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# Pathways from street experiments to transformation: a systematic review of theories of change

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**ABSTRACT**

In the face of the challenge of a transformation of urban mobility, experimental approaches have seen a rise: Tactical urbanism, open streets, pop–up bike lanes, and superblocks have spread globally, and under the term *street experiments*, an expansive body of literature has emerged. This debate is based on the notion that experiments have a transformative capacity to provide an impetus for wider change. However, the understanding of this is still limited and forms only a tacit background in most articles. This systematic review therefore analyses the implicit and explicit theories of change that underpin the literature on street experiments. From a qualitative content analysis of 62 papers, it distinguishes four perspectives: the *local implementation, innovation, citizens,* and *critical* perspective. It also identifies the theoretical frameworks and components used to analyse or conceptualise the pathways from street experiments to transformation, finding a wide range from comprehensive frameworks – such as the multi–level perspective – to smaller, inductive components. However, their added value is partially limited because they are not sufficiently empirically grounded or conceptually adapted to the specificities of street experiments. The paper concludes that to construct more robust theories of change, there is a need to use available theory to conceptualise key impact mechanisms such as "learning" or "acceptance", inductively connect abstract theoretical models with the complex reality of street experiments, and empirically assess assumptions.

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Tactical urbanism; urban mobility; public space; urban planning; transition; systemic change

## Introduction

As the climate crisis accelerates, a comprehensive societal transformation has become more pressing. Transportation, particularly road traffic, remains a significant contributor to global CO2 emissions (IEA, 2023; IPCC, 2023, p. 44). A transformation of mobility is

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therefore urgently needed (Berger et al., 2014), tackling car dependency (Banister, 2008; IPCC, 2023, p. 103) as well as fostering a broader shift from "space for traffic" to "space for people" (Bertolini, 2023). In these endeavours, public space plays a key role: Space needs to be reallocated to active and public transportation, for climate adaptation measures and for social life. However, the implementation of such projects is often challenging, facing significant political resistance, financial limitations or regulatory obstacles (Bardal et al., 2020; Marquet et al., 2024; Zografos et al., 2020). As traditional planning approaches have recurrently struggled to achieve the hoped-for effects in the face of these challenges, the broader shift towards experimental approaches (Bulkeley & Castán Broto, 2013; Evans et al., 2018; Fuenfschilling et al., 2019) can also be observed in transport planning (de Bruijne et al., 2010; Glock, 2023; Smeds, 2021): In the last decade, practices from parklets and open streets to pop-up bike lanes or superblocks have spread globally, especially accelerated by the pandemic (Zhao et al., 2024).

Since Bertolini's 2020 seminal article, "street Street experiments can be defined as "an intentional, temporary change of the street use, regulation, and/or form, aimed at exploring systemic change in urban mobility, away from 'streets for traffic', and towards 'streets for people'" (Bertolini, 2020, p. 734). There are many expectations associated with experiments. Some expect their temporary nature to allow for testing more radical ideas without the effort and cost of traditional infrastructure projects (Meinherz & Fritz, 2023; Vecchio et al., 2021), enabling learning processes about implementation and impacts, strengthening transformative capacities (Glaser & Krizek, 2021; Kinigadner et al., 2024). Others suggest they help increase social acceptance of more far-reaching interventions, because they are flexible and reversible, allow for participation, and make potential benefits tangible (Stevens et al., 2024; VanHoose et al., 2022).

Fundamental for street experiments is that their transformative capacity lies not in the single project, but in the impetus they provide for larger changes (Bertolini, 2020; Kinigadner et al., 2024; VanHoose et al., 2022). However, the understanding of how street experiments lead to such change remains limited. In most empirical articles, the notion of how street experiments lead to transformation is only implied in the subtext or briefly touched upon. Only a few articles present explicit theoretical frameworks for the interrelationship between street experiments and transformative change (for example Kinigadner et al., 2024; Nello-Deakin et al., 2024; VanHoose et al., 2022). This calls for explicating the mostly implicit linkages between street experiments and transformation.

Existing reviews found positive immediate effects of street experiments, such as on road safety or social interactions, and set normative criteria (Bertolini, 2020). Others explored the potential of COVID emergency measures to stay after the pandemic, discussing ambivalences (Verhulst et al., 2023). One review provided insights into barriers and enablers for the implementation of street experiments (VanHoose, 2023). Also, an overview over recurring topics and the chronological development of the literature was provided (Garau et al., 2024). The only reviews investigating longer-term effects of street experiments found a maintenance of play street programmes (Bridges et al., 2020) and a partial continuation of COVID open streets in the US, covering a timespan of six months after implementation (Glaser & Krizek, 2021). To date, no review has engaged with the theoretical assumptions at the heart of the street experiments discourse yet – their *theories of change* (Novy, Haderer, et al., 2023).

Thus, this systematic literature review aims to provide an overview of how the pathway from street experiments to transformation is currently understood. By addressing this conceptual gap, it also aims to establish a foundation for more robust empirical research. To achieve this, the following research questions will be addressed:

- RQ1: What implicit and explicit theories of change underpin the literature on street experiments?
- RQ2: What concrete theoretical frameworks and components are used in the literature to analyse or conceptualise pathways from street experiments to transformation?

The article is structured as follows: First, the article is situated in the context of current debates on transformation and "theory of change" is introduced as the analytical framework. Second, the methodology is described, following the guidelines by van Wee and Banister (2016) for literature reviews in transportation and the PRISMA standard (Page et al., 2021). In the results, a general overview over the literature is provided, four perspectives on street experiments and transformation with different pathways of change are characterised (RQ1), and the theoretical frameworks and components are presented (RQ2). Finally, the discussion and conclusions reflect upon the findings and methodology and suggest directions for future research.

## Theoretical background

### *Transformation*

Transformation is a term that has become increasingly popular since the 2010s in both academic and policy discourse. Prominent examples include the UN's 2030 Agenda for Sustainable Development entitled "Transforming our World" (United Nations, 2015) or the European Green Deal, aiming at "a set of deeply transformative policies" (European Commission, 2019, p. 1). Transformation can be characterised as an umbrella term for concepts that aim "to provide a comprehensive understanding of current global environmental change and to contribute to a social and political strategy for dealing with the crisis" (Brand & Wissen, 2017, p. 1). The literature highlights the need for "a 'fundamental' shift that questions and challenges values and routine practices and changes prior perspectives employed to rationalise decisions and pathways" (Nalau & Handmer, 2015, p. 351). Particularly, this means going beyond incremental adjustments and sectoral approaches, combining technical and social innovations, and dealing reflexively with the complex and dynamic nature of socio-ecological systems (Brand et al., 2013, p. 481; Hölscher et al., 2018, p. 1).

