross, Mitchell and May, 2012). Ross, Mitchell and May (2012) analyse the struggles and successes of sixteen grassroots transport ICT innovators—largely mobile phone application designers—using user innovation and social innovation theories. Schwanen (2015) describes the way the different innovation contexts of Oxford and Brighton uniquely influence the pathways of the cities' respective GIs in low-carbon mobility. Although not framed as grassroots innovations, de Boer and Caprotti (2017) describe the importance of GIs to the cycling transition in The Netherlands, such as the white bicycle free sharing scheme, and the Stop de Kindermoord organisation's reclaiming of automobilized space through such activities as do-it-together bicycle lane paint. Though framed more as grassroots *campaigning*, the activists described by Newman *et al.* (2008) deployed temporary street closures, at first informally, in an attempt to create pedestrian friendly spaces in a Toronto neighbourhood.

2.2 Geography and anthropology of infrastructure

Supportive infrastructure is a requirement for the equitable expansion of active transportation, but what exactly constitutes "infrastructure" is currently under theoretical interrogation. The term itself is derived from the Latin *infra*, which means "below" and the more obvious "structure" (from French); in other words, the structures that support a system. To think of only *physical* infrastructure and its enchanting promises of progress and modernity (Harvey and Knox, 2012) would be to miss other critical supportive systems and affective dimensions of infrastructure (Cupples and Ridley, 2008; Larkin, 2013). Liang *et al.* (2014: p. 1135) found that "…an objectively good environment for bicycling was necessary but not sufficient for [encouraging] bicycling", and as Star (1999), Larkin (2013), Amin (2014), Schwanen and Nixon (2019), and others have claimed, we need to think more broadly about what constitutes infrastructure, particularly its social and psychological dimensions. In other words, there is a need to broaden the narrow focus on the physical and material elements of walking and cycling infrastructure (Lugo, 2013; Temenos *et al.*, 2017).

Lugo (2013: p. 206, emphasis added) contends that, "instead of reducing movement in the street to an individual engagement with physical transport infrastructure, the concept of *human infrastructure* emphasises the role of social interaction in how people move… People

are part of the infrastructure enabling or disabling certain mobilities", such as when high cycling rates reduce collision risk and thereby facilitate greater cycling mode shares (Jacobsen, 2003). Bicycle mass rides like CicLAvia in Los Angeles (Lugo, 2013), or street closures for pedestrians, cyclists, and leisure activities on Avenida Paulista and the Minhocão in São Paulo (Nixon, 2025), are examples of bodies refashioning the meanings and purposes behind existing physical infrastructure through collaborative efforts. Lugo argues that alternative social perspectives and associated practices already co-exist with absent or problematic physical infrastructure, creating new infrastructural realities, such as networks of cyclists sharing their embodied knowledge of best routes, advice that may contradict more hegemonic resources such as generic online maps aimed at drivers (see also Nixon and Schwanen, 2024).

The concept of "social infrastructure" has varied definitions but here it follows the first two of four concepts identified by Latham and Layton (2022: p. 660), namely: "people as infrastructure", and particularly, "the sociality that gathers around conventional hard physical infrastructures... [and] allows otherwise precarious technological networks to function... [via] intricate social workarounds... in underfunded and under-supported urban environments." This paper thus uses "social infrastructure" to mean networks of collective practice that both support social life and "actuate" physical infrastructure otherwise dysfunctional for certain groups of people.

2.3 Infrastructure and the mobility of the disabled

It is essential to ask for what and for whom a walking or cycling infrastructure is provided, who benefits from a particular intervention, and what assumptions about needs and embodiment may be built into the design.

A good example of exclusion through well-intended yet arguably fetishized infrastructure provision is shared-space design. Shared-space is an approach that assumes that mixing pedestrians, cyclists, and drivers in the same space, with only subtle cues to subconsciously encourage polite negotiations of movement, will encourage higher pedestrian usage and more interactions that support social cohesion and community building. However, Imrie (2012) argues that these spaces are predicated upon an assumed occupation by only stereotypically-abled bodies in possession of all sensory faculties, particularly the perfect vision required to negotiate movement with others behind windshields who may themselves not see a pedestrian. In this way, the infrastructure standardisation (Schwanen and Nixon, 2019) shared spaces impose belies the "open" connotations associated with their design. Their construction to some extent represents a post-political, technocratic attempt to solve urban problems through design borne of values functionally uncontestable in their ambiguity and ossification in policy (Imrie, 2013). A result is that the needs of vision-impaired individuals are ignored, and thus they are dis-abled by shared-space design (Imrie, 2013). Yet, a car and wheelchair trip to a shared-space destination may be easier to traverse owing to fewer physical obstacles. The key lessons here are that (a) the diversity of disability is myriad, and involves both physical and psychological dimensions; and (b) capabilities, including motility, are determined at the "interface" between the individual and their socio-physical environments, not strictly in one or the other.

