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Re-thinking urban infrastructures as spaces of learning

Leonie Tuitjer[1] | Anna-Lisa Müller[2]

[1]Institute of Economic and Social Geography, Leibniz University Hanover, Hannover, Germany

[2]Institute for Migration Studies and Intercultural Research (IMIS), Osnabrück University, Osnabrück, Germany

Correspondence
Leonie Tuitjer, Hanover Institute of Economic and Social Geography, Leibniz University, Schneiderberg 50, Hannover 30167, Germany.
Email: tuitjer@kusogeo.uni-hannover.de

Abstract

Research on urban infrastructure has advanced to the forefront of human geography inquiry in the last two decades. Among other topics, geographers have looked into the privatization and neo-liberal splintering of urban infrastructures; the failings of infrastructures and the power relations revealed within these failings; the political ecology of infrastructural provisions; the specific infrastructural challenges of cities within the so-called Global South; and the entanglements of everyday experiences, affects and emotions with infrastructures. Yet, little attention has been drawn to the ways in which infrastructures need to be learned to fulfil their role of smoothly providing people with diverse services. Given the increasing spatial mobility of populations (e.g., as refugees, migrants, expatriates, and tourists), as well as the accelerating pace of infrastructural change (e.g., in the name of Smart City developments) however, it has become more salient than ever to open-up urban infrastructural research more explicitly towards critical inquiries of learning. Thus, this paper proposes to re-think urban infrastructures not only as socio-material configurations, but more specifically as important spaces for learning.

KEYWORDS
learning, refugees, smart city, urban infrastructure

Many things about infrastructure are singularly unexciting

(Star, 1999, p. 377).

The infrastructure age is upon us

(Steele & Legacy, 2017, p. 1).

1 | INTRODUCTION

Within the last 20 years social scientists, and many geographers among them, have performed a sharp U-Turn in their appreciation of researching (urban) infrastructures, as the two above quotes exemplary demonstrate. While infrastructures were deemed boring, or "singularly unexciting" when ethnographer Susan Leigh Star published her article in 1999, today, about 20 years later, infrastructural research is one of the most vibrant strands within the wider social sciences, evident through important contributions in anthropology by Larkin (2013) or *The Promise of Infrastructures* by Anand et al. (2018) and geographic examinations. Furthermore, the concept of infrastructures has been stretched to include a variety of meanings. From a focus on socio-technical networks to provide services such as energy, transport or water (e.g., in Graham & Marvin, 2001) infrastructures have increasingly been appreciated as a socio-material apparatus (Braun, 2014) or assemblage (Bennett, 2005) that include more-than-human forces, as well as affective and emotional relations.

In this study, we share the former perspective on infrastructures and focus on reviewing geographic research on infrastructures, to highlight how processes of learning about these socio-technical networks have been a blind spot in geographic infrastructural research. We find this blind spot particularly noteworthy, as Star's (1999) afore cited programmatic article explicitly mentioned that infrastructures are indeed: "*Learned as part of membership.* [...] Strangers and outsiders encounter infrastructure as a target object to be learned about" (Starr 1999, p. 381, emphasis in the original). As cities increasingly accommodate new, diverse, temporal, and cosmopolitan populations like tourists, expatriates, refugees, asylum seekers, international students, (internal and international) migrants specific learning needs when navigating urban infrastructures in new contexts arise. Moreover, changing infra-structural provisions (e.g., new regulations for sorting and collecting recyclables, new urban transport schemes, and smart city innovations) may present more longstanding urban residents with new learning challenges. Learning to navigate new or changing infrastructural provisions may prove as difficult as navigating infrastructures in new places. Thus, an attention towards infrastructures as spaces of learning seems legitimate and overdue.

In this article, we first briefly summarise the most prolific contributions to the field of infrastructural research (Amin & Thrift, 2017; Graham, 2010; Graham & Marvin, 2001; Graham & McFarlane, 2015; Kaika & Swynge-douw, 2000) before drawing on theories of learning (Freire, 1970; Ingold, 2000; McFarlane, 2011 a, b) that are deemed important for re-thinking urban infrastructures as spaces for learning. The final section gives two examples (urban refugee studies and smart city research) where such an approach to infrastructures seems to be fruitful for further research.

