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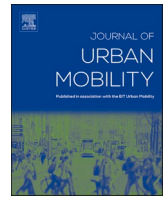
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# Learning through experiments: The case of low-traffic neighborhoods in London

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## ABSTRACT

City street experiments have proven to possess a capacity to trigger system change in urban mobility. The role that learning plays during this process remains unexplored. Drawing from transition studies and experiential learning theory, this paper focuses on the learning of local government actors involved in street experiments. The paper explores how these actors learn, with whom they learn and what they learn. Two cases of low-traffic neighborhood experiment programs in London reveal how local government actors gain instrumental knowledge concerning the design and implementation of street experiments and how to effectively engage citizens. Transformative knowledge amongst local government actors was observed less, revealing an important consideration for the role experiments play in transitions. Because street experiments reflect the complexity of 'real-life' and automatically include participants, they are prone to conflict, which can provide increased opportunities for learning.

## 1. Introduction

Transition scholars consistently laud learning as *the* key mechanism by which experiments contribute to transitions (Beukers & Bertolini, 2021; Stam et al., 2023). Through learning, actors interact and ultimately develop different perspectives on reality and ways of doing, which in turn can lead to new behaviors, norms, regulations and infrastructures (Geels, 2012; Grin et al., 2010). We define learning as “the process whereby knowledge is created through the transformation of experience” (Kolb, 2014, p. 38). Despite great attention for the concept, the learning process during experiments remains abstract, empirical evidence is lacking, and how learning through experiments contributes to transitions is understudied (Van Mierlo & Beers, 2020; Van Poeck et al., 2020; Stam et al., 2023).

This is also true for city street experiments. City street experiments feature the “intentional and temporary change of the street use, regulation and or form, featuring a shift from motorized to non-motorized dominance and aimed at exploring systemic change in urban mobility and public life” (Bertolini, 2020, p. 735). While certainly not new (VanHoose et al., 2024), contemporary liveability challenges have prompted many local governments to reimagine their streets ‘for people instead of traffic’ (Gehl, 2010) by way of such experiments. Street

experiments are viewed by local governments as a relatively low-risk way to test potential solutions by way of experience (VanHoose et al., 2022; Smeds, 2021; Smeds & Papa, 2023; von Schönfeld, 2024). By altering “a quintessential social public space” (Mehta, 2015), city street experiments provide the opportunity to prefigure future scenarios without sizable investments or a need to reach consensus that permanent change requires.

Researchers have identified several distinct characteristics of street experiments. First, street experiments are locally embedded and implemented temporarily. Examples of street experiments include the partial or total closure of streets to motorized traffic for use as public space (e.g. Ciclovias or ‘Play Streets’), the repurposing of car parking spaces as mini parks (e.g. Parklets) or the re-marking of streets to stress purposes other than facilitating traffic (e.g. Intersection Repairs) (Bertolini, 2020). As such, city street experiments are short-term initiatives and therefore do not require the investments associated with permanent infrastructure projects. Some street experiments, such as flexible closures, feature the temporary closure of road space to cars during certain times of the day (e.g. School Streets across the UK), while some can last up to one year (e.g. the entire re-purposing of Piazza Bacone in Milan). Furthermore, city street experiments are not only temporary, but are typically of a short duration and are often swiftly

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implemented.

Second, street experiments do not only feature a shift from motorized to non-motorized traffic but further aim to increase other purposes of public space such as socializing, playing, and exercising (Glaser & Križek, 2021). In doing so, they go “beyond... mobility itself to reconceive streets as public places for social interaction and conviviality” (Prytherch, 2021, p. 690). This is an important characteristic that distinguishes street experiments from other types of initiatives that solely focus on mobility (e.g. pop-up bike lanes). In doing so, such experiments can be viewed as true “system innovations” (Evans et al., 2016) and inherently radical, as they aim to initiate practices fundamentally different to dominant ways of urban and transport planning in which circulation is the primary if not sole function of streets.

Third, street experiments occur in ‘the wild’ (Bertolini, 2020) and as such are characterized by ‘automatic inclusion’ (VanHoose, 2024), meaning that anyone who uses the street or passes through the changed neighborhood is principally a participant in the experiment, whether they have been involved in their design or not. This represents a crucial difference between street experiments and other transition experiment types, since not only “knowledgeable actors draw in their actions and therefore provide the action context” (Giddens (1984) in Van Mierlo & Beers, 2020, p. 257), but also include actors who may be indifferent or even against the goals of the experiment. This automatic inclusion, coupled with the radical and speedy transformation of streets is often accompanied by resistance from involved stakeholders (VanHoose, 2023).

While street experiments have proven to possess a capacity to trigger system change in urban mobility (VanHoose et al., 2022), empirical understandings of their contribution to transitions are still lacking (Smeds, 2021; VanHoose, 2024). A missing piece of this puzzle lies in uncovering the role of learning during city street experiments. In particular, we are interested in uncovering how local government actors - as the initiators of such experiments (VanHoose & Bertolini, 2023) and important players in transitions (van Doren et al., 2020) - learn. This paper explores three themes in particular: how government actors learn, with whom they learn, and what they learn. We consider this to be an important and topical addition for both transition studies in general, and street experiments more specifically. As street experiments continue to proliferate, yet without a proper understanding of the learning process, their contribution to a sustainability transition in urban mobility may remain limited. Therefore, opening the ‘black box’ of learning (Van Poeck & Östman, 2020) and bringing more understanding to the learning process as it occurs during street experiments is the primary aim of this paper. To our knowledge, an empirical analysis of the learning process during a street experiment has yet been conducted, making this a novel and valuable contribution.