Under headings like great, green, or socio-ecological transformation and socio-technical or sustainability transition(s), a wide variety of approaches have emerged. These differ significantly in terms of theoretical perspectives and practical contexts: Transformation is both used analytically to retrospectively describe change dynamics, and as a normative concept to draw pathways towards desirable futures. It can be considered either an ongoing process or a rare historical event, as well as a long-term metamorphosis or a short-term rupture. Furthermore, it can refer to both a process and a result (Brand et al., 2013, p. 481; Nalau & Handmer, 2015, p. 350; Termeer et al., 2024, p. 3; Wolfram et al., 2016, p. 19). Perspectives on transformation also vary significantly, ranging from

market – or innovation-based perspectives over systems theory to social metabolism approaches (Novy, Haderer, et al., 2023). This wide range reflects the need for multi-perspectivity to effectively tackle the challenges of the intertwined ecological and social crises (Novy, Kubeczko, et al., 2023, p. 652). However, it also requires a reflexive use, as "a lack of conceptual clarity […] can void the terms of their contribution to challenge the status quo" (Hölscher et al., 2018, p. 1). The debate on urban transformation, for example, has been criticised for its "terminological variety, epistemological disjunctions and blind spots" (Wolfram et al., 2016, p. 18) that need to be reflected upon to develop successful strategies.

For the discourse on street experiments, the concept of transformation is foundational. The term itself was introduced by Bertolini against the backdrop of the need for a "transition to sustainable urban mobility" (Bertolini, 2020, p. 735), drawing on the concept of transition experiments "as potential triggers of socio-technical transitions" (Bertolini, 2020, p. 744). This remains fundamental to the evolving debate: Many articles explicitly situate street experiments within the debates about transformation or transitions, while others share the focus on the impact beyond the individual experiment without using the terminology literally. However, only few articles explicate their understanding of transformation and the role street experiments play in it. As conceptual clarity is essential to ensure meaningful contributions to strategic discourse and practice, it is necessary to examine the implicit understandings.

## *Theory of change*

To do so, "theory of change" is used as an analytical lens. It has its roots in the 1990s' theory-based evaluation of social programmes (Stein & Valters, 2012, p. 3) and is widely established in fields like international development (Rogers, 2014; UNSDG, 2017; Vogel, 2012), health (Landers et al., 2020; Silva et al., 2014), or education (Jankvist et al., 2021; Reinholz & Andrews, 2020) today. It has also been taken up by social movements (I. L.A. Kollektiv, 2022) and in transformation research (Novy, Haderer, et al., 2023). The concept asks practitioners to "explicitly state how they expected a programme to work, thereby making their implicit assumptions explicit […], [so] it can be interrogated, assessed, and revised systematically as it is being implemented" (Reinholz & Andrews, 2020, p. 2). Despite the name, it does not mean creating a comprehensive "theory" in an academic sense. Rather, it means explicating the "mental model" (Holtrop et al., 2021) how an envisioned change can be brought about through concrete actions (Stein & Valters, 2012, p. 2; Vogel, 2012, p. 5). This makes it possible to empirically assess the underlying assumptions and invite critique to generate "better assumptions, better hypotheses of change to strengthen our work, learn from what happens and improve it" (Ortiz in Vogel, 2012, p. 26).

In this sense, theory of change will provide the analytical framework for this paper, drawing on Anderson (2005, pp. 5–7) and Vogel (2012, p. 4). It is comprised of the following elements: (a) *Intervention*: the understanding of street experiments; (b) *Long-term outcome*: the notion of transformation to be achieved with street experiments (whether explicitly stated or implied in the subtext); (c) *Preconditions*: the (empirically recorded or normatively conceptualised) changes brought about by street experiments that form necessary steps towards transformation; (d) A*ssumptions*: the reasons underpinning

why street experiments lead to these changes, and why these changes lead to the envisioned transformation. These assumptions can be explicit, elaborated upon and backed by theoretical frameworks and components, or they may be only implicit backdrops of the argumentation. Together, these elements form an article's inherent theory of change.

Thus, bringing Bertolini's original definition together with the transformation debate, in this paper, "pathways from street experiments to transformation" will refer to empirical descriptions and normative assumptions about how street experiments unfold an impact beyond the individual experiment itself, aimed at triggering a fundamental shift in urban mobility, away from "streets for traffic", and towards "streets for people". This includes aspects like experiments' role in initiating and furthering permanent planning projects, their impact on public debate and acceptance of streetspace reallocation, or their effect on local political dynamics, governance, or regulations.

## Methodology

This section describes the methodology for the systematic review, following the guidelines by van Wee and Banister (2016) and the PRISMA standard (Page et al., 2021). The objective was to identify peer-reviewed academic articles containing conceptual elements about street experiments and transformation, published since Bertolini's seminal article on street experiments in 2020. The search was restricted to English language and utilised the databases Scopus, Web of Science, and TRID. The keyword development presented the challenge to include articles that cover the phenomenon but do not use the literal terms without losing specificity. For street experiments, both established terms like "summer street" and combinations of a term for traffic spaces (like "street") and a term for experimentation (like "pop up") were included. For transformation, following on from the definition in the previous section, a broad set of terms was selected to keep the search open to various understandings of transformation (see Figure 1). In addition, articles citing Bertolini's, 2020 article were also searched to ensure comprehensive coverage.

An initial search was carried out in July 2024 for the period from 2020 to June 2024, which formed the basis for the analysis. In January 2025, the search was repeated for the second half of 2024 and new articles added. Both times, the same methodology was used (see Figure 2). After the removal of duplicate entries (194), titles and abstracts were screened for "false positives' without connection to the topic (340) and for articles not meeting three relevance criteria (76) – (a) *Street*: Involvement of tangible traffic space changes; (b) *Experiment*: Including temporary or provisional measures; (c) *Transformation*: Explicit mentions of transformation, transitions, systemic or institutional changes; or a broader analysis of changes brought about by experiments, such as in political processes, attitudes, or discourse. From the remaining records, one article could not be retrieved, and 27 more were excluded after full-text assessment for not meeting the relevance criteria. Finally, 62 articles were included in the review.