Historically, disabled people have been overlooked in UK cycle planning (Andrews *et al.*, 2018; Hickman, 2016) and almost totally ignored in São Paulo. There exists a widespread assumption that disabled people do not cycle, but rather predominantly use public transit, walk, or drive, even though in many instances cycling may actually be easier than walking or taking transit (Andrews *et al.*, 2018; Inckle, 2020). In the rarer cases where it is thought that they *do* cycle, it may be assumed that specially adapted cycles are always a necessity, which

may not be the case (Andrews *et al.*, 2018; Inckle, 2020). It may also be assumed that adapted cycles are *all* that are necessary, when this may overlook other needs such as suitable cycle parking, route directness, co-pilots, and/or information such as maps (Andrews *et al.*, 2018; Inckle, 2020).

The social model of disability (Oliver, 1983) sees social exclusion as arising from a "failure of society to plan inclusively for a range of individual characteristics" (Andrews *et al.*, 2018: p. 148). Dokumaci (2020: p. S99) provides the example, among many, of the twist-off cap as, "a materialized form of 'ignorance' of corporeal variations and vulnerabilities", but suggests that "people as affordances" may in some cases bridge the gap. Affordances are opportunities for action arising from the relationship between an individual (or other organism) and their environment (Gibson, 1979). In this way, potential action is not a product of a person's characteristics or an environment's properties alone. Dokumaci (2020: p. S99) argues that disability, "can be defined ecologically as a shrinking of the environment and its available affordances... but this shrinkage can also incite invention and improvisation that makes the same environment afford otherwise", whereby, "people may enable, facilitate, or interfere with and disable the emergence of affordances for one another" (Dokumaci, 2020: p. S98) through what Bloomfield, Latham and Vurdubakis describe as "collective accomplishments" (2010: p. 419). People as affordances thus arise, "through the complementarity of multiple perceivers and the world", in what Dokumaci calls "care intimacy" (2020: pp. S102, S103) whereby one person intimately understands another's access needs. Where these people as affordances come together in supportive constellations, they may be considered social infrastructure.

2.4 Putting grassroots innovations, affordances, and infrastructure together

The literature discussing grassroots innovation and the critical scholarship on infrastructure have not, as of yet, explicitly collided. Grassroots innovations *in infrastructure* may be seen as "autoconstructions" (Amin, 2014: p. 155), "pioneering citizenship" (Holston, 2008: p. 8), or "people as infrastructure" (Simone, 2004: p. 407), characterisations that strongly resonate with Dokumaci's (2020) people-as-affordances. Tonkiss (2015: p. 389) suggests that "human bodies are the basic carrying element of these auto-infrastructures... [that] fill in for, compete with, or extend incomplete, exclusionary or inadequate networks of hard infrastructure which are often more vulnerable to technical failure, environmental risk, elite colonisation or economic collapse". Some similarly argue that in economically challenged regions, "access to services is not determined via connections to formal networked infrastructures... [but] is the emergent outcome of myriad socio-technical assemblages created by households and communities" (Goodfellow, 2016: p. 27). By combining the frameworks provided by the GI and affordances literatures, and the more critical and political interrogations of infrastructure, we can better articulate how civil society may potently contribute towards more equitable and sustainable mobility futures.

3.0 Methods: From Haringey to Heliópolis

The aim of the larger DePICT[1] project was to examine grassroots innovations aimed at improving infrastructures for walking and cycling, in London and São Paulo, and critically evaluate if and how these innovations can contribute to just transitions in urban mobility. Qualitative fieldwork was undertaken between 2016 and 2017. Both cities have comparably large and growing populations, carry significant economic gravity in their regions, and possess deep inequalities. The mayoral governments in both cities have proposed and provided cycle

[1] DEsigning and Policy Implementation for Encouraging Cycling and Walking Trips (DePICT).

infrastructure such as separated cycle tracks and bike sharing schemes; however, evidence is mounting that these infrastructures are failing to support walking and cycling among all demographics of the population.

The 49 organisations[2] selected for interviews were identified differently in London and São Paulo because of differences in data availability. The DePICT project was particularly interested in initiatives supporting marginalised communities. The spatial sampling frames in London consisted of four neighbourhood clusters that were in the lowest 2015 Index of Multiple Deprivation (IMD) decile, within four boroughs that were among those with the highest walking and cycling levels in that city. All possible cases of grassroots walking and/or cycling activities were identified in these neighbourhoods through web searches, local key informants, and multiple site visits. A further five cases involved in similar missions in other parts of London were identified through snowball sampling and were included in the study. Altogether 49 organisation leaders, staff, beneficiaries, and intermediaries (such as local politicians) were interviewed, some in the same interview.