This paper is structured as follows. First, we provide a brief overview of the challenges of learning through experiments for transitions. Next, we conceptualize learning using Kolb’s (2014) experiential learning theory (ELT). We then detail our framework for analysis which includes questions related to three themes: the ‘how’, the ‘who’, and the ‘what’ of learning during city street experiments. These questions are informed by knowledge gaps highlighted in existing research on city street experiments and more general challenges for learning from transition studies. These three themes serve as an analytical framework for our case study: the low-traffic neighborhood street experiments in the London boroughs of Hackney and Islington. In the Methodology section, we defend our choice for comparing the same type of city street experiment in two different local contexts and explain the methods used. The findings are then presented, revealing the specific type of knowledge local government actors gain and the mechanisms by which this happens. We conclude with two distinct considerations for learning during street experiments: first, the role of transformative knowledge and second, the role of conflict as a learning opportunity.

## 2. Theoretical considerations

### 2.1. The challenges of learning through experiments for transitions

Learning for transitions is primarily seen as taking place in niches and experimental settings (Stam et al., 2023; van den Bosch & Rotmans, 2008; Van Mierlo & Beers, 2020). Experiments house the radical alternatives to the locked-in challenges facing socio-technical systems and are “applied and tested in real-life contexts with the aim of technological, social and institutional learning” (Evans et al., 2016, p. 18). As Ansell and Bartenberger (2016, p. 70) point out: “all logics of experimentation imply the intention to learn from some intervention.”

Transition scholars therefore agree that learning is *the* mechanism by which experiments contribute to transitions (Beukers & Bertolini, 2021; Torrens & von Wirth, 2021). Explaining how learning through experiments can contribute to transitions remains, however, a challenge (Stam et al., 2023). This is due to both conceptual and practical issues. Conceptually, transition scholars are not always clear about the theories they use to analyze learning, or the theories are only loosely applied, leading to confusion (Van Mierlo & Beers, 2020; Van Poeck et al., 2020). Practically, learning does not always come easy (Beukers & Bertolini, 2021; Van Mierlo and Beers, 2020). While experiments are low risk in terms of implementation, they are equally at a high risk of failing, remaining small, or ‘dying’ (Savini & Bertolini, 2019; Von Wirth et al., 2019). There is further a risk that any knowledge accumulated in experiments is lost once they are concluded (Von Wirth et al., 2019), and transferring the lessons learned within a single experiment to other experiments or contexts remains a challenge (Smith et al., 2010).

These challenges are further recognizable in the research on city street experiments. The few studies on street experiments that mention learning note that it is not always a priority (Bertolini, 2020; VanHoose et al., 2022) or is dropped during the process due to a lack of resources (VanHoose, 2024). Typically, street experiments are implemented as a response to pressing challenges, and are more concerned with short-term goals (Smeds, 2021). Bertolini (2020, p. 749) confirms this: “Potential weak points [of their transformative potential] seem feeble or non-existing links with broader and longer-term urban policies and with social and organizational learning processes that reach beyond the event.” This may be related to the fact that street experiments, despite their transformative potential, are often viewed as one-off, ‘fun’ events (Hipp et al., 2017), and thus are not always viewed as arenas for wider and longer-term change where learning is prioritized. In Bertolini’s review of street experiments, many sources noted the lack of evaluation as a major limitation (e.g., Eyler et al., 2015; Hipp et al., 2017). In the examples where learning is considered, it is often used to improve and learn from the experiment ‘experience’ itself, rather than about wider, longer-term change (VanHoose et al., 2022).

### 2.2. Conceptualizing learning: the experiential learning theory

In an attempt to fill these knowledge gaps, for street experiments more specifically and transitions more generally, we conceptualize learning through the lens of experiential learning theory (Kolb, 2014; rooted in American pragmatism philosophy (see Dewey, 1929, 1971)). According to the ELT, learning is defined as “the process whereby knowledge is created through the transformation of experience” (Kolb, 2014, p. 38). Learning takes place in four iterative stages: concrete experience, reflective observation, abstract conceptualization, active experimentation, and connecting the lessons learned to concrete experience, where the cycle starts again (Kolb, 2014; Fig. 1).

The suitability of the ELT for understanding learning through experiments for transitions has already been explored by Beukers and Bertolini (2021; 2023). Beukers and Bertolini (2021) note that the act of experimenting is by nature an experiential learning exercise. Experimenting allows for reflection on a certain problem, prompts thinking of possible solutions, and makes these insights actionable by experiencing

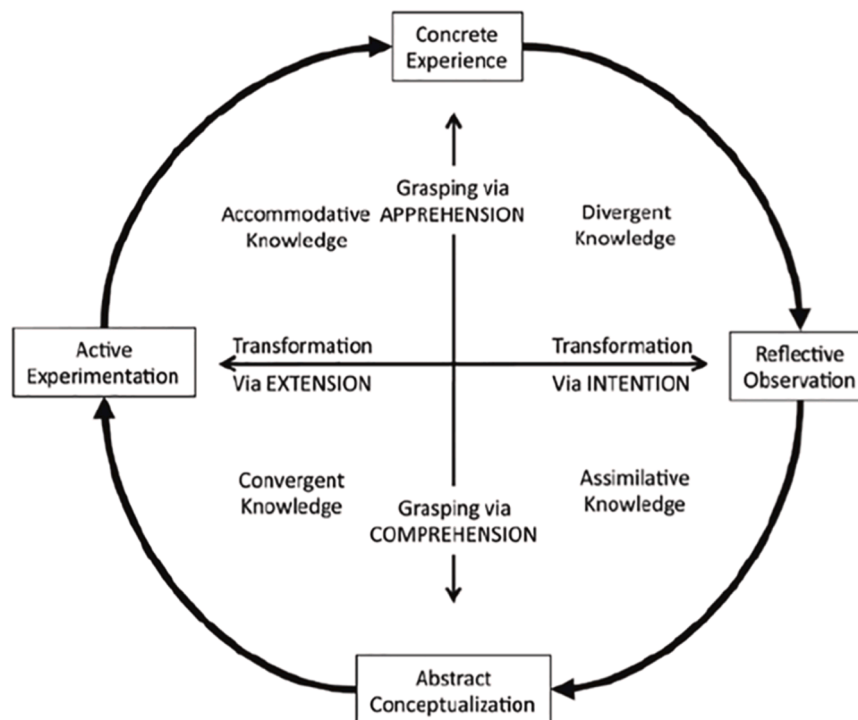


Fig. 1. The experiential learning cycle (Kolb, 2014).