These were systematically categorised into a table, capturing metadata (authors, year, title, journal, article type), content (type of street experiment, case study number and locations), and methods used. Then, a qualitative content analysis (Mayring & Fenzl, 2019) was carried out. First, in a full-text reading of all selected articles, the passages mentioning change beyond the single experiment were identified. These could include clearly

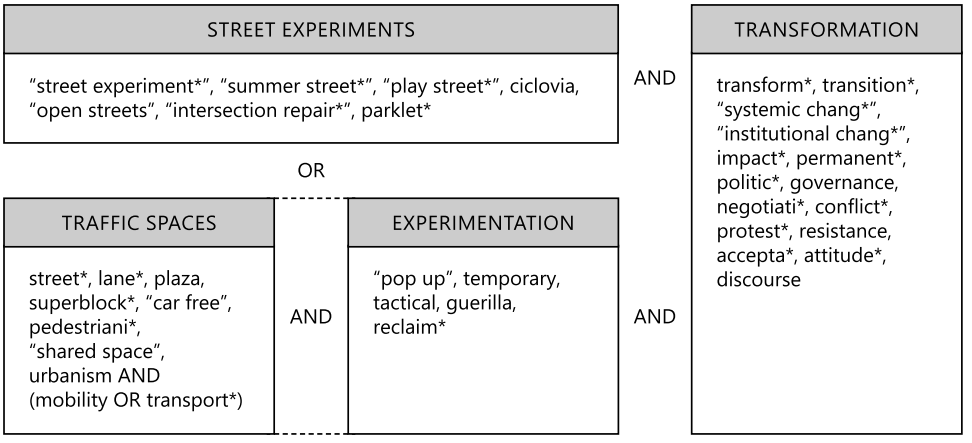


**Figure 1.** Keywords for the systematic search in databases.

articulated theoretical frameworks and components, less elaborated but still explicit assumptions about how experiments lead to transformation, or descriptions of actual or expected changes that imply the link of experiments to transformation. To answer RQ1, the passages were analysed with the analytical framework to identify the theory of change elements. Subsequently, the articles' theories of change were summarised and clustered into four perspectives with shared basic assumptions. The results were discussed in a workshop with four other scholars. For RQ2, all theoretical frameworks and components were listed and summarised, their disciplinary background was investigated, and they were clustered inductively into categories.

## Results

### *Description of literature*

During the period under review, there has been a significant growth in scholarly attention. The number of articles has increased from four in 2020 to 19 in 2023 and 25 in 2024. The analysed literature was published across 35 journals, most in the *Journal of Urban Mobility* (9) in a special issue. Most articles analysed case studies: comparisons of street experiments within or between cities (32) or in-depth single case studies (15). Fewer articles systematised larger numbers of cases (6), using review methodologies and/or own empirical research. Some articles were also purely conceptual works (9). Methodologically, qualitative interviews were the prevalent method (30), followed by surveys (14), and document analyses (13). Media analyses (4), GIS analyses (3), participant observations (3), or other approaches (8) were less common but contribute to the field's methodological diversity. The types of street experiments covered in the literature are diverse, ranging from open streets (14) and pop-up bike lanes (12) to pedestrianisations (6), play streets (5), summer streets (5), parklets (5), superblocks (4), and outdoor dining (4). Several articles also dealt specifically with street experiments as COVID-19 measures (6). Thus, the literature seems to represent well the diversity of approaches in practice.

Geographically, the big majority of articles analysed case studies from Europe (29). North America (9), Australia and Oceania (5), Asia (5), and South America (4) follow