Geo-spatial data of similar currency and resolution were not available for São Paulo, so here a list of walking and cycling initiatives concerned with disadvantage was compiled using internet searches, local key informants, and Como Anda's (2017) national survey. A sum of 38 organisation leaders, staff, beneficiaries, and intermediaries were interviewed in São Paulo, some in the same interview. Just over half of these interviews were conducted in Portuguese, and the remainder in English when the participants were comfortable doing so.

The 70 semi-structured interviews in both cities took between thirty minutes and three hours, most often taking place within cafés, leaders' homes, public or voluntary-sector meeting rooms, and locations of activities with beneficiaries. Questions revolved around GI leader background, involvement, and visions; initiative contributions, barriers, and enablers; and the impact on beneficiaries. Data were recorded through field-notes and audio recordings that were later transcribed and translated where necessary. These texts were then organised and interpretively coded in NVIVO. Selected discourse was further interpretively analysed in printed form. The participant names used in what follows are pseudonyms, and translations have been provided where necessary.

4.0 Discoveries

This section has five major subsections. Section 4.1 provides an overview of all the organisations studied in the larger research project. Section 4.2 turns to three organisations supporting people with disabilities and describes barriers (such as poor physical and social infrastructure, insufficient mobility technologies, intersectional disadvantage, or common beliefs), conditions (such as social isolation, sedentarism, or sensory deprivation), and the needs of both disabled people and their carers. Section 4.3 turns to the assemblage of physical and social infrastructure provided by the three organisations. Section 4.4 describes their immediate local impacts, including the number of people cycling both at group rides and independently, and sensorial, psychological, and social benefits (including inclusivity, independence, and personal security). Finally, section 4.5 discusses the wider role of the disability initiatives in mobility transitions, particularly the fruits of experimentation and the political force behind social infrastructures that demonstrate alternatives.

[2] In São Paulo, these organisations consisted of 18 grassroots innovation organisations, 3 of which had grown to cover areas exceeding the city of São Paulo, 1 governmental organisation and 1 large international NGO. In London these organisations consisted of 24 grassroots innovation organisations, 3 governmental organisations, 1 company and 1 funding agency.

4.1 A mosaic of grassroots infrastructure serving mobility and social needs

Almost all of the organisations studied catered to particular social groups with a mobility need, or more than one need, that remained unattended by the existing transport system (please see **Figure 1** for a typology of the organisations studied). These groups included: disabled people; women and the gender variant; refugees and asylum seekers; ethnic, cultural, and/or religious minorities; those in deprived neighbourhoods, particularly those with lower levels of income or education; and disadvantaged age groups such as the young or old. A couple of groups served all those interested in walking and cycling in greater London and city of São Paulo, with no particular target. However, most of these groups found that the needs they