what works and what doesn't. Following their cue, we therefore understand street experiments as the setting in which the experiential learning described by Kolb occurs.

In the following sections we outline the 'how', the 'who', and the 'what' of learning during street experiments. In an effort to further the synergy between these fields, the themes are guided and informed by the ELT, existing knowledge gaps concerning street experiments and more general challenges for learning from transition studies.

### 2.3. The 'how'

To our knowledge, there has yet to be a study conducted which investigates how government actors learn during street experiments, prompting a very rudimentary question. To answer this question, we consult the ELT. As a way to test and learn from temporarily implementing new street configurations, street experiments match the cyclical and iterative learning process outlined by the ELT. The experiential learning process is characterized by an interplay between acquiring and transforming knowledge. The process of learning according to the ELT involves "moving from apprehension (which is grasped through concrete experiences) to knowledge internalization (reflecting on that experience and relating it to other information) to comprehension (conceptualizing this reflection) to knowledge extension (applying the conceptualization in interactive experimentation in an external environment)" (Kolb, 2014; Kayes, 2002 in Beukers and Bertolini (2023, p. 3)). Complete or 'deep' learning only takes place when all four stages of learning are experienced by the learners. The experiential learning process is therefore described as a learning spiral, wherein experiences become richer, broader, and deeper with each new loop (Kolb & Kolb, 2009).

Both the ELT and many transition scholars emphasize that deeper learning happens through interaction with others (Beers et al., 2016; Beukers & Bertolini, 2021). Van Mierlo and Beers (2020) offer the term *discursive interaction* to describe the exchange of knowledge and meanings between actors, which can lead to a shared understanding of a problem and possible solutions. The mechanisms by which this occurs however, remain understudied. Scholars are critical of the notion that as

long as actors interact, learning will happen (Tan, 2022; von Schonfeld et al., 2020). This is related to understudied dynamics of social interactions (Stam et al., 2023). Indeed, most descriptions of learning in transition literature describe a vague process by which actors involved in experiments alter their perspectives (Bulkeley & Castan-Broto, 2013; Evans et al., 2016; Karvonen et al., 2014; Loorbach & Rotmans, 2006; van den Bosch, 2010; van den Bosch & Rotmans, 2008). Furthermore, Stam et al. (2023) recognize a lack of attention for potential other mechanisms by which actors learn, opening up the possibility that there are other mechanisms that fuel the experiential learning process that takes place during street experiments. These knowledge gaps and challenges prompt the following question that guide our analysis of 'how' learning happens during street experiments:

- How do local government actors learn during and between street experiments?
- What constitutes a social interaction in the context of learning during street experiments?
- Are there other mechanisms by which local government actors learn?

### 2.4. The 'who'

City street experiments can be considered a 'new generation of urban initiatives' (Grin, 2020) that are initiated by or involve the local government in some capacity. However, street experiments are not solely a product of government efforts. VanHoose and Bertolini (2023) show the different roles that local governments can take in such initiatives, ranging from top-down promoters, to enablers, to collaborating partners (VanHoose & Bertolini, 2023). While the local government is always an actor in street experiments, the extent of their responsibility can therefore vary, opening up doors for involvement from other stakeholders.

Regardless of who is in the leading role, street experiments are always characterized by what VanHoose (2024) describes as 'automatic inclusion'. Because they occur 'in the wild' (Bertolini, 2020) and not occur in a protected environment (like Urban Living Labs (see Von Wirth et al., 2019)), street experiments involve a very wide range of actors, both on their own choice and unwillingly. Anyone who uses the street or

passes through the changed neighborhood is principally a participant in the experiment, whether they want to be or not. This represents a crucial aspect of street experiments, since not only “knowledgeable actors draw in their actions and therefore provide the action context” (Giddens (1984) in Van Mierlo & Beers, 2020, p. 257), but also include actors who may be indifferent or even against the goals of the experiment.

This automatic inclusion, coupled with the radical and speedy transformation of streets is often cause for conflict (VanHoose, 2023). Ultimately, street experiments challenge the deep-seated notion of automobility as a ‘right’ (Brovarone et al., 2023, p. 2), which often leads to a fear amongst some users of being inconvenienced by rerouted traffic or the removal of parking spaces (VanHoose et al., 2022). The potential for conflict in the learning process is acknowledged by both the ELT and transition scholars. The ELT shows that a difference in learning preferences among participants can lead to richer learning experiences, but can also result in conflict (Beukers & Bertolini, 2023). Transition scholars echo this insight: “due to the diversity of actors engaged in social learning and therefore the implicit or explicit differences in perspectives, interests, values, cultures and languages, social learning can either lead to surprising processes of knowledge co-creation and/or towards deep conflicts” (Sol et al., 2018, p. 1386). Controversy and conflict is therefore an important aspect which can shape the trajectory of these innovations and wider transition processes (Bulkeley et al., 2014). Because they are especially prone to resistance, the role of conflict for learning during street experiments is especially intriguing. The following questions guide our analysis of the ‘who’:

- With whom do local government actors learn during street experiments?
- What is the role of ‘automatic inclusion’ of participants for learning during street experiments?
- What is the role of conflict between stakeholders in the context of learning during a street experiment?