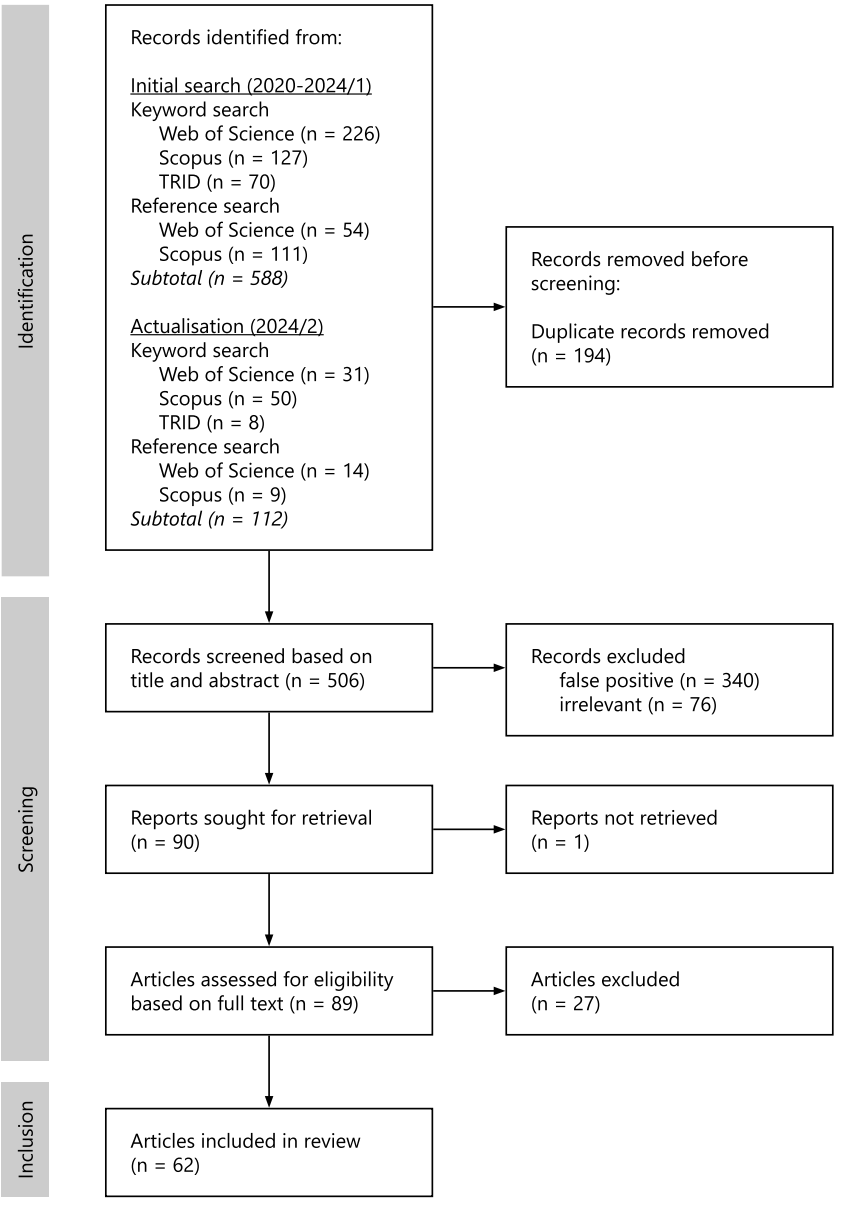


**Figure 2.** PRISMA flow chart of the search and filtering process.

behind, while Africa is not represented at all in the literature. This does not reflect the distribution of street experiments in practice: There is, for instance, a rich landscape of street experiments in the US, the birthplace of tactical urbanism (Lydon et al., 2015), or Latin America, well-known for initiatives like Bogotá's ciclovías (Montero, 2017), not to mention the much more widespread informal appropriation of streetspace for other purposes in the Global South (von Schönfeld, 2024, p. 3). For such informal practices, the lack of consideration might stem from the fact that these practices are rarely acknowledged as experiments but often overlooked or even framed as problems (Hou, 2018). The

disproportionate focus on Europe may also indicate a particular European interest in questions of experimentation and transformation. Also, only two articles draw on a global sample of cases, indicating a potential for more cross-regional comparative research.

## *Theories of change: four perspectives on street experiments and transformation (RQ1)*

In this section, the literature is grouped into four perspectives on how street experiments are related to transformation. For each perspective, the theory of change and its basic assumptions as well as the understandings of experiments and transformation are elaborated. Subsequently, the perspectives are compared and RQ1 answered.

### *The local implementation perspective: "Paving the way for permanent measures"*

From the *local implementation perspective*, street experiments can be seen as a planning instrument to help achieve or accelerate a permanent redesign of a particular space. There are different views in the literature on how they can do so:

Firstly, in one strand of literature, street experiments are perceived mainly as quick, low-cost interventions that are easier to implement than traditional projects, encounter less resistance due to their reversibility, and thus allow for a faster roll-out of infrastructure. Pop-up bike lanes (Becker et al., 2022; Rérat et al., 2022) and other COVID-19 emergency measures (Vásquez et al., 2024; Vecchio et al., 2021) can be seen as prime examples for this. The pandemic was a catalyst for the emergence of such practices, as the extraordinary circumstances promoted the new approach (Meinherz & Fritz, 2023; Nello-Deakin et al., 2024; Verhulst et al., 2023). However, the rapid implementation and deviation from standard planning procedures also raised questions concerning inclusivity and participation (Meinherz & Fritz, 2023; Nello-Deakin, 2024; Slabaugh et al., 2022; Vásquez et al., 2024).

In a second strand, street experiments form part of broader planning processes for permanent streetspace reallocation projects. In this context, experiments are seen as a testing ground, allowing to try out innovative designs (Becker et al., 2022), learn from mistakes and quickly adapt interventions (Vecchio et al., 2021), gain insights on locally specific needs (Cariello et al., 2021; Treija et al., 2023; Vasilev et al., 2023), or create the necessary acceptance for permanent projects (Collins et al., 2024; Gregg & Kickert, 2024; Kyriakidis et al., 2023; Te Boveldt et al., 2023; Tzamourani et al., 2023). They are also seen as a possibility to initiate processes that bring a possible redesign of a space to the municipal agenda, and step by step build public support and political coalitions over time (Stevens et al., 2024).

Closely connected is a third strand, for which experiments are mainly viewed as platform for participation, not only providing insights into community needs, but also making planning processes for permanent redesigns more inclusive (Beyazit et al., 2023; Treija et al., 2023). Street experiments could be characterised from this view as "bottom-linked" processes that allow local communities to collaborate with municipalities. The literature also highlights challenges: For example, it is pointed out that expectations of lasting change are often not met, which can lead to participation fatigue (von Schönfeld, 2024).

This perspective's theory of change can be summarised as follows: Temporary experiments pave the way for a permanent reallocation of streetspace in a specific place. The implicit understanding of transformation could be characterised as a step-by-step urban renewal process, one streetspace at a time. This theory of change is well established in practice, however, there are no explicit theoretical frameworks or components for analysing or conceptualising the pathway from street experiments to permanent implementation and broader transformation. In part, the literature also diverges: While the first strand emphasises rapid implementation even at the expense of inclusivity, the second and third see precisely participation, feedback loops, and learning processes as crucial to building support for permanent measures.

### *The innovation perspective: "Scaling up experiments"*

The second perspective takes a much more theoretical approach: Rooted in transition studies, experiments are characterised as catalysts for innovation. This is theorised most often with the *multi-level perspective* (MLP) for socio-technical change (Geels, 2002). It is quoted explicitly in many articles (Becker et al., 2022; Corais et al., 2022; Hahn & Te Brömmelstroet, 2021; Nello-Deakin et al., 2024; VanHoose, 2023; VanHoose & Bertolini, 2023), but its rationale underpins even more implicitly. Another approach is social innovation (Cruz & Paulino, 2020; Stuchi et al., 2022).