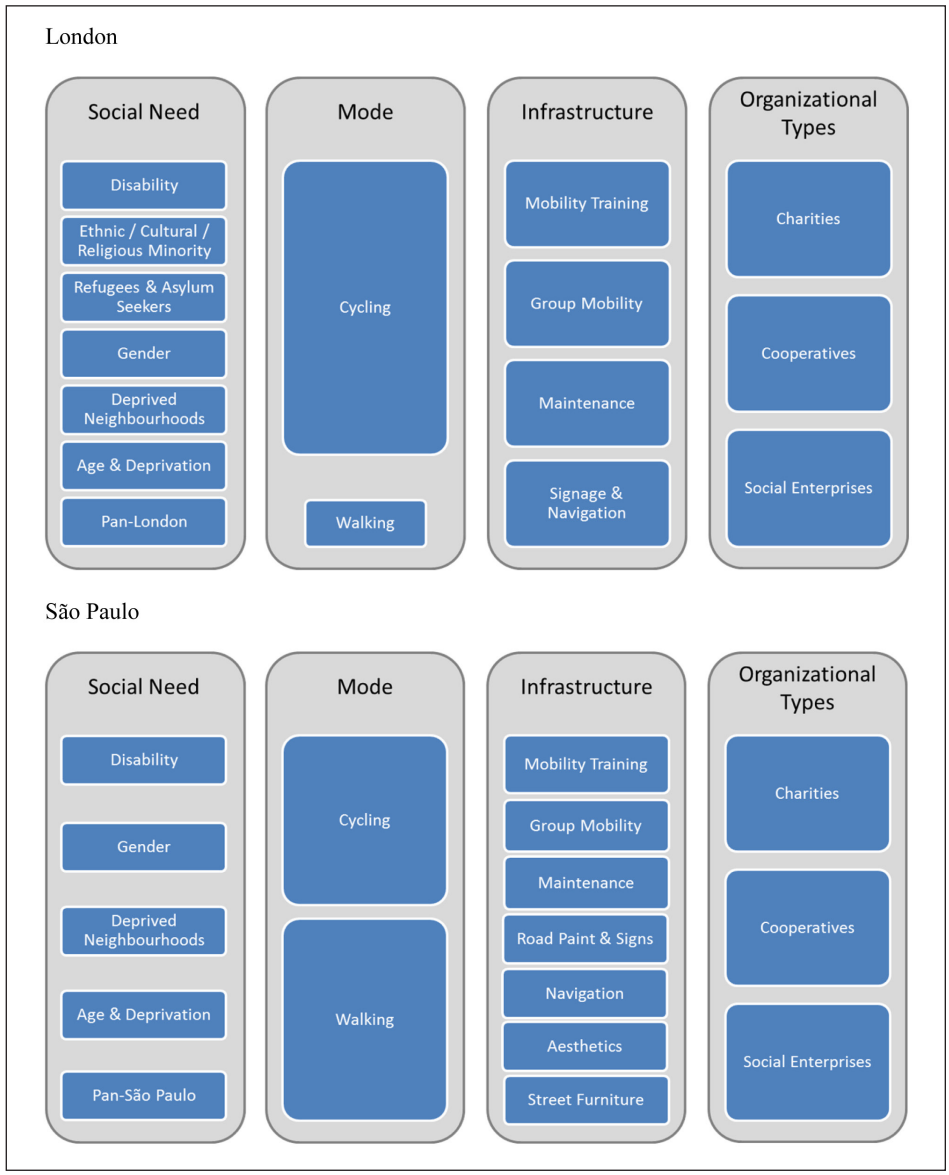

Figure 1: Grassroots infrastructure typologies for London and São Paulo.

served went beyond the mobility itself, and included other related necessities, such as socially supportive environments that enhance wellbeing (Schwanen and Nixon, 2020).

All of the organisations provided supportive infrastructure for walking and/or cycling in the form of: mobility training, such as learning to cycle; group mobility, such as gathering groups of potential GI beneficiaries to partake in walking or cycling collectively; cycle repair training, such as basic maintenance classes or full mechanic's training; and signage and navigation, such as posting home-made signs, painting (guerilla) crosswalks/zebra-crossings, or designing and attempting to disseminate creative route maps. However, again, the support provided sometimes exceeded this, including such things as gifting helmet and lock kits for refugees, or tea and biscuits for the disabled and women and gender-variant groups. The organisers claimed that these "extras" rendered their activities more attractive to beneficiaries and filled in gaps in their motility and social lives.

Most of the organisations identified were small, with fewer than five full-time volunteers or employees, and although GIs *may* be performed by private business or social enterprise (Seyfang and Smith, 2007), most of the research participants were involved in charitable or cooperative organisations, some with social enterprise branches or goals to have revenue-generating branches. For some publications on other topics from this project, please see: Nixon (2025), Nixon and Schwanen (2018), Nixon and Schwanen (2019), Nixon and Schwanen (2024), Schwanen and Nixon (2019), and Schwanen and Nixon (2020).

4.2 A mosaic of needs within a need: Infrastructure for disabled cycling

4.2.1 Unique bodies and barriers to mobility

Three organisations and their respective leaders interviewed, 'Elizabeth' and 'Emily' in London, and 'Lucas' in São Paulo, provide cycle training and group mobility opportunities to those with a range of physical and mental capabilities that differ from the assumed norm in type and degree. These beneficiaries sometimes need to move more slowly, may require accompaniment, or need safer, more secure environments to enable their movement without undue stress. In both cities stated barriers to mobility include: personal security concerns; challenging sidewalk/pavement surfaces and spaces; deteriorating assistive technologies such as older wheelchairs; cycles ill-suited for bodies with different capabilities, such as those who use their arms, rather than legs, for propulsion; automobilized environments too dangerous or stressful to traverse; and taxi drivers that one participant claimed were too often unwilling to pick up passengers with disabilities. Disabled mobility is also discouraged by limited disability incomes that do not cover the costs of renting or purchasing special equipment. Reflecting Imrie's (2012) contention that visual impairment cannot be reduced to a homogenous 'type', each beneficiary presents a unique embodied habitus (Bourdieu, 1977) with their own particular mosaic of intersectional needs.

4.2.2 Social isolation, inadequate exercise, and sensory deprivation

Concomitant with limited mobility is a certain degree of social isolation, inadequate levels of activity and exercise, and inadequate sensory stimulation. Emily, the leader of one of the London organisations said, "you know a lot of these kids, they don't know how to have a conversation". Carers and members at one of the London events also claimed that the social isolation could be suffocating, and that this, combined with otherwise very sedentary lifestyles, and low stimulation, made life more difficult for both those disabled and their support staff. Emily suggested that the needs of the support staff could not be separated from the needs of those they cared for, as the two lives were woven together, perhaps akin to Dokumaci's "care intimacy" or Imrie's (2012) description of guide dogs as "conduits" for the body's movement. Lucas, the disability cycling GI leader from São Paulo, spoke at length about the critical

importance of getting differently-abled people to leave their homes, action greatly hampered by insufficient infrastructure.