### 2.5. The ‘what’

Street experiments are implemented by local governments in order to test new situations and learn from them. In regards to ‘what’ is learned, existing research on street experiments features a heavy focus on the immediate monitoring and assessing the effects on traffic, or *instrumental knowledge*. This type of learning output derives from Argyris and Schon (1978) well-known framework on single-and double-loop learning in organizations, and refers to practical skills, strategies, and insights into cause-and-effect relationships between interventions and outcomes (Van Doren et al., 2020). For street experiments, instrumental knowledge includes monitoring and evaluating the effects of the intervention on traffic flow, business activity, and user behavior and perceptions (Bertolini, 2020). *Transformative knowledge*, or insights concerning the underlying assumptions, values, structures, problem perceptions, or goals underlying such initiatives (Van Doren et al., 2020) receive considerably less attention (Bertolini, 2020). This focus on instrumental knowledge and less attention for transformative knowledge represents a missed opportunity for the potential of street experiments to spark system change. Because street experiments are implemented to explore mobility and livability challenges, learning outcomes should be broadened to include more than the “mainstream methodology of... mobility data” (Bertolini, 2020, p. 747–748): “not just data on motorized traffic flow or traffic crashes need to be counted but also impacts on physical activity, well-being, social capital, perceptions, and economic activity.”

This reflects a wider gap within transition studies (Van Poeck et al., 2020). For instance, as Van Poeck et al. (2020) point out, in Sol et al. (2018) analysis of Dutch regional governance networks for sustainability transition, reframing is emphasized but no empirical examples of how sustainability issues are reframed are included, leaving “the content of learning...black boxed.” Such transformative knowledge is shared by

multiple actors across society to develop new cultures, practices, and structures (van den Bosch & Rotmans, 2008; Wolfram, 2016) and can be used to “scale up processes directed at transforming the institutional environment in favor of the innovations experimented” (Van Doren et al., 2020, p. 3). Transformative knowledge has received less attention, indicating an important knowledge gap as it ultimately concerns the insights that can lead to change within transitions.

- What do local government actors learn during street experiments?

## 3. Methodology

### 3.1. Case selection

Following VanHoose et al.’s (2022) characterization of city street experiments, we determined five criteria to select the type of experiment for study. First, an urban context in which experiments are actively being implemented to explore solutions to mobility and livability challenges. Second, experiments should feature the streetscape (the road and adjacent public space) as the object of transformation. Third, the experiment should have been implemented as a temporary intervention with the aim to explore system change. Fourth, for data accessibility reasons, experiments must have occurred after 2020. A fifth requirement was the existence of multiple experiments rather than a single initiative (i.e., an experiment program), to also explore how learning happens between experiments. Taking these and other practical concerns into consideration, the choice fell to low-traffic neighborhoods (LTNs) in London, England.

LTNs reduce through-traffic in residential areas by way of filters in the form of planters, bollards, cameras and road signs (see Fig. 2). While LTNs have been employed in London for some time, especially in the borough of Hackney, the Corona pandemic of 2020 boosted the process. As a measure to prevent car recovery and provide more public space during the pandemic, London boroughs introduced 101 temporary LTNs to provide more public space and to prevent car recovery (Bosetti et al., 2022). This was made possible by the Experimental Traffic Order (ETO) which allowed boroughs to implement experimental schemes without prior public consultation, speeding up the typically year-long process (Statute Law Database, 2023). Any objections to the scheme must be considered within six months and within 18 months a decision must be made on whether to make the changes permanent (Statute Law Database, 2023). The ETO further allowed for a swift implementation of the LTNs without further consultation. As a result, the local councils responsible for implementing the schemes were criticized for not including the public in the process (McIntyre, 2022) and the LTNs were characterized by resistance and conflict. This aspect of the LTNs further made them a suitable choice to explore the role of conflict in the context of learning during street experiments.

Using desktop research, we narrowed our focus to East London which revealed the greatest increase in LTNs since 2020. The choice fell to two neighboring boroughs of Hackney and Islington. While in both boroughs LTNs were accelerated by the pandemic, street interventions have a distinct history. The borough of Hackney has a reputation for innovation in sustainable transport (Hackney Council, 2015) and is one of the first London boroughs to employ this method of traffic containment with the De Beauvoir LTN in the 1970s. At the time of writing, 85 % of the borough is covered in LTNs (L1). Islington has a more recent track record, with seven LTNs covering 24 % of the borough and plans to implement six more schemes that will encompass 70 % of its roads (L3). We consider these differences in context particularly relevant for understanding the dynamics of learning between experiments and between actors directly involved in the experiment and those functioning at a city-wide level. The three themes are explored in a multi-embedded case study design. We selected London as the context and the boroughs of Hackney and Islington as our cases ( $n = 2$ ). The LTN program in each borough as the embedded unit of analysis ( $n = 2$ ).



Fig. 2. Low-traffic neighborhoods feature modal filters that prohibit the passing of motorized traffic in residential streets. Photo credit: Author.

