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An interdisciplinary perspective on scaling in transitions: Connecting actors and space

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ABSTRACT

The question of how sustainable innovations and how niche experimentation lead to systemic changes are a core motivation of sustainability transitions research. As an inherently interdisciplinary field, although this question is addressed from different academic perspectives, the dominant understanding of relevant scaling processes is grounded in concepts of growth, diffusion and expansion. This article contributes to the discussion of more nuanced understandings of scaling, acknowledging the value of ontological levels for analytic purposes, but also drawing on knowledge from socio-psychological and spatial perspectives. Alternative understandings of spatial and agency-related scaling approaches are discussed and compared. An integrative socio-spatial framework is developed, providing a mid-range framework capable of supporting analysis of transitions that connects different disciplinary perspectives within a level-based ontology. We use an illustrative case study and derive implications for how this can inform questions of scaling and particularly spatial upscaling of new ways of doing, thinking & organizing

1. Introduction

The question of how to scale 'sustainable' innovations or, in transition terms, how to foster upscaling processes that lead from niche experimentation to wider socio-technical change, is a core research interest of the field. According to van den Bosch and Rotmans, scaling up refers to a shift of scale from the niche to the regime level, "defined as embedding a transition experiment in new dominant ways of thinking (culture), doing (practices) and organizing (structure), at the level of a societal system" (Grin et al., 2010; van den Bosch and Rotmans, 2008, p. 146, p.33) .[1]

For now, the multi-level perspective (MLP; Geels 2002) is the dominant framework that tends to shape our understanding of scaling in transitions. This MLP-based thinking has shaped our understanding of scaling in a holistic way and has provided a set of shared concepts for the research field, aiding the rapid development of sustainability transitions research (see Köhler et al., 2019). Yet, it also embodies particular limitations in terms of perspectives on scaling. These limitations have to do with some of the origins of the

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[1] Here we leave aside the issue of what 'embedding' constitutes in terms of agentic theory. Our intention is rather to highlight socio-psychological dimensions that are likely to be important at an actor level, in place-based socio-technical transitions.

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socio-technical transitions field, i.e. evolutionary thinking and economics, science and technology studies, and theories of innovation, all of which have their own ontological assumptions or implicit theories of change, e.g. along the lines of an S-curve model (Safarzynska et al., 2012). This type of thinking sometimes leads to questions of upscaling being reduced to an oversimplified focus on the growth of specific indicators, e.g. in terms of diffusion of innovation, market growth, spatial expansion etc. (Augenstein et al., 2020) and implies an image of growth-oriented "bigger is always better" (Lam et al., 2020, p. 4).

Especially in the context of urban transitions and research in urban real-world labs, this particular perspective on scaling has limitations with regard to the more subtle change mechanisms which real-world labs aim at, e.g. changes in actors' attitudes and behaviours, as well as network and capacity building, all of which play a role in broader transition processes (Schneidewind et al., 2018; Wolfram 2016; Hodson and Marvin 2010). As a consequence of the growing interest in urban transitions and locally embedded transition experiments, a number of studies have recently begun to develop typologies describing different mechanisms of scaling in these new urban contexts (von Wirth et al. 2019; Dijk et al., 2018; Ehnert et al., 2018). As pointed out by Augenstein et al. (2020), a major challenge is to integrate this emerging body of knowledge, where concepts of scaling are based on a variety of different underlying ontologies, epistemologies and also practice-based approaches. So far, research on scaling tends to produce a "simplification dilemma" where frameworks or typologies suggest predictable mechanisms of change - e.g. building on stylized and ideal-typical S-curve models - failing to "embrace the complexity of social change and to accept that innovation and transformation is neither predictable nor controllable" (Augenstein et al., 2020, p. 144).

In order to improve our understanding of the complexities involved in niche-regime interactions in local urban contexts, the goal of this paper is to develop a framework which allows us to study these various underlying change mechanisms in their place-based context. Our starting point is the very simple fact that urban sustainability transitions are "inherently rooted in geographical contexts, political cultures, and driven by engaged citizens or entrepreneurs" (Loorbach et al., 2020, p. 252). Following from this, we are particularly interested in studying the human-centered individual and societal change mechanisms in their locally embedded, spatial context. Two novel research strands on transitions which play a key role here are those on *actors* ("engaged citizens or entrepreneurs") and *space* ("geographical contexts, political cultures").