4.2.3 Absence of supportive infrastructure

Elizabeth, the other London initiative leader argued that the unique benefits of cycling for disabled individuals rendered supportive infrastructure for cycling an unchallengeable *need*, rather than a wanted "luxury" as so often framed in mass-media critiques of the mainstream cycling lobby. Yet some have suggested that the cycling infrastructure for those with disabilities is grossly inadequate (Andrews *et al.*, 2018), as in modern bike share systems that offer cycles designed for only one type of body (Nixon and Schwanen, 2019). The leaders of all three organisations spoke of the total absence of supportive social and physical infrastructure for disabled cycling prior to the formation of their initiatives, such as Emily:

> 'Why don't I try to get her into a cycling club?' Absolutely nothing. At the time, it was all mostly men in Lycra whizzing around, and good for them, you know, great. But it doesn't accommodate people who need to go much more slowly and who haven't got stamina for long distances, all that sort of thing.

This echoes confirmations that London's cyclists are predominantly male and white (e.g. Aldred and Dales, 2016) and may be explained in part by the common misconception that those that are disabled simply cannot cycle. As Elizabeth articulated: "one of the huge barriers to disabled people cycling is that they can't, they don't realise, they can't even imagine themselves cycling. Don't realise it's possible". The ability to comprehend one's capability to move in a particular way has been called "cognitive appropriation" and is one of three interdependent constituents of motility (Kaufmann, Bergman and Joye, 2004; Schwanen and Nixon, 2020). As one reviewer pointed out, the deleterious effects of a lack of belief in one's capacity to swim, cycle, or move in other ways, may also apply to able-bodied people.

Lucas in São Paulo spoke of the absence of information on the navigability of routes and destinations for differently abled bodies:

> It's interesting that the greatest deficiency today is a lack of information, people don't have the information, we need to provide accessibility information.
>
> *E é interessante que assim, a maior carência hoje é a informação, as pessoas hoje não têm informação, precisa prover informação de acessibilidade.*

Some of the earliest interrogations of the concept of infrastructure were concerned with information and data (e.g. Star, 1999).

4.3 Physical and social infrastructure: Side-by-sides and breakfast

The most obvious physical infrastructure that the London organisations provide are fleets of specialised cycles to be ridden during group cycling sessions. Many of the beneficiaries require cycle technologies that are different from the common standard two-wheeled "safety bicycle", such as three or four-wheeled bikes, hand-pedaled drives, or special seats. For those that may still need accompaniment, in-line or "side-by-side" tandems, and cargo trikes with platforms for wheelchairs provide a means to cycle (see Andrews *et al.*, 2018, Norcliffe *et al.*, 2022; Clayton, Parkin and Billington, 2017 for some typologies of these). These cycles may be very expensive—as much as £7500 to purchase (more for electric assist) or £15–£20 per

hour to rent—and thus otherwise unaffordable for many disabled people (Clayton, Parkin and Billington, 2017). Emily thus charged £5 for a session when the beneficiary's sponsoring organisation—such as a school or religious institution—can afford it. They are also somewhat cumbersome to store; one organisation filled thirteen shipping containers at their three locations with their cycles.

The London organisations provided most of their cycling opportunities at sports stadiums and similar locations where the riding could be performed in an off-road, traffic free environment. These environments provide safe environments for the participants, and as suggested by one reviewer, also provide a respite for the oft-stressed caregivers.

In addition to finding donations of improved wheelchairs and special cycles for those with inadequate "wheels", Lucas has established a growing spatial database of São Paulo route and destination accessibility information and two public facing "apps" to access this information. Destinations include not only stationary entities such as restaurants and museums, but also events such as plays and musical performances. Although the devices, and electrons that constitute the database and apps could be described as physical, the accessibility information inputted is gathered through social outings by a team of differently abled volunteers Lucas calls "accessibility ambassadors [*embaixadores da acessibilidade*]".

Therefore, it could be said that these different physical infrastructures are *actuated* by social infrastructure such as: the space-time coordination of the spaces, such as sports tracks for the beneficiary sessions or the ambassador outings and new wheelchair drop-offs; the paid human mechanical intervention to adjust the cycles for different bodies and occasionally do repairs or outsource welding; riding skill training by staff; treasury accounting, admission and refreshment table volunteering; the management of volunteers and staff; and all of the "extras" that enrich the benefits for those who partake. Emily describes some of the extras her organisation provides:

> So what we did, we started like a breakfast club [for] kids who wanted to could come along. We'd have cycling games, then we'd have a really good breakfast… I always had flowers on the table and proper crockery 'cause I thought let's make it, it'll feel a bit special with really little things. And then I used to take an interesting piece of fruit along. We would all sit around guessing what it was called and whether we liked it or not.