### 3.2. Data collection

The most important aspect of the research design was the selection of interview respondents (see Appendix, Table 1). Because street experiments are primarily initiated by local governments or at least feature the local government in a prominent role (Kronsell & Mukhtar-Landgren, 2018; VanHoose & Bertolini, 2023), we targeted this actor group (Carayannis & Campbell, 2009). This actor group included borough officers, local and city-wide policy makers, and local politicians. Identifying relevant respondents was achieved through preliminary desktop research including various websites, news outlets, policy documents and previous studies, complemented by a mapping of actors named during the interviews. Attention was given to collecting a highly diverse set of local government actors, ranging from local policy-makers, city-wide policy-makers and politicians. Additionally, acknowledging the multi-actor context of street experiments, we interviewed other stakeholders who showed an active involvement in the experiments, including representatives from local activists groups and from city-wide knowledge institutions. To cross-check the information provided by the local government actors concerning the experiments and particularly, the participation process, residents living in an LTN were also interviewed. For context regarding low-traffic neighborhoods in London an academic expert was also interviewed. Given the conflictual nature of the LTNs, we attempted to accommodate for respondents regardless of their personal opinion towards the experiments.

In total 14 interviews averaging one hour were conducted between November 2022 and May 2023. The four themes were translated into sub-questions and subsequent leading questions for the interviews. The interviews followed the same protocol involving a semi-structured format. Data was thematically analyzed (Ritchie & Spencer, 2002) according to the three themes using Atlas.ti analytical software. Content analysis was employed to determine how government actors learned during experiments and between experiments (e.g. discursive interaction and other mechanisms), which government actors learned during the experiments and with whom they learned (e.g. the role of automatic inclusion and conflict between stakeholders), and what the actors involved learned (e.g. instrumental knowledge and transformative knowledge). Additionally, this study employed official evaluations of the LTNs, Commonplace online interactive evaluations of the LTNs,

academic articles concerning the LTNs, and news articles to triangulate user opinions and experiences (see Table 2 in the Appendix for a summary of the empirical material). Data saturation was reached when no new actors or insights were found.

In the following section we present the empirical analysis per theme followed by a concluding discussion in which we reflect on the findings.

## 4. Analysis

### 4.1. The 'how'

#### 4.1.1. How do local government actors learn during and between street experiments?

Prior to the implementation of the LTNs, both boroughs had 'sensed tensions and potentials' in the present arrangements of their neighborhoods. Acting on this, the LTNs were implemented by local government actors in order to test new configurations and grasp knowledge through active experimentation. During the LTNs, concrete experiences were clearly reflected upon through observation, followed by abstract conceptualization and active experimentation (Kolb, 2014). Firsthand experience did not refer to how the local government actors experienced the LTN, but observing, collecting and understanding how the users experienced the implementations. "You have to let them experience it... I really have firsthand evidence of residents who hated the experiment at the start and now they are the biggest champions" (L3). Observation and reflection on users' experience was believed to be key to identify problems with current arrangements of uses, forms and regulations of city streets, and opportunities for different arrangements, resulting in different conceptualizations of what street space might be for, to be actively experimented with. "The experimental aspect also helps with the consultation and engagement side of things. If boroughs can say do some consultation beforehand, put the scheme in and get feedback again, they can visibly show that they have changed it. I think you'll get a more positive response that way than just putting them in permanently" (L6). In this way, street experiments can be understood as the stage for experiential learning wherein the impetus for new developments prosper. For example, one borough officer shared they were receiving requests from borough residents to put an LTN in their neighborhood "because they have experienced an LTN firsthand in

another area and want one too" (L2). One respondent noted that the entire point of implementing the experiments is "to allow the community to have a real time view of what their street will look like and also provide feedback.

#### 4.1.2. What constitutes a social interaction in the context of learning during a street experiment?

Confirming already noted insights from transition studies, the learning we identified was fueled primarily by interaction between local government actors and other stakeholders involved. Social interaction occurred in a multitude of settings, which varied in terms of formality and varied depending on who the local government actors were interacting with. These included face-to-face settings (e.g. meetings, conferences, site visits, focus groups, protests, door-to-door leafleting) and virtual settings (e.g. online platforms, webinars, emailing) which were particularly important to interaction in the analyzed phase of the LTN experiments, due to physical restrictions related to the COVID-19 pandemic. Most social interactions could be described as informal. Interactions occurring between borough officers, which often took place in more formal settings (e.g. meetings, conferences), could be also described as informal. Borough officers often knew each other personally (L2; L3), some even describing others as 'friends' and would informally chat about schemes outside of work settings (L7). The social interactions between local government actors were based on connections and stemmed from a need to share best practices under uncertain circumstances: "Borough officers were all fighting the same battles and wanted to help each other. I've never come across someone saying, 'I don't want to share my success'" (L9). "There was a lot of contact between us. It was a bit of a mutual support group at some point. A lot of people were under a lot of pressure" (L14). This happened across physical (e.g. meetings, conferences, site visits) and virtual settings (e.g. meetings, webinars). Regular meetings between officers from different boroughs and TfL officers occurred to discuss shared LTN schemes. Formal, city-wide organizations like TECH, London Council's transport committee which connects all of the transport leads across London, played a key role in providing a place where such interactions could take place. The NGO Urban Design London, which is funded by TfL, further brought borough officers and politicians together and the activist group Living Streets, which were also active on a borough level, have a city-wide organization that acts as a connecting network across the entire city (L10). Consultants also proved to play an important role in the sharing of best practices as they would work at multiple different boroughs at a time, acting as knowledge brokers between their multiple clients: "It was quite a lot of talking, talking to the borough officers. We had the advantage of working for multiple different boroughs so we could say: 'this is what we're doing in Lambeth' and suggest that to others. We could propose to do it a certain way because we tried it in another place and saw that it worked" (L6).

Additionally, informal contact between politicians and borough residents happened: "The lead counselor lives in our neighborhood and we have a little chat that is slightly more than neighborly" (L11). Borough officers used social media as an informal way to learn about users' opinions: "You've got Twitter and people complaining there. It happens in very different ways, how people contact us. We tend to listen to all of these different channels" (L2). Respondents further mentioned learning about LTNs via news outlets: "There was something that came out in our press yesterday, a comment about removing the traffic in the neighborhoods that it causes traffic in the main roads" (L10).