Following the MLP, street experiments can help to create *niches*, in which new practices are developed that challenge the dominant urban mobility *regime*. In conjunction with changes at the overarching *landscape* level, these can change or replace the established practices of the regime. To evolve from niche to regime, experiments need to be *scaled up*. Articles use typologies such as *embedding, translating, and scaling* (von Wirth et al. 2019 in VanHoose, 2023) to normatively outline this process (Bertolini, 2023; Corais et al., 2022; VanHoose, 2023). Other articles lay out dimensions on which street experiments are supposed to unfold their impact (Kinigadner et al., 2024; Nello-Deakin et al., 2024; VanHoose et al., 2022), such as *new ways of thinking, doing, and organising* (Schreiber et al., 2023). Still others employ or develop frameworks that characterise trajectories for niches and scaling under different context conditions (Bertolini, 2023; Corais et al., 2022; Sierhuis et al., 2023; Villani & Talamini, 2023). Furthermore, articles have analysed enablers and barriers for the transformative impact of street experiments, such as intermediaries and local patrons as drivers, or projectification of experiments as barrier (Schreiber et al., 2023). Within the literature, also more concrete mechanisms can be identified for how street experiments can achieve change. First, the literature highlights that they can engage locals and stakeholders, enable collaborative processes, and thus foster public support (Kinigadner et al., 2024; Nello-Deakin et al., 2024; Schreiber et al., 2023), even beyond a specific project, but for a transformation of urban mobility more generally (Bertolini, 2020; VanHoose et al., 2022). Second, it is emphasised that experiments can generate knowledge, e.g. on impacts, attitudes of stakeholders, barriers and drivers, and possibilities of implementation (Kinigadner et al., 2024). This can also help mobilising political support by demonstrating feasibility (Vecchio et al., 2021) or providing evidence to policymakers (Becker et al., 2022). But, more prominently, knowledge and collaborative processes are viewed as key for enabling learning processes (Hahn & Te Brömmelstroet, 2021; Kinigadner et al., 2024; Schreiber et al., 2023). So, street experiments may not only pave the way for measures in one place, but could be replicated,

adopted as ongoing programmes or policies, or translated to other cities (Bertolini, 2023; Brody et al., 2024; Glaser & Krizek, 2021; Malamut, 2024; Zhao et al., 2024). Learning processes are also deemed capable of innovating planning procedures (Kinigadner et al., 2024; Meinherz & Fritz, 2023), changing mindsets and norms, fostering a culture of experimentation and participation, and facilitating flexible and agile processes (Blewden et al., 2022; Glaser et al., 2020; Hahn & Te Brömmelstroet, 2021; Schreiber et al., 2023), changing governance more generally.

The theory of change can thus be summarised in the following way: Experiments create and nurture niches in which new practices are developed. They can be scaled up through generating knowledge, fostering learning processes, and mobilising actors, thus enabling adaptation, replication, institutionalisation, and, ultimately, shifts in governance and planning culture. So, they can challenge and – in interaction with landscape-level developments – change the established local mobility regime.

### *The citizens perspective: "Creating acceptance with experiments"*

The *citizens perspective* focuses on citizens' habits, attitudes, and lived experiences. Thereby, it further explores a crucial element of both previous pathways of change: that street experiments can mobilise citizens, foster public support, and create acceptance for transformation. Again, there are different research foci:

In a first strand, street experiments are understood as catalysts for changing behaviour, and acceptance as use by citizens. The experiments are seen to be able to disrupt established routines and encourage shifts towards more sustainable mobility practices. This is most common in the evaluation of pop-up bike lanes (Becker et al., 2022; Rérat et al., 2022). However, it has been criticised that longer-term aspects such as car ownership need to be considered (Kopp & Pérez Del Pulgar Frowein, 2024).

A second strand focuses on acceptance as an attitude towards projects or policies. This encompasses research on citizens' acceptance of street experiments, understood as precondition for permanent measures (Jarman & Stratford, 2023; Kyriakidis et al., 2023; Treija et al., 2023; Tzamourani et al., 2023). It also includes studies on street experiments' impact on the acceptability of permanent measures, showing a positive effect (Kingham et al., 2020; Noland et al., 2023; Te Boveldt et al., 2023).

The role of citizens' multifaceted lived experiences with street experiments is emphasised in a third strand, criticising an instrumental focus on public acceptance (Smeds & Papa, 2023). In the context of planning processes, it is thus investigated how citizens perceive elements of street experiments to inform permanent measures (Vasilev et al., 2023). More fundamentally, if street experiments are supposed to create acceptance, not only for single projects but also for transforming urban mobility more generally (Bertolini, 2020, 2023; Kinigadner et al., 2024; VanHoose et al., 2022), it is pointed out that citizens' lived experience of experiments needs to be considered crucial for this (Chan, 2024; Smeds & Papa, 2023). This includes research on what citizens value about street experiments (Smeds & Papa, 2023), how experiments disrupt, change, or (re)produce everyday rhythms (Chan, 2024), and how citizens' experience as a psychosocial process, emphasising the role of individual emotional experiences and relationships to place (Marcheschi et al., 2022). From a justice perspective, it is stressed that considering the lived experiences of citizens (Smeds & Papa, 2023), and especially marginalised groups (Kim &

Vogel, 2024; Klaever, Roessner, et al., 2024; Slabaugh et al., 2022, 2023), is necessary if a transformation should not perpetuate inequalities.

A fourth strand investigates street experiments as forms of everyday urbanism or activism, focusing more ephemeral forms like play streets (Lu & Wang, 2024), car free days (Gatarin & Andal, 2024), or unsanctioned pop-up bike lanes (Thorpe, 2023). Here, citizens are conceptualised not as mere recipients of change, but as active political actors.

Overall, this perspective highlights the agency of citizens in transformation processes in its theory of change. While it is disputed if street experiments can directly change habits sustainably, street experiments are seen as capable of influencing citizens' attitudes towards permanent measures and the transformation of urban mobility more generally. Whether this happens depends on the lived experience, for which providing an actual use value with street experiments is key. By generating knowledge about citizens' lived experiences, experiments can also inform permanent measures to better represent local needs and tackle inequalities.

### *The critical perspective: "Dealing with power and conflicts in experiments"*

The *critical perspective* emphasises that street experiments are deeply entrenched in power relations. The research focus lies on the political processes and structures, providing a critical examination of both underlying assumptions and actual political impact of street experiments.

In all perspectives, the pathway of change involves political aspects, such as changing political constellations or planning processes. However, simply assuming experiments will have such an impact "risks painting an overly optimistic picture, in which experiments are seen as neutral interventions with necessarily beneficial outcomes" (Sierhuis et al., 2023, p. 316). This addresses two lines of critique. The first is that the experimentation paradigm can also be viewed critically against a larger political backdrop: Street experiments can become an instrument of austerity urbanism when they merely replace permanent measures (Verlinghieri et al., 2023), confine the combat against climate change to localist measures (Frago & Morcuende, 2024), or transfer power over public space to private sector actors, fostering privatisation, commercialisation, and gentrification (Malamut, 2024; von Schönfeld, 2024). The second is that the political aspects at stake are highly contentious, so, for instance, the assumption that niche innovations will grow and eventually prevail at the regime level is criticised for underestimating the political influence of the established regime actors (Villani & Talamini, 2023; von Schönfeld, 2024). Overall, it is pointed out that it is a result of political struggles whether and how street experiments can contribute to a positive change in urban mobility.