These social "extras" may actually be necessary incentives to become mobile, as Lucas argues when describing the group mobility activities his organisation leads:

> The first step is to actually make someone leave their home. If someone doesn't leave their home for anything, it's not by going to work that I'm going to persuade them to leave home. That's why I use the provocation of culture, of mass events, to give them a bit more confidence. Leaving for pleasure is much easier than leaving for obligation, understand?
>
> *É primeiro tirar o cara de casa, porque se o cara não sai de casa de jeito nenhum, não vai ser trabalhando que eu vou convencer ele a sair de casa, então sai pra trabalhar. Então é por isso que eu uso a provocação da cultura, dos eventos de massa, que é para dar um pouco mais de segurança. Sair pelo prazer é muito mais fácil do que sair pela obrigação, entendeu*

The challenge of getting some disabled people to leave their homes may be exacerbated by lower employment rates and larger portions of those over 60 among those with disabilities (Andrews *et al.*, 2018).

Elizabeth alluded to the socially and physically aggregate nature of the diverse infrastructure they provide:

> You know if people don't have access, to the right technical kit, if they don't have access to support and training, if they don't have access to venues where they feel safe trying, then they are never going to try. So all of that is what [the organisation] was set up to do, to provide all of those key things... [so] that people could come and try it, practice it, enjoy it, for, at the end of the day, improving people's wellbeing, as cycling does [237]

Without these tailored cycle "products", and the "service" (Sagaris, 2015: p. 70) offered by these grassroots organisations, many would go on to assume that those with disabilities simply cannot cycle.

4.4 Multiple impacts

The organisations' leaders, beneficiaries and websites reported on a host of positive impacts their infrastructure had brought about.

4.4.1 Quantities and development of motility

One of the London organisations now has 2,000 members, and the other one 1,300 people per year who cycle 8,000 times per annum. Lucas said that his apps have had 2,000 users; he is aiming for one-hundred thousand users but has throttled the expansion while he gathers more information for the database. Elizabeth and Emily estimate that around five and fifteen percent, respectively, of their disabled cyclists per year go on from the sessions to ride on-road for their daily mobility needs. However, both London leaders suggested that large numbers of the parents and support workers—around thirty percent per year for one of the initiatives—have taken up cycling on the road, which may include the carers riding tandems with the beneficiaries:

> We taught [the carer] and she's gone on to qualify as a cycle trainer and she now works at [our organisation]. [The participant] uses her bike as her main form of transport and takes her son who has additional needs on road [Emily]

A carer who attended the other initiative's session suggested that, "some have been able to cycle on the road... [and that] the rides do support eventual utility cycling". Lucas has a more direct goal of mobility independence for his beneficiaries, but starts with small accompanied outings.

This transition of disabled cyclists from (arguably) non-utilitarian cycling to utilitarian trips complicates the leisure/utility binary that both governments and researchers sometimes perpetuate. In other words, track or group rides are likely to be classified as "leisure" activities, but the way in which these may prepare disabled cyclists for more "practical" solo trips renders this classification, and the larger distinction, questionable. Therefore, the tendency for government funds to favour infrastructure supporting common conceptions of utilitarian trips (e.g. cycle superhighways for trips to work or school) may ignore the ultimate utility of other forms of cycling infrastructure.

4.4.2 Sensorial and psychological

One carer declared that the sessions provide an opportunity for their strongly autistic individuals to receive unique sensory experiences that are critical to their well-being. All carers mentioned the benefits of exercise for those they cared for, particularly when these people were hyperactive or emotionally unwell. For some beneficiaries such as those with cerebral palsy, and one attendee with vertigo and bad knees, cycling is the *only* way for them to achieve vigorous movement, echoing similar realities among Inckle's (2020) research participants. Emily claimed:

> For our members, their concentration has improved because their balance is improved, socialising is improved, their conversation, everything is good because they're having fun. Any sort of exercise makes you feel happier.

These discoveries agree with those of Clayton, Parkin and Billington's (2017) research on a similar organisation's activities in Bristol.

4.4.3 Independence, sociality, and inclusion

The London cycle training sessions were also seen as a safe space to be both independent (e.g. pedalling around the track themselves), in a life otherwise heavily dependent upon direct support, as well as social, since all attending were understanding of others' differences. One carer felt that the beneficiaries felt more included, despite the activity still being non-verbal for some. This echoed feedback Emily received from a carer:

> And I had one, a sister of a profoundly disabled person who couldn't be moved out, actually she did use a wheelchair, but she had profound and complex needs, non-verbal, and her sister was riding around on the Duet bike, and she said, 'You know that's the first thing we've ever done together?' And they're adults, both adults.