The actor-centered perspective on transitions focuses on scaling strategies which take human action - rather than increasing the uptake of innovations per se - as a key focus. It improves our understanding of individual and social behavior as a key part of transitions (Bögel and Upham 2018; Upham et al., 2020; de Vries et al. 2021). So far, these approaches focus most often on consumers but more recently also addressing other actor groups, e.g. planners (see Bögel et al., 2019a). These individual-level focused, psychological approaches come with certain limitations, e.g. the risk of overestimating the power of individuals in steering or influencing transitions and to a certain degree a neglect of the (spatial) structures in which individuals act (Bögel and Upham 2018). However, they are a response to the converse risk, which is arguably more prevalent, namely of omitting important micro-level processes in higher-level accounts.

Implications for scaling from a spatial perspective highlight the spatially grounded coordination and local context of socio-technical innovation (e.g. Binz et al., 2020). The recent strand on spatial approaches in transitions, e.g. the geography of transitions, improves our understanding of the spatial embeddedness of transitions processes. Yet, this comes with certain limitations as well, with regard to scaling approaches, e.g. the challenge of measuring the impact of urban real-world labs as physical interventions and hence estimating consequent societal change, as well as a lack of scaling strategies beyond 'more of the same in more and different places'.

Neither actor nor spatial approaches come without attendant limitations, therefore. Yet, brought together, they do have the potential to inform a framework for the study of human-centered change mechanisms in their locally-embedded context. Such a framework can use the respective strengths of the approaches to support the study of explicit interrelations between place-based change and corresponding mechanisms in terms of social dimensions. To date, in transition studies and in the context of scaling, explicit research on the *interrelated* change mechanisms of both spatial and social processes is still uncommon (for notable exceptions see e.g. Horlings 2017; Strambach and Pflitsch 2020).

For this purpose, we start from a common starting point that different spatial and social science approaches share: the concept of relational space. Here, space represents on the one hand a constituting variable - space as a container that determines certain behavior - and on the other hand as a socially constituted variable - space that is made by people. Accordingly, the nature of space is an inherent actor-centered approach in itself, and manifold spatial concepts have been established in sociology (e.g. sociology of space, Löw 2008); psychology (e.g. place attachment, Scannell and Giffrod 2010); human geography (e.g. human geography generally, Malpas 2012), spatial planning (e.g. place-making, Jessop et al., 2008); and in transition studies, the geography of transitions (e.g. Binz et al., 2020). We identify the relational space concept as common ground to start from for the transition discussion as well, to deepen our understanding of societal-spatial change mechanisms for urban real-world labs.

Concepts of relational space, where space is the container for agency and simultaneously constructed through agency, connect well to the sociological foundations of the MLP (regarding spatial concepts in the MLP see also Raven et al., 2012). Building on Giddens' structuration theory Giddens (1984), levels in the MLP are differentiated along degrees of structuration, i.e. the degree to which knowledgeable actors reproduce their structural contexts or shape and change these contexts as an outcome of their action (Geels 2011). The concept of scaling in the MLP - new ways of doing, thinking, organizing - is inspired by Giddens' modalities of structuration: actors draw on interpretative schemes, norms and resources in social interaction situated in spatial contexts. We want to contribute to a better understanding of these structural dynamics in urban real-world labs (Schneidewind et al., 2018) focusing on scaling as an outcome of spatially situated structure-agency dynamics. Our approach is thus a socio-spatial one.

With regard to its spatial roots, the socio-spatial approach that we are proposing draws not on the traditions of geographies of transitions (Binz et al., 2020; Coenen/Truffer, 2012; Raven et al., 2012; Binz et al., 2014; Truffer et al., 2015), but rather from a

perspective of spatial transformative planning (e.g. Horlings 2017, Grenni et al., 2020, Levin-Keitel et al., 2018). Both disciplines start from a relational understanding of space. Yet, the focus of