Therefore, it is cautioned to avoid "uncritically adopting universally agreed-upon concepts" (Verlinghieri et al., 2023, p. 17). Thus, articles explore not only *transformation* but also *assimilation, marginalisation,* or *death* of niches (Bertolini, 2023; Villani & Talamini, 2023). Others investigate power in processes, focusing local communities (Klaever, Goetting, et al., 2024; Slabaugh et al., 2023) or more specific groups like mobility-disabled people (Klaever, Roessner, et al., 2024), highlighting the role of previous experiences and personal resources to participate (Klaever & Verlinghieri, 2024). Others analyse discourses around street experiments as political struggles over competing narratives (Hickman & Huaylla Sallo, 2022; Jarman & Stratford, 2024; Nello-Deakin, 2023). Again, others study the resistance of actors within the political-administrative system (Niitamo,

2024) or local businesses (Jarman & Stratford, 2024; Vásquez et al., 2024). Thereby, the critical perspective makes clear that there is no simple right or wrong and highlights dilemmas that need to be reflected upon. Articles point out the tensions between institutionalisation and taming (VanHoose & Bertolini, 2023), equity and viability of implementation (Nello-Deakin, 2024), and different scales (Frago & Morcuende, 2024), or discuss dilemmas of temporariness, commercialisation, distribution, and privilege (von Schönfeld, 2024), or environmental justice (Slabaugh et al., 2022, 2023).

A central theme is conflict. Articles examine conflicts in everyday use of the experiments (Villani & Talamini, 2023) or over planning processes (Verlinghieri et al., 2023; Vitale Brovarone et al., 2023), and introduce conflict typologies: *Substantive conflicts* over spatial implications; *procedural conflicts* over participation in decision-making; *relational conflicts* between political actors of different parties or administrative levels (Verlinghieri et al., 2023; Vitale Brovarone et al., 2023) or caused by mistrust in institutions (Jarman & Stratford, 2024; Kim & Vogel, 2024; Klaever, Roessner, et al., 2024); and *identity conflicts* touching upon underlying values and visions (Klaever, Goetting, et al., 2024; Verlinghieri et al., 2023; Vitale Brovarone et al., 2023). Often, conflict is understood as a barrier for transformation that needs to be prevented or resolved by involvement and consensus building (VanHoose, 2023; Vecchio et al., 2021; Villani & Talamini, 2023).

From a post-political perspective, however, conflicts are seen as an essential component of transformation that cannot and should not be suppressed. It is argued that a consensual approach harbours the risk of excluding alternatives not compatible with the prevailing hegemonic order (Sierhuis et al., 2023). This, in turn, would not only undermine challenging the dominant regime, but also lead to antagonistic polarisation (Verlinghieri et al., 2023). Instead, street experiments should enable radical visioning beyond narrow narratives (Bertolini, 2023) and create an arena for conflicts. Therefore, it is argued, street experiments need to balance politicisation and conflict management (Sierhuis et al., 2023): While experiments without politicisation might end up *optimising the status quo*, without any institutional embedding of conflict they might get stuck in *antagonistic conflicts*. Only considering both would lead to an *agonistic transformation*.

To summarise: From this perspective, transformation can be understood as a political struggle over hegemony, aiming to overcome the prevailing urban mobility system based on neoliberal urbanism and fossil capitalism. Within this political process, street experiments open arenas for agonistic debate, allowing radical alternatives to emerge and fostering societal competence in dealing with transformation conflicts.

### *Comparing the perspectives*

The four perspectives offer distinct focal points, theoretical contributions, and empirical insights. They are not mutually exclusive, and many article combine different aspects. Rather, they help to understand basic assumptions about the transformative impact of street experiments as ideal types. The full list of articles and their assignment to perspectives is provided in the appendix.

As Table 1 shows, each perspective offers a different *understanding of experiments*. From the local implementation perspective, experiments are seen as quick and cheap interventions, testing grounds for permanent designs, or participation instrument. The innovation perspective conceptualises them with transition studies theory as niches where new practices can be developed. From the citizens perspective, encompassing

ideas and methodologies from travel behaviour research, environmental psychology, and everyday urbanism, experiments are interventions in the lifeworlds of citizens. The critical perspective, again, considers experiments as arenas of conflict and agonistic debate, drawing on post-political theory.

The differences are also mirrored in the *understanding of transformation*. The local implementation perspective envisions transformation as a material, step-by-step urban renewal process. The innovation perspective conceptualises transformation with the multi-level perspective as socio-technical change in an interplay between niches, regime, and landscape level. From the citizen perspective, transformation can be thought of as a societal shift in attitudes and everyday practices. The critical perspective highlights transformation as a political struggle over hegemony, aiming to overcome an urban mobility system grounded in neoliberal urbanism and fossil capitalism.

And so, the *preconditions* and overall *theories of change* diverge, too: For the local implementation perspective, experiments can pave the way for a permanent solution in the same place, because they are quick and inexpensive to implement, provide insights for permanent plans, and allow for participation. The innovation perspective emphasises the role of collaboration, knowledge, and learning for scaling up experiments, which