#### 4.1.3. Are there other mechanisms by which local government actors learn?

Alongside social interaction, the learning process was supported by two other mechanisms: *monitoring and assessment* and *vandalism*. Monitoring and assessment involved various means of evaluation to understand the effects of the LTNs, including both public opinion, and physical functioning of the schemes. Although formal public consultation was not necessary under the ETO, both boroughs made use of the online platform

Commonplace as the primary source for feedback from users. Borough residents could provide feedback on the different LTN schemes. For instance, in Hackney the local council used Commonplace to receive live feedback on the different schemes (L1; L2). The collection of feedback occurred differently per borough; for instance, in Hackney comments posted on the Commonplace website were handled as they were published and the platform remained open for the entire length of the experiments: "We read them with an open mind and having the right attitude towards them but also realize that people are going to perceive things differently" (L1). Because of the open access nature of this platform, respondents would debate online, placing comments in favor of a scheme to balance out those against (L2). In this way, online platforms further acted as a learning mechanism for citizens who could read about how certain schemes were functioning according to other users on the platform. Borough officers further carried out more formal, qualitative assessments of the schemes, including polling, organized focus groups, town hall style meetings, and online questionnaires (L2; L3). Quantitative data collection methods were also employed to monitor the effects of the LTNs on traffic volumes, air quality, emergency response times, and bus journey times. In both boroughs, these many sources of data were triangulated to create an accurate picture of both the real effects of the LTNs, but also to cross-check claims made by residents on Commonplace (L1).

Another, albeit less common, mechanism by which the local government actors learned was *vandalism* (L10; L2). Following the implementation of the LTNs, people would show their disapproval by removing bollards, spray painting graffiti on signs and disabling cameras (Taylor & Murray, 2023). Interview respondents noted learning about public opinion by way of such visible cues. "We put little green 'road open' signs on the side of planters in the LTNs and they just got ripped off by angry people. It shows that you've got people for and against" (L11).

## 4.2. The 'who'

### 4.2.1. With whom do local government actors learn during street experiments?

During the LTNs, local government actors represented an interdisciplinary group of civil servants. This included borough officers, ranging from project managers to traffic engineers to politicians. Though the LTNs were a city-wide phenomenon, they were initiated by the borough councils, meaning civil servants at the local level were responsible for planning, implementing and managing their own experiments. Local politicians worked to actively lobby for the experiments: "We have very [...] engaged (politicians); the current councilor took 25 meetings in one month to be the face of the [...] LTNs. They speak at conferences and they lead tours; they get politicians from other boroughs asking if they can be shown around" (L1). At a city-wide level, policy makers and politicians were further involved. In a few exceptions, TfL officers were directly involved in LTNs that included bus routes or 'red' roads which fall under TfL's jurisdiction, but primarily worked on a wider metropolitan level as funders for many of the LTNs and provider of guidelines for boroughs under the Mayor of London's transport strategy (L6).

In line with other studies of learning during experiments (Stam et al., 2023), we identified other actors from the quadruple helix of interaction (Carayannis & Campbell, 2009) with whom local government actors learned during the LTNs. For example, some boroughs hired consultants to help process responses to the survey and advise the organization of the experiments. These consultants were further involved in the learning between experiments and the broader context, acting as knowledge brokers between the different boroughs.

Local government actors interacted primarily with actors from the group 'civil society'. This group includes borough residents, neighboring residents, and city-wide NGOs. Borough residents living in a LTN were the most directly involved, however the extent to which that involvement was active or passive was left to their own agency. For instance,

some residents living within a LTN experiment were unaware that their neighborhood had been changed at all (L3). Alternatively, residents living close to the LTN were sometimes more involved than those living inside the boundary of the experiment (L3): “Isn’t my journey going to get longer when I go to visit my elderly parent?” (L2). Due to the heated nature of the LTNs, activist groups were highly active in both boroughs. These included activist groups both for and against the LTNs, including Horrendous Hackney Road Closures, Cycle Islington and Living Streets, the latter which also acted on a city-wide level. On a city-wide level, the NGO Urban Design London, which is funded by TfL, acted as a knowledge broker, training borough officers and bringing civil servants together.

#### 4.2.2. What is the role of ‘automatic inclusion’ of participants for learning during street experiments?

Interview respondents noted experiences of ‘automatic inclusion’ (VanHoose, 2024) during the LTN experiments, coupled to limited, or skewed deliberate participation. The limited amount of communication and reliance on online surveys and platforms further led to misconceptions among the actor group ‘civil society’ concerning who the experiments were intended for. The respondents noted that some borough residents chose not to partake in the surveys because they believed they were intended for car owners, and, at the same time, primarily car owners responded to the surveys: “We all know of the shortcomings of consultation, it is self-selective meaning only people who really have a stake - so in this case car drivers - are overly represented” (L3). For instance, in Islington, borough officers noted that 60 % of survey respondents were car owners (in a borough where only 30 % of residents have access to a car). To combat this, certain actors were targeted by borough officers to reach a better representation in the surveys. These groups included young residents, older residents and people with disabilities: “We tried to reach out to young people, people who are socially isolated and to people within the LTNs who would not typically participate in the consultation” (L3).