2 | INFRASTRUCTURAL RESEARCH: FROM A FOCUS OF NATIONAL POLITICS TO LOCAL KNOWLEDGE

Among the first spatial research on infrastructures were contributions from the field of political ecology (Gandy, 2002, 2014; Kaika, 2006; Kaika & Swyngedouw, 2000; Swyngedouw, 2004) and political economy (Graham & Marvin, 2001). Infrastructures are at the very heart of political ecology research that investigates both the power relations that determine access to infrastructures as well as their representative functioning as symbols of progress, modernity and state power (e.g., Kaika, 2006). Through the concept of socio-metabolism, infrastructures are

highlighted as the socio-material artefacts through which nature is transformed into resources and commodities (Heynen et al., 2005). Graham and Marvin's *Splintering Urbanism* (2001) exemplary uses a political economy lens to diagnose a "splintering" of urban infrastructure provisions, which names the shift of financial and political authority over infrastructures away from the state to other, often private, actors (Warf, 2003). Splintering urbanism reveals the shift inherent to neoliberal state politics that has replaced the political ideal of social cohesion with market-oriented values (Wakefield, 2018). From a critical security perspective, Graham's (2010) edited volume *Disrupted cities. When infrastructure fails* shows how infrastructures are often invisible, or taken for granted by many citizens, until their breakdown. "Critical infrastructures" have since increasingly been noticed as vital for the functioning of (present and future) societies (Wakefield, 2018). In the current age of the Anthropocene, research has started to investigate concepts of resilience and adaptability within urban infrastructures (Amin & Thrift, 2017; Braun, 2014; Broto & Bulkeley, 2013, 2015). Urban infrastructures are thus not only embedded within the political economy of the nation state but also within strategic national, security-oriented interests and are thus deeply political (McFarlane & Rutherford, 2008).

Postcolonial scholars however have pointed out that the relationship between infrastructures and the state in the cities of the global south have long been splintered before neoliberalism could take hold in Western countries (Kooy & Bakker, 2008; McFarlane, 2008). Within many states, urban infrastructures were designed as fragmented along racial lines from the very beginning (Gandy, 2014), revealing present-day inequalities and future fault lines (Ranganathan, 2015; Whitington, 2016) that equally occur in cities of the global north such like in the United Status (Steinberg & Shields, 2008). Within the context of global inequalities and colonialism, scholars have started to point towards a relationship between (un)learning and infrastructures: First, infrastructures were a means to learn about and dominate new territories (Chattopadhyay, 2012). Second, educating local populations about how to use particular infrastructures was an important part of their colonial quest (Gandy, 2014; Kooy & Bakker, 2008). Third, critical research needs to question normative assumptions about how infrastructures work by investigating heterogeneous configurations of real existing infrastructures in diverse cities (Lawhon et al., 2018). Within these literatures, infrastructures have been foregrounded as sites of political struggle and domination in which processes of learning and struggles between "local" and "Western" knowledge are highly politicized.

A further aspect of infrastructural research in cities of the so-called global south is an attention towards everyday interactions between people and infrastructures within the city. For example, Simone (2004a, 2004b, 2010, 2014) has pointed out that using and maintaining infrastructural networks are dependent on a variety of local practices and knowledges. Indeed, it is through a relational attention to infrastructures that Simone understands the ways in which people inhabit the city. He is pointing out that infrastructures are not so much things or networks for him, but sets of social relations and modes of (in)action (Simone, 2015). By attending to the everyday uses of infrastructures important insights are won as habitual use of infrastructure is "both a key domain through which practices are regulated and normalized, as well as an arena for negotiation, resistance and points of difference" (Graham & McFarlane,2015, p. 2). Sultana (2011) and Truelove (2011), furthermore, have examined the emotional labor, intimate knowledge and local relations of (gendered) power, necessary to obtain clean drinking water in India.