**Table 1.** Summary of the perspectives.

| Perspective | Local implementation perspective | Innovation perspective | Citizens perspective | Critical perspective |
|---|---|---|---|---|
| Theory of change | Experiments pave the way for a permanent reallocation of streetspace in a specific place | Experiments are scaled up through replication and institutionalisation, leading to shifts in governance and planning culture | Experiments influence citizens' habits and attitudes towards permanent measures and urban mobility transformation more generally | Experiments foster agonistic debate and allow radical alternatives to emerge |
| Understanding of experiments | Quick, low-cost intervention; Testing ground; Participation | Niche in which new practices are developed | Intervention in citizens' lifeworld | Arena for participation, conflict, and visioning |
| Understanding of transformation | Step-by-step urban renewal process | Interplay of niches, regime, and landscape level (Multi-level perspective) | Societal shift in attitudes and everyday practices | Political struggle over hegemony |
| Preconditions | Experiments are quick and inexpensive to implement, provide insights for permanent plans, and allow for participation | Experiments foster collaboration, generate knowledge, and enable learning processes | Experiments provide an added everyday value and are received well by citizens | Experiments can keep the balance between politicisation and embedding of conflict |
| Theoretical frameworks and components | - | Experiment characteristics, Transformation models, Scaling mechanisms, Impact dimensions, Change trajectories | Experience and value models | Change trajectories, Conflict typologies, Dilemmas |
| Backgrounds | Urban planning, Participation | Transition studies, Social Innovation | Mobility behaviour research, Environmental psychology, Everyday urbanism | Policy analysis, Post-political theory |
| Number of articles | 20 | 24 | 19 | 21 |

enables replication, institutionalisation, and, ultimately, shifts in governance and planning culture. From the citizens perspective, experiments influence citizens' attitudes towards permanent measures and urban mobility transformation more generally, when they can provide an added everyday value. In the critical perspective, experiments create spaces for agonistic debate and the emergence of radical alternatives, if they can balance politicisation and embedding of conflict.

## *Theoretical frameworks and components (RQ2)*

This section answers RQ2, presenting the theoretical frameworks and components used in the literature to analyse or conceptualise pathways from street experiments to transformation, which elaborate and substantiate the assumptions inherent in the theories of change. Table 2 provides a short overview. A full table with all primary and secondary sources is provided in the appendix.

Between the perspectives, the amount, comprehensiveness, and detail level of theoretical frameworks varies widely. The local implementation perspective, for instance, involves no explicit theoretical components. On the one hand, this mirrors its rather straightforward theory of change and frequent combination with other perspectives. On the other hand, it may also indicate a need for theorising to better understand how and under what conditions street experiments lead to permanent change, and to what extent this contributes to wider transformation.

The innovation perspective, in contrast, thrives on the number of theoretical frameworks that it imports, mostly from transition studies. It includes *transformation models* such as the multi-level perspective, by far the most widely used framework in the literature. These help situating experiments within a wider transformation process. *Change trajectories* sketch out paths of successful transformation and failed attempts, shedding light on the interaction between experiments and their political contexts. *Experiment characteristics* contain different normative criteria for what makes street experiments transformative or innovative, such as *radical*, *feasible*, or *challenge-driven*. *Scaling mechanisms* break down how experiments are supposed to catalyse broader change. Some offer somewhat open keywords, such as *deepening, broadening, and scaling up*, others more comprehensive and specific models of project-scale change such as a *political economy framework for transport innovations*. These mechanisms contain fruitful components for building theories of change, even though they remain, in places, formulaic. *Impact dimensions* help to systematise (interim) outcomes to be achieved with experiments, such as *behavioural, institutional, material, and organisational changes*, or *new ways of thinking (culture), doing (practices) and organising (structure)*. These can be thought of as individual levers of a more comprehensive transformation. *Assessment frameworks* combine several of these aspects to provide more comprehensive guidance for evaluation. Compilations of *enablers and barriers* offer practical guidance and allow insights into the preconditions for a transformative impact of experiments.

The citizens perspective supplements the conceptual toolbox with *experience models*. Stemming from environmental psychology, the *human environmental interaction model* conceptualises how citizens experience street experiment as a psychosocial process between the physical environment, the social environment and individual resources. Drawing on urban design theory, a street value typology highlights what they value in

**Table 2.** All theoretical frameworks and components (short overview).

| Category | Theoretical frameworks and components | Background | Perspective |
|---|---|---|---|
| Transformation models | Multi-level perspective: Niches, regimes, landscape | Transition studies | Innovation |
| | Multi-phase concept for transitions: Pre-development, take-off, acceleration, stabilisation | Transition studies | Innovation |
| Change trajectories | Transition context scenarios: Reorientation of trajectories, endogenous renewal, emergent transformation, purposive transition | Transition studies | Innovation |
| | Niche trajectories: Death, marginalisation, assimilation, transformation | Transition studies | Innovation, Critical |
| | Scenarios of change: Optimising the status quo, blind leap, antagonistic conflict, agonistic transformation | Post-political theory | Innovation, Critical |
| Experiment characteristics | Transition experiment criteria: Radical, challenge-driven, feasible, strategic, and communicative | Transition studies | Innovation |
| | Transition experiment characteristics: Innovation, connection to long-term social challenge, focus on interactive learning | Transition studies | Innovation |
| | Social innovation characteristics | Social innovation | Innovation |
| Scaling mechanisms | Deepening, broadening, scaling up | Transition studies | Innovation |
| | Diffusion: Embedding, translating, scaling | Transition studies | Innovation |
| | Consolidating experiment results: Making permanent, replicating, learning | Transition studies | Innovation |
| | Multi-agent model of innovation in services | Innovation theory | Innovation |
| | Political economy framework for transport innovations | Political sciences | Innovation |
| Impact dimensions | Dimensions of system change: Behavioural, institutional, material, organisational | Transition studies | Innovation |
| | Change types: New ways of thinking (culture), doing (practices) and organising (structure) | Social innovation, Transition studies | Innovation |
| | Change types: Practices, norms, governance | Transition studies | Innovation |
| | Carbon footprint model of urban mobility behaviour | Environmental politics, Mobility behaviour research | Citizens |
| Assessment frameworks | Combination of transition experiment criteria and dimensions of system change | Transition studies, Evaluation | Innovation |
| | Goals, characteristics, impacts, learnings | Transition studies, Evaluation | Innovation |
| Enablers and barriers | Experiment internal and external barriers and enablers | Evaluation | Innovation |
| | Enablers on micro, meso, and macro-level | Social innovation, Transition studies | Innovation |
| | Ideal-typical roles of municipalities: Promoter, enabler, partner | Transition studies, Political sciences | Innovation |
| Experience models | Human environmental interaction model applied to street experiments | Environmental psychology | Citizens |
| | Street value typology: Mobility, public space / Functional, social, safety, environmental, economic | Urban design, Environmental psychology | Citizens |
| | Interaction of rhythms: Disrupting, changing, activating hidden, (re)producing | Everyday urbanism | Citizens |
| Conflict typologies | Procedural, distributional, identity | Political sciences | Critical |
| | Substantive, procedural, relational | Political sciences | Critical |
| Dilemmas | Paradoxes for open streets: Displacement, hegemony, safety, white spaces, engagement, stigma | Environmental politics | Critical |
| | Dilemmas: Temporariness, commercialisation, distribution, privilege | Critical planning theory | Critical |
| | Epistemic justice: Testimonial, hermeneutic | Philosophy | Critical |
| | Environmental justice: Distributional, interactional, procedural, recognitional | Environmental politics | Critical |
| | Dilemmas: Institutionalisation, taming | Transition studies | Critical |
| | Trade-off: equity, viability of implementation | Critical planning theory | Critical |
| | Scale paradoxes: Local-centrism, horizontal fragmentation, functional fragmentation | Critical geography | Critical |

their experience. Finally, a typology of interactions with rhythms of everyday life gives insights why some well-intentioned interventions fail to resonate with citizens. These theoretical frameworks and components provide analytical tools to help understand whether and how street experiments can generate the acceptance they are supposed to.