Lucas made similar comments about the social participation his organisation's group outings facilitate: "we've even had weddings, we've had a forty-year-old who had never set foot in a theatre in their whole life. [*E já saiu casamento, já saiu uma pessoa com 40 anos que nunca tinha pisado em um teatro na vida].*"

4.4.4 Beneficiaries beyond the disabled

Emily felt that the social benefits extended to parents of disabled children, who were able to share tips and recommendations:

> So [our organisation] is like a school gate for parents of children with disabilities, and I've had lots and lots of times parents have said to me, 'oh so-and-so's parents just told me about this or just told me about that.' So that networking and school gate effect happens at the cycling club. That's hugely beneficial to our community.

Walking and cycling are themselves argued to be important modes for facilitating access to social interactions (Matous, Todo and Mojo, 2013; Nixon, 2014), and "social infrastructures constitute a kind of latent capacity—for interaction, for exchange, for social reproduction" (Tonkiss, 2015: p. 385), and arguably for improving people as affordances (Dokumaci, 2020).

4.4.5 Personal security and empowerment

Elizabeth saw personal security benefits for disabled people who chose to cycle for their mobility:

> …as a disabled person walking along the pavement, wheeling along the pavement, you are far more vulnerable than you are when you are on the streets cycling. You are much more empowered, you are much less looking like a victim…

Lucas noted how the ability to use cycle lanes [*ciclofaixas*] allowed differently abled folks to avoid the problem of São Paulo sidewalks/pavements:

> We do some trips on the cycle lanes, which is something I like. I think that what motivates people regarding the cycle lanes is that they're an option for accessibility because of the deficiencies of the pavements.
>
> *Então a gente faz alguns passeios também por ciclofaixa, que isso é uma coisa que eu gosto. Eu acho que o que motiva da ciclofaixa foi uma opção de acessibilidade para as deficiências das calçadas.*

Lucas's infrastructure—wheelchair/cycle upgrades, accessibility-related wayfinding apps and group outings—render the otherwise standardized infrastructure of the cycle lanes and separate tracks usable by a wider group of people.

4.5 Role in wider transitions: High-risk experiments, precedential infrastructure, and their demonstrative politics

Besides positive *direct* impacts, these grassroots innovations contribute to larger transitions by setting infrastructural precedents which may be drawn upon for other interventions. They generate this new infrastructure through a process of experimentation. It is common for GI leaders to have to carry the burden of risk (e.g. financial) of experimentation in the early stages of GI growth (Ross, Mitchell and May, 2012). High risk experimentation is ongoing in the GIs explored here, as expensive cycles and shipping containers, pricey app development, or labour-intensive database building must be attained and deployed to assess their real usefulness to their beneficiaries:

> But usually organisations… well, you have to listen to your users, don't you? I mean, I know how this works because of what people say to me and how many people turn up for it [Emily]
>
> It takes quite a lot of careful and time-consuming work to actually get the right answers, get the right approach, develop the right approach [Elizabeth]

Aiken argues that, "it is this experimenting with existing technology, in tweaked social settings, that alters the relationship between the infrastructure, practices, and habits" (2015: p. 768). Experimentation leads to learning and demonstration effects that increase the momentum of alternative approaches to mobility (Temenos *et al.*, 2017). In this way the GIs "lead by example", generating procedural and technical knowledge along the way, and thus differ in political praxeology somewhat from mainstream activism.

One of the leaders avoids formal politics for fear that this may distract her from her infrastructure provision:

> So there were a lot of areas I could pursue, but that would get me into the politics of everything. I haven't really got time for that 'cause we've got to get on and do it [Emily]

As Chatterton and Pickerill argue, "resistance is perhaps better seen as hard-wired into the productive daily acts of project building rather than as a part of direct action and confrontation" (2010: p. 482).

However, Chatterton and Pickerill (2010) also claim that political identities emerge through mundane practice rather than pre-exist, and many of the grassroots leaders interviewed in the larger project spoke of how their early experimentation solving walking or cycling barriers grew into larger political interests and engagement. In this way "infrastructural subjects" (Tonkiss, 2015: p. 384) become politicised "infrastructural actors". Elizabeth and Lucas have led their teams into far more explicit political engagement:

> We are starting to take much more of a political view. This is about a right to being physically active in your mode of transport, and it's about a right to accessing your community, and it's, you know, it isn't about the individual's problem; it's about the environment being accessible to all [Elizabeth]

> I think we've managed to do a lot of things in the city council. But sometimes you come up against political issues, don't you?
>
> *Eu acho que a gente consegui bastante coisa em prefeitura. Mas você sabe que sempre esbarra em questões políticas, né?* [Lucas]

Lucas also explicated the politics inherent in the way his app revealed deficiencies in the government's provision of accessible infrastructure.