In the context of our argument, such research is interesting as it reveals that using infrastructures is deeply embedded in and part of daily routines, habitual practices and everyday struggles. Furthermore, perceiving infrastructures as sites of learning can take on historical and highly political dimensions, especially within postcolonial contexts. Yet, within these contributions, we find surprisingly little attention to the processes of learning involved when currently encountering new or changing infrastructures, or what processes or learning techniques are necessary when being confronted with infrastructures in new places. Rather, the local knowledge described seems to be simply acquired through opaque processes of socialization and immersion in everyday life. This prompts us to say that Star's claim that infrastructures are indeed "*learned as part of membership*" (Star, 1999, p. 381) has resonated less within scholarship on infrastructures[1].

3 | RE-THINKING URBAN INFRASTRUCTURES AS SITES OF LEARNING

Various disciplines (we limit our discussions to pedagogy and urban geography here) have explored more general processes of learning within urban contexts.

Pedagogy has particularly paid attention to the question in how far urban learning infrastructures (e.g., museums and libraries) advance educational aims for children and adults alike (Ellenbogen et al., 2004). Learning is here seen as guided by and made possible through concrete pedagogic interventions and methods (e.g., through guided tours, audio tours etc.). With regard to natural history museums, Bakker et al. write that museums hold "authoritative records of biological diversity across time and space" (2020, p. 2) and thus are crucial for public education purposes. Public learning, in contrast to socialization, is here seen as a distinct effort to better people, for example, so they become more deeply informed citizens. Crucially, the "authoritative" nature of museum records reveals that what is to be learned in museums is highly selective and decided upon by curators, cultural ministries, and other political bodies. Given the role of public funding and national agendas in many museums, these learning infrastructures are riddled with absences, injustices and exclusion (Kinsley, 2016) that complicate or contradict intended learning processes. Given our focus on infrastructures defined as socio-technical networks to provide services (e.g., water, energy transport etc.), a concept of learning seems needed that is less embedded within (state sanctioned) pedagogy and educational ideals and more informed by encounters with urban life itself.

Within urban studies then, learning has received particular attention in work concerned with aspects of urban planning (e.g., van Assche et al., 2020) and within debates on urban governance and economic innovation (e.g., Ward, 2018). Within critical literature on urban governance and economic innovation there tends to be an understanding that cities perceive themselves to be under high pressure to "learn" how to attract businesses and revenue and how to successfully compete with other urban spaces (e.g., Peck, 2005). Within the planning literature "learning", however, is increasingly being perceived as an alternative to competition and conflict among cities (Van Assche et al., 2020, p. 2). Critically, however, Van Assche et al. point out that: "learning is often promoted in a normative, teleological, unproblematic manner, as an extension of promotion of good governance, deliberation, of evidence-based policies" (2020, p.2). Within the context of planning, governance and the urban economy learning is predominantly perceived as institutional learning, thus the focus is less directed to the question of how "the city" itself is learned by its diverse inhabitants.

However, we can find such a direct engagement with questions of urban learning from a geographic perspective within the work of Colin McFarlane (2011a, 2011b) who proposed to take learning as a salient category for experiencing urban life in his book *Learning the City*. We propose making his work useful for a more explicit consideration of how urban infrastructures might become sites of learning.

Learning here emerges as a complex process that is characterized by both cognitive and non-cognitive components. Importantly, learning always seems to correspond to some form of provocation in which the individual encounters a need to shift perceptions, acquire a skill or craft, through (sometimes turbulent) processes of re-orienting oneself. It involves both formal training as well as enhancing personal competences through experiences and practice. What is more, within McFarlane's (2011a) definition, learning is seen as a way of transforming the self. Such transformation than can either lead to some form of new ordering of knowledge or skills as well as to a situation of confusion and instability. Learning can thus involve turbulent phases of destabilization in which for example cherished believes and practices must be overcome. This is, as we argue, especially consequential for social cohesion in societies encountering transformation through either a significant influx of migrants or a rapid digitalization of urban amenities and infrastructures in the context of smart city developments.