The critical perspective, finally, complements theoretical frameworks and components that allow to reflect upon political processes and results. Building a bridge to the innovation perspective, *change trajectories* explore also failed attempts and negative outcomes of experimentation. The analysis and understanding of *conflicts*, understood as crucial for the political impact of street experiments, is supported by *conflict typologies*. Finally, *dilemmas* point to the ambivalences of street experiments that need to be reflected upon when aiming at transformation. These are both inductively developed from street experiment case studies and derived from more abstract justice theories.

## Discussion and conclusions

This article aimed to contribute to understand how street experiments lead to transformative change by a systematic review of the literature, analysing the implicit and explicit theories of change (RQ1) as well as theoretical frameworks and components (RQ2).

The results show a notable increase in academic attention in the last years. The debate is diversifying in content, methodology, and theory; however, the results also indicate a geographical bias as most articles focus on European cases. This does not reflect the actual geographical distribution of what could be labelled "street experiments" but might rather indicate a particular European interest in questions of experimentation and transformation.

Reflecting on the methodology, several limitations must be acknowledged. Firstly, while much of street experiments debate is driven by practitioners in grey literature, the analysis was restricted to academic articles. However, this paper did not aim to provide an exhaustive overview over street experiments' transformative impact. Instead, it focused on the theoretical level, reviewing how the pathway from street experiments to transformation is academically conceptualised. Secondly, this paper also did not tap into the potential of neighbouring debates, such as living/real-world labs in mobility. This limitation indicates a missing link between these debates and the street experiment discourse. Thirdly, this article did not evaluate *whether* experiments lead to transformation, as this is beyond the scope of such a review. Nevertheless, clarifying *how* the pathway to transformation is conceived can be seen as a prerequisite for its theoretical and empirical assessment.

For this endeavour, theory of change proved valuable as analytical framework. In the qualitative content analysis, the articles' conception of street experiments and transformation, preconditions, and basic assumptions could be discerned, allowing to identify and compare the respective theories of change. Doing so, four perspectives on street experiments and transformation with different theories of change could be distinguished (RQ1): For the *local implementation perspective*, experiments pave the way for a permanent solution in the same place. In the *innovation perspective*, experiments build niches that are scaled up through replication and institutionalisation, leading to shifts in governance and planning culture, challenging the urban mobility regime. From the *citizens perspective*, experiments influence citizens' attitudes towards permanent measures and urban

mobility transformation. The *critical perspective* considers experiments as arenas of conflict, in which radical alternatives can emerge from agonistic debate, highlighting transformation as a political struggle over hegemony.

In most aspects, the perspectives rather provide complementary viewpoints than mutually exclusive beliefs about street experiments and transformation, and many articles combine different elements. However, there is an incompatibility between an evolutionary notion of transformation, most prominent in the innovation perspective, reflecting the communicative planning paradigm, and the conflictual notion of the critical perspective, reflecting an agonistic planning paradigm. However, contributions that bridge this gap are particularly valuable: The innovation perspective can benefit from political science analyses for an empirical reality-check and a reflection on the embedding of experiments in larger political trends. The critical approach, in turn, which is often "less outspoken about actionable strategies and practices" (Sierhuis et al., 2023, p. 316) can benefit from the practice-oriented theoretical frameworks from the innovation perspective.

In the next step, the theoretical frameworks and components were discussed (RQ2). Especially the innovation perspective offers a great number of theoretical contributions, predominantly from transition studies. This includes transformation models, such as the often-used *multi-level perspective* (MLP), change trajectories, experiment characteristics, scaling mechanisms, impact dimensions, assessment frameworks, as well as enablers and barriers. The citizens perspective provides experience models that help understanding whether and how street experiments can create acceptance for further transformations. Finally, the critical perspective offers typologies of conflicts and dilemmas that help to address the tensions inherent in transformative processes. Overall, the literature contains a wide range of theory from comprehensive frameworks to small components, serving various analytical or normative purposes, both inductively developed from empirical work on street experiments and deductively applied theory from other fields.

Partially, however, the added value of imported theories is limited because they are not sufficiently applied to the specificities of street experiments or empirically grounded within the street experiments literature. For example, the MLP often remains a mere background with which the empirical results are not brought into dialogue. Also, key concepts such as "acceptance" or "learning" are not defined or further elaborated on. Thus, despite the growing body of research, it remains to a considerable extent unclear whether, how and under what conditions street experiments actually have an impact beyond the individual project, and to what extent this contributes to a wider transformation.

There is therefore a need for researchers to develop more robust theories of change to better inform street experimentation in practice. This requires, on the one hand, theorising: Inductive theorising from concrete cases can provide a way to better connect abstract theoretical frameworks and components to the complex reality of street experiments. Importing available theory from other fields can help to better understand and conceptualise key impact mechanisms, such as generating knowledge, enabling learning processes or creating acceptance. On the other hand, an empirical assessment of assumptions is needed to test the established theories of change. To date, few studies have systematically examined the afterlife of experiments over a longer period. Latest publications already demonstrate the value of such an approach (VanHoose et al., 2025; Schreiber, 2025).

The conclusions for practitioners are to carefully design street experiments so that process and outcomes can drive long-term change. A theory of change can help move

beyond buzzwords to concrete steps and help linking street experiments to strategic goals. Also, especially in a polarising debate about mobility transformation, practitioners should not avoid conflict, as it is an inherent part of transformation. Rather, they should leverage the potential of street experiments to proactively address conflict.

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