The embodied experience of the aforementioned infrastructure also contributes to their political potency. All three leaders felt that the immersive experience of mobility was essential in convincing both disabled folks, and the public at large, that cycling is a realistic option for many of those otherwise considered immobile or only "automobilizable". Elizabeth states that:

> You talk about it, you explain it, you show pictures, you might even show moving pictures. People sort of go, (uncertainly) 'Ah, yeah... yeah, yeah.' And then you say, 'Do come down, try.' And then they try, and they go, 'Oh my God! You know you were saying it, but I didn't really realise.' And it's a completely different experience then, a really different understanding... there aren't many opportunities for people to get to try.

More broadly, these group mobility sessions could be said to set a precedent for the capacity of people with disabilities to cycle, given the right infrastructure. Politically, this turns the attention towards the omission of these types of initiatives in other locations, and concomitant exclusionary standardisation of walking and cycling infrastructure at large.

These organisations have thus formed two political orientations—one that quietly enacts the future they wish to see, in the form of special cycle provision and training, and the other that engages the existing transport regime directly through campaigning. But they maintain that their work is still very much about concrete, mundane mobility. Whereas Chatterton and Pickerill (2010) call this "prefigurative politics" it is suggested here that it may also be framed as the demonstrative politics of precedential infrastructure.

5.0 Discussion and recommendations

This paper contributes to academic discourses in two key ways: first, it vivifies the concept of affordances within the growing literature on disability and active travel and demonstrates that many disabled people can cycle when provided with appropriate infrastructure; and second, it brings together grassroots innovation theory with critical perspectives on infrastructure, showing empirically how assemblages of both physical and social infrastructure innovations from grassroots organisations not only meet unmet mobility needs of disadvantaged groups, but also provide a politically charged example of more just and sustainable mobility infrastructure.

More specifically, the paper has provided some examples of the ways that creative initiatives led by members of civil society, interpretable as "grassroots innovations", provide complex cycling infrastructure to groups with needs ignored by standardised transport infrastructure that otherwise leaves them immobile or unable to fully realise the multiple benefits of active transport. The infrastructure delivered by the disability initiatives provides safer spaces for exercise and socialisation that improves the well-being of the beneficiaries and facilitates the development of cycling skills and route knowledge. This also allows some to become more mobile outside of the training sessions. Through their innovation and experimentation, the initiative leaders provide a living example of social and physical infrastructural assemblages, and concomitant affordances, founded upon values that emphasise caring for vulnerable groups. This leads to the conclusion that civil society has an important role to play in achieving sustainable and *just* mobility transitions.

The recognised value of grassroots infrastructure innovations must be elevated, particularly in contemporary contexts of government budget cuts and devolved responsibilities that reduce the capabilities of local and regional governments to provide universal infrastructure. For instance, in the United Kingdom, Coalition rhetoric on Big Society localism and community do-it-yourself service provision masked deep cuts to local governance and welfare (Carter and Clements, 2015; Dowling and Harvie, 2014; Gillard, 2016; MacMillan, 2013; Runswick-Cole and Goodley, 2015; Taylor-Gooby and Stoker, 2011; Williams, Goodwin and Cloke, 2014). This austerity urbanism left London and its formal transport governance body, Transport for London, with debilitating, ongoing budget cuts.

According to Sagaris (2015: p. 69), "the fact that citizen groups are so ubiquitous everywhere cycling has made steady progress, and weak or absent where it has not, suggests that rather than just being another factor in success, how citizen engagement is organised and above all, how well societal arrangements nourish (or starve) their organisations may be crucial to progress beyond the span of single governments".

That said, the apparent tendency of jurisdictions with more ambitious cycling strategies to make use of disability cycling clubs (Andrews *et al.*, 2018) may be a mixed blessing. On the one hand, the intimate knowledge, multifaceted interventions and adaptability of these GIs clearly benefit local disabled cycling, provide demonstrative infrastructure, and some of those running the organisations themselves may benefit from the salaries provided by institutional funding. On the other hand, said funding is often austere and "projectified", leaving these organisations in a long-term state of precarity and insufficiency heavily reliant upon volunteers. The "offloading" of infrastructural *responsibility* to charities may constitute a particularly pernicious form of neoliberal devolution. In other words, recognition of grassroots efforts to achieve just and sustainable transport should not be paired with unreasonably constrained funding for GI organisations, nor should it offload onto them larger shares of responsibility for infrastructure.

Data Accessibility Statement

Anonymised qualitative data from the DePICT project can be accessed, after registration with the UK Data Service, at: http://doi.org/10.5255/UKDA-SN-853677.

Ethics and Consent

This research, which involved human participants, was approved by the University of Oxford's Central University Research Ethics Committee (CUREC), approval number SOGE 1A-189.

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Competing Interests

The author has no competing interests to declare.

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