Learning, McFarlane continues, first entails some form of translation (McFarlane, 2011a, p. 16). This means that knowledge is passed on through intermediaries of all kind, which shape the process of learning and are foundational for it. With regard to urban infrastructures, mundane and routine forms of learning emerge through the reading of signs, instructions or manuals, or the observation of other people.

Second, learning new content is never passed down unaltered or complete from a source of knowledge, but rather each individual needs to re-construct this content. Appreciating learning as a more dynamic activity opens learning to the possibility of failure. People might not be able to find access to learning about new infrastructures or infrastructures within new places (e.g., due to language barriers). Within the urban, there is no single authority passing down information on how to use specific infrastructures. Rather, urban infrastructures can only be learned through an assemblage of devices, people, information, past experiences, observations etc. This means that learning is crucially embedded within spatial-temporal processes. Learning about new infrastructures means to draw on previously achieved knowledge that might have been gathered in radically different time-spaces.

Third, learning involves a form of transformation within the perception of a subject matter. This can involve both a transformation of cognitive orientations as well as a transformation of feeling. Learning is hence far more than a simply cognitive effort, but rather involves a range of tactile, affective and emotional responses. Drawing on the anthropologist Ingold (2000), learning emerges through the body being immersed in its surrounding. While Ingold's (2000) essays predominantly revolve around remote, indigenous sites, within the city the built environments harbors myriad of affective, emotional, and sensory clues that enable or hamper processes of learning. Atmospheres of urban deprivation might for example deter people from learning how to use certain infrastructural services. Infrastructures (as sites of learning) are thus embedded within affective relations (Knox, 2017; Truelove, 2019).

Fourth and finally, learning is not a level playing field, McFarlane (2011a, p. 15–16) warns as it "entails a range of inclusions and exclusions of people and epistemologies". The relation between learning and power has been most prominently explored by Paulo Freire (2017 [1970]) in his *Pedagogy of the Oppressed*. Heavily inspired by Marxist and de-colonial struggles, Freire observed that learning is deeply embedded in socio-political and economic structures. McFarlane (2011a, 2011b) confirms that people can draw on radically different resources (both material as well as immaterial resources such as confidence in one's own ability to learn) when learning the city. Older citizens for example might feel excluded from infrastructural changes in their city such as the new transport sharing services that often require digital devices (smart phones) and applications to use.

4 | TOWARDS A RESEARCH AGENDA FOR URBAN INFRASTRUCTURES AS SPACES OF LEARNING

4.1 | Learning in the smart city

Smart cities or rather: cities as sites of supposedly smart technologies, are an interesting case for commencing research on urban infrastructures as spaces of learning.

First and of utmost importance to our paper, smart cities are spaces in which learning new skills is demanded from all kind of people. Establishing new "smart" infrastructures such as smartphone apps for public transport, digital traffic monitoring and management systems not only transforms the infrastructural environment of the city as Coutard and Rutherford's (2015) edited volume shows; rather, it transforms people's everyday practices of using the city and its infrastructures. Be it established or new residents with migration or non-migration background, tourists, expert developers or users, people need to continuously learn the evolving smart applications. Here crucial questions about the modes of learning arise. How do people learn how to use infrastructures that are nested within wider systems of technological change? Critical research on urban infrastructures could look for the newly emerging practices that co-evolve in relation to infrastructural changes and investigate how these changes alter the human actors themselves, their bodies and the social interactions within the urban.

A critical look at emerging social practices in the context of establishing new smart infrastructures in cities is particularly important as it sheds light on new forms of "responsibilization", ultimately "co-produce [ing] what we could call a 'smart citizen'" (Vanolo, 2013 p. 893, emphasis in the original). This smart citizen then is the one who

has successfully learned how to deal with Information and communication technology (ICT) enhanced urban infrastructures. The city, in turn, "becomes a distributed laboratory for testing smart city technologies, especially those utilizing Internet of Things (IoT), run by public and private stakeholders to help solve city challenges and attract investment." (Berglund-Snodgrass & Mukhtar-Landgren, 2020; Coletta et al., 2018, p. 357).