#### 4.2.3. What is the role of conflict between stakeholders in the context of learning during a street experiment?

Conflict and alternative opinions showed particularly relevant to learning during the LTN experiments. Their swift implementation, lack of formal public consultation and targeting of automobiles proved to lead to contention and polarization: “People fall out with their family and their neighbors about LTNs. It’s such a shame” (L13). This was compounded by the circumstances of the pandemic, including an urgency to implement schemes and a lack of public consultation due to social distancing guidelines. Contrasting to the typically 18-month long traditional public consultation characteristic of British local councils, which involves a series of face-to-face meetings between borough officers and residents, the consultation surrounding the LTN experiments took on the form of online feedback through the platform Commonplace and the opportunity for residents to email borough officers with their concerns and complaints. “The narrative that we were not consulting really took hold, even though we were very much consulting” (L1). While this way of doing allowed borough officers to ‘quickly implement’, which was necessary in light of the COVID-19 pandemic, it led to a feeling of exclusion amongst borough residents:

“Communities didn’t feel like we took them on the journey with us. No matter how much we told them that this is consultation, that they can write to us and use Commonplace, the community felt like we weren’t taking them with us but that it was happening to them.” (L2)

In both boroughs, activist groups (both for and against the LTNs) appeared soon after their implementation. When asked about the relation between conflict and learning, one borough officer noted: “The publicity, good or bad, means that everyone will know what we are doing. I suppose it becomes something that several people will think about and that others will start demanding in a way that they wouldn’t

have done had it not been so public” (L13). The conflict further prompted both borough councils to change their methods for engaging with the public, which is described in more detail in the section below.

While these conditions led to confusion amongst borough residents and “there was pressure on the officers on a day-to-day basis getting loads of emails coming in” resulting in a “level of engagement that was very resource intensive” (L14), the conflict that occurred during the LTN experiments proved to be an important source of learning for primarily the borough officers. “It obviously provoked strong feelings at the pace we did it, but that also generated genuine important feedback” (L1). The resistance and subsequent interactions that took place forced the borough officers to change their way of working:

“We now make sure that we talk to people during the early stages of the LTNs that we are working on. Everything we have done since then has taken into consideration that people have time to adjust and build trust in [us]. We can definitely say we have been learning as a Council; we learned from what happened during the pandemic, and the speed at which we did things” (L2).

### 4.3. The ‘what’

#### 4.3.1. What do local government actors learn during street experiments?

In line with the research on street experiments (Bertolini, 2020), we observed local government actors learning primarily instrumental knowledge. This included knowledge related to the design and functioning of the LTNs, as well as practical strategies for dealing with citizen participation throughout the process. Local government actors further noted gaining instrumental knowledge in their interaction with other borough officers in the form of sharing ‘best practices’ (L6). One significant difference was observed between the boroughs. In Hackney, which had been implementing LTNs for a considerably longer amount of time, the ‘what’ appeared to be more concerned with instrumental knowledge concerning very specific details of the schemes. One borough officer in Hackney explained: “The thing is, we as [traffic] engineers knew that the experiment would work, we just needed to see how it would run and give us that necessary feedback” (L2). In Islington, where LTNs had a shorter history, instrumental knowledge was collected, however much more thorough; a detailed monitoring strategy was implemented including measuring the impacts of the LTNs on traffic speeds, volumes, congestion, emergency vehicles, and air quality before, during and after the experiment (L3).

Borough officers further, and arguably more fundamentally, learned about practical strategies for dealing with citizen participation throughout the process. In Islington, policy-makers responsible for organizing the experimental schemes originally organized on-street information sessions, advertising the location and time, at which residents could learn more about the LTN program. After protesters thwarted chances for the borough officers to interact and tell passersby about the experiments, the officers no longer advertised where and when they would have information stands (L3). The same was necessary for virtual settings:

“The way they connect with the public has changed. One meeting they had, they couldn’t even finish their presentation because there were people protesting against them. Last week they had an online Zoom meeting with 190 people, and it was run by another company. That went much better” (L10).

This resulted in the experiment organizers adapting their public engagement strategy along the way: “So then we decided to not advertise and do street intercept, so just standing on a street corner and talking to random people” (L3). The lessons learned were implemented during the process: “We made quite a few changes in those early days. People were telling us that a [road] closure was in the wrong place so we ended up moving it” (L1).

Transformative knowledge, which includes insights concerning the

underlying assumptions, values, structures, problem perceptions, or goals underlying street experiments, was observed far less amongst local government actors. It appeared that borough officers - even those in Islington, where LTNs were a newer phenomenon - were not in doubt about the value or goal of the LTNs but were rather focused on practical issues (such as the design). Instead, transformative knowledge seemed to primarily concern resident *users*. Local government actors at least indirectly acknowledged its relevance by stressing the importance of continuously observing and reflecting upon shifting user behavior and public opinion.

## 5. Concluding discussion

Drawing from transition studies and experiential learning theory, this paper focuses on the learning of local government actors as the main implementers of street experiments. Guided by existing knowledge gaps related to learning in the context of transitions and for street experiments, this study represents a first empirical study of who local government actors learn with, what they learn and how.

This study revealed the usefulness of applying the ELT to understand learning in the context of street experiments. The LTNs originated from the '*sensing* of tensions and potentials' by local borough officials and politicians. Across the city, different local government actors sensed a need for new street arrangements and felt the potential threats of the pandemic for furthering the quality of urban mobility in the city. With the help of the ETO, local governments quickly implemented schemes with the intent to *observe* and *monitor* the impacts of the LTNs on traffic and user behavior. These were *reflected* upon in real time, identifying problems and *adapting* during the experimental process. Social interaction acted as the fuel for learning during the LTN experiments. Borough officers learned both with and through other government actors and residents. The exchange of knowledge and meanings between actors, which can lead to a shared understanding of a problem and possible solutions, or *discursive interaction*, was observed in a multitude of settings, which varied in terms of formality and varied depending on who the local government actors were interacting with. In regard to learning between experiments, there is a clear need for actors, organizations, spaces, activities that serve a connecting purpose. Social interaction was noted as a primary mechanism for learning between local government actors from different boroughs, albeit functioning at a different scale and across different time frames (e.g. daily vs. weekly). Learning at this level was heavily reliant on networking between these actors and was supported by the presence of city-wide organizations like TfL. Interestingly, learning at the city-wide level grew out of a need to share best practices and act as a support system for one another during periods of uncertainty. This represents a point for policy - while learning was not an explicit goal on a city level, the presence of a clear direction from an overarching government institution provided a context in which learning at a local level could take place and in turn could and needed to be shared.