Modified or new, ICT enhanced urban infrastructures have not only the potential to transform urban governance (Carr & Hesse, 2020; Cowley & Caprotti, 2019; Lake, 2017). Rather, they demand a reframing of our notions of citizenship and add digital competences to those dimensions along which inequalities and power structures are shaped, manifested, and reproduced (Ruppert & Isin, 2015; Tanabe et al., 2002). Ultimately, then, learning about the functioning of infrastructures in the smart city becomes key for civic participation and social cohesion.

Second, the city itself is transformed into a learning subject as smartphone applications and monitoring technologies surveying traffic, public affairs, even shopping and leisure activities collect data to facilitate and improve the usage of the city for its users. Applied appropriately, the city learns and then "knows" how its inhabitants and visitors move at what time of the day. It can then organize traffic and parking systems accordingly (Seya et al., 2018); it assists people and the local administration in providing services as e-government (Popescu Ljungholm, 2015); it is informed about movements in and to the city that can improve planners' ability to identify functional zones within a city (Royuela & Vargas, 2009 for housing market areas). Here, it is technologies that are implemented in the urban fabric that enhance or add new urban infrastructures to the city (Karvonen et al., 2019 for a comprehensive collection of case studies) and provide (political) actors with data that they can translate into policies or strategies (Barns, 2016). Learning is in the first place done by machines, better: algorithms. This is testing the limits of our outlined conceptualization of learning, as it demands a posthumanist appreciation of the deeply liberal and humanist ideal of learning that we do not provide here at this point. Further research is deemed necessary to establish a view of learning that attends to disembodied "learners" like algorithms.

4.2 | How are urban newcomers learning about infrastructures?

As we have entered the age of "planetary urbanism" (Amin & Thrift, 2017), in which more people live in cities than rural sites, cities are faced with growing demands of services by increasingly diverse (and at times only temporary) populations. Tourists, expatriates, regional, international and internal migrants, displaced people, international students move to urban centers, albeit for different reasons and differentiated by legal entitlements (Nail, 2015). Among the diverse scholarship that researches the living conditions of these mobile groups, refugee studies in particular have attended to the increasing amount of urban settlements and the role of urban life and the built environment for the experiences of refuge (Cheshire & Zappia, 2015; Crisp et al., 2012; Darling, 2017; Sanyal, 2012; Tuitjer & Batréau, 2019). Thinking about the challenges that newcomers encounter in the "arrival city" (Saunders, 2011) in unfamiliar infrastructural contexts, learning emerges as a key aspect to study. For example, it has been shown that urban refugees in cities of the global south are often confined to informal settlements that feature improvised infrastructures at best which might pose particular risks (e.g., lack of sanitation, and fresh water; Sanyal, 2012). Yet, it is less well understood in how far such improvised infrastructures also pose particular learning challenges. Where and when to obtain drinking water may in fact involve deep knowledge of local customs and hierarchies, as well as particular knowledge about water markets and technical devices such as pumps or water filters (see the discussed examples in Section 2 by Sultana, 2011 and Truelove 2011) that need to be learned as part of local integration. A critical conceptualization of learning might help us to understand what types of inclusions and exclusions of people and epistemologies are at work within these infrastructures. Thinking about learning in this context may help us appreciate the turbulent processes of re-orienting oneself in new terrains in which the functioning of basic services need to be re-learned.

Next to informal integration processes that can be enabled or hindered through the (non)learning of urban infrastructures, these learning processes can also be discussed regarding the role within formal integration policies.

For example, and contrary to Sanyal's (2012) observation about refuge in informal urban settlements, Cheshire and Zappia (2015) note that in Western countries like Australia, Canada or the United States urban refugees often find themselves in infrastructural rich urban quarters with

> cheap housing, community services, economic development projects, neighbourhood renewal initiatives, employment and training programmes and similar projects, all of which are designed to turn a functionless and redundant population into a contributing and respectable sector of society (Cheshire & Zappia, 2015, p. 2085).

Here it remains to be investigated, how urban refugees learn to use such diverse infrastructures and whether such learning processes are part of for example formal integration courses. In how far does learning about these infrastructural services entail a transformation within the perception of a subject matter? How does learning here involve emotional as well as affective responses? A perspective on learning as outlined in section 3 that acknowledges learning as a *trans*-local, as well as a *trans*-temporal process might moreover help to better understand the efforts necessary to re-organize one's life within new urban—and thus crucially new infrastructural—contexts. From such a perspective, we can inquire what devices are useful, or not so useful, in the process of learning new infrastructures through *translation* (McFarlane, 2011a, p. 16) and in how far knowledge previously gained helps to navigate new infrastructural spaces. Finally, an attention to learning would here include learning about how these infrastructures are produced and governed and how newcomers can make claims about belonging to the new city through knowing about such practices, possessions and productions.

5 | CONCLUSION

Twenty years after Star's (1999) essay, urban infrastructural research remains as salient as ever to unpack the ways in which societies are organized and functioning. Urban infrastructural research might gain new critical impulses from considering the contested and unequal access to learning processes within the city in the context of both increasingly mobile populations as well as infrastructural change. Re-thinking urban infrastructures as sites of learning first reveals another dimension of politics and power within our infrastructural lives and second it allows us to rid infrastructures of their transparency without focusing on times of exception within our research. In other words, appreciating the processes of learning involved in the use of infrastructures allows us to scrutinize infrastructures within their functioning, and not within their failure. While our research agenda is limited to aspects of smart cities and urban newcomers here, topics such as the everyday life of infrastructures could usefully be included, too. Small, incremental changes in, for example, water provisions (Furlong, 2010) or transport options continuously encourage us to (re)learn how to use the infrastructures that surround us. Longstanding urban dwellers thus routinely and continuously have to (re)learn how their surrounding infrastructures work, who provides those infrastructures and who governs them. A further critical scrutiny of youth and children geography (Love, Villanueva, & Whitzman, 2020) or the geography of age and aging (Bowering, 2019) and (re)learning infrastructures could further broaden our understanding of how we continuously re-learn infrastructures throughout our life course and the politics of social participation that come with that. A critical approach to infrastructures as spaces of learning hence enables us to unpack local power relations and further reveals patterns of inclusion and exclusion that shape our daily infrastructural routines.

ORCID

Leonie Tuitjer 🄳 https://orcid.org/0000-0001-6178-7757

ENDNOTE

[1] A marked exception are of course research contributions that specifically foreground urban infrastructures of learning such as museums (Ang, 2017; Bakker et al., 2020; Ellenbogen et al., 2004; Huvilla, 2013; Kinsley, 2016; Unsal, 2019). Here learning in the form of public education is at the very center of research and part of the raison d'être of these "information institutions" (Huvilla, 2013, p. 1377). Museums thus have frequently been explored as sites in which various educational ideals and pedagogical methods come together to educate citizens on (inter)national, biological or cultural heritage and increasingly on pressing socio-political issues (Ang, 2017; Unsal, 2019).

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AUTHOR BIOGRAPHIES

Dr. Leonie Tuitjer, (Tuitjer@kusogeo.uni-hannover.de) works as postdoc at the Leibniz University Hanover, Germany at the Institute for Economic and Cultural Geography. Her work as an urban geographer focuses on topics such as urban infrastructures, environmental change, mobility and refuge as well as on urban cohesion in periods of crisis. She has recently published in *Mobilities* and *City—Analysis of urban trends culture theory policy action*.

Dr. Anna-Lisa Müller, (anna-lisa.mueller@uni-osnabrueck.de) works as senior researcher at the Osnabrück University, Germany in the Institute for Migration Studies and Intercultural Research (IMIS). She has recently published in *CITIES* and is author of several monographs (e.g., *Migration, Materialität und Identität. Verortungen zwischen Hier und Dort*. Stuttgart: Steiner Verlag (2020)).