Contrary to 'classical' transition experiments, street experiments *do* reflect the complexity of 'real-life' (Van Wymeersch et al. 2019), 'automatically including' participants in the experiment, be they willing or not. Local government actors primarily gained *instrumental knowledge* related to the design and implementation of the LTNs and practical strategies for dealing with citizen engagement throughout the process. Interestingly, the findings revealed less instances of local government actors gaining *transformative knowledge*, or insights concerning the underlying assumptions, values, structures, problem perceptions, or goals underlying such initiatives. It seemed that, in comparison to residents, borough officials, traffic engineers and politicians at a local and city-wide level were already convinced of the value of the LTNs. While this is certainly positive, it does echo earlier findings that show that learning during street experiments often involves improving the 'experience' itself, rather than about wider, longer-term change (VanHoose et al., 2022), which could hamper their transformative potential.

Further, it begs the question of whether or not transformative knowledge is generated during experiments wherein the local government is less sure of the success of their interventions than it seemed in this case. Instead, transformative knowledge seemed to be gained primarily by residents, who learned about the benefits of the LTNs by experiencing them firsthand and learning about their own behavior and use of streets. This was a primary goal of the LTN experiments: to allow users to experience firsthand, providing borough officers insights into user engagement and preferences. This finding therefore reflects the fact that transitions are multi-actor processes (Wolfram, 2016; ) and that these actors learn different types of knowledge in different ways. This, combined with the notion that complete or 'deep' learning only takes place when all four stages of learning are experienced by the learners (Kolb, 2014), highlights the complexity of learning during street experiments and prompts the question of whether or not deep, transformative learning can take place. While the learning of other actors was not the focus of our study, investigating how the heterogeneous mix of actors involved - either willingly or unwillingly - in street experiments learn, and whether all actors can experience each stage of the learning cycle, represents an important point for future research.

The study points to another consideration concerning the role of conflict during street experiments. The automatic inclusion of actors and the way that users were engaged provided a glimpse into the role of conflict during street experiments. In these cases, shared differences can act as important resources (Beers et al., 2016). Interestingly, the conflict that occurred did not appear to negatively impact the learning process. The conflict forced borough officers to change their strategies for citizen engagement, revealing reflexivity, an important part of the learning process (Moore et al., 2018) and revealed the role of conflict as an opportunity for learning and improvement. The conflict surrounding the LTNs led to an increase in involvement of different actors by way of protests and meetings, performing acts of vandalism, and sharing insights online. This brought more attention to the experiments and in turn, the number of social interactions. If social interaction is the fuel of the learning process (Beers et al., 2016; Stam et al., 2023), then arguably as more actors meet each other, there is an increase in the exchange of ideas and in the potential to generate knowledge. While we do not intend to make the simple claim that increased interaction leads to more learning, this fact does prompt questions for further research surrounding the amount and type of interaction and their relation to lessons being generated during experiments.

Finally, it is important to note that, while we believe learning through experiments can contribute to transitions, we agree with Engeström et al. (2015) that learning which "is truly transformative or expansive to the system that learns... is likely to require a years-long process that features different phases, trials for new actions, and continuous adjustments in different aspects of the learning system and its context(s) before the learning has become completed" (Engeström et al., 2015). For this reason, in this paper we do not make any claims about the learning that happens during street experiments leading to any kind of systemic change in urban mobility or livability practices (e.g. lasting behavioral change). Rather, we have zoomed in on the 'how, the 'who' and the 'what' of learning as a first step in shedding light on this process.

## CRedit authorship contribution statement

**Katherine VanHoose:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Luca Bertolini:** Writing – review & editing, Writing – original draft, Supervision, Project administration, Methodology, Funding acquisition, Formal analysis, Conceptualization. **Thomas Straatemeier:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Formal analysis, Conceptualization.

**Declaration of competing interest**

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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**Appendix**

Tables 1 and 2

**Table 1**  
Overview of interviews.

Interview code	Profile interview respondents
L1	Sustainable Transport and Engagement Group Manager, London Borough of Hackney
L2	Sustainable Transport and Engagement Manager, London Borough of Hackney
L3	Interim Team Leader Transport projects and people-friendly streets, Islington Council
L4	Active Travel Officer, London Borough of Tower Hamlets
L5	Assistant Director Policy and Projects, City of London
L6	Principal City Planner, Transport for London
L7	Resident of Hackney
L8	Director, Urban Design London
L9	Director of Design, Urban Design London
L10	Chair of Islington Living Streets
L11	Member of London Cycling Campaign
L12	Senior Researcher in Urban Mobility, University of Westminster
L13	Resident of Islington
L14	Executive Member for Environment, Air Quality and Transport, Islington Council

**Table 2**  
Overview of collected empirical material.

Material	N	Analysis
Interviews		Thematically analyzed
Interviews with local policy-makers, planners and politicians	5	
Interviews with residents	4	
Interview with city-wide policy makers and planners	2	
Interview with academics and researchers	3	
Media		Content analysis
Newspaper articles	4	
Articles in academic journals	3	
Other		Content analysis
Official evaluations of LTNs	2	
Commonplace feedback evaluations of LTNs (online forum)	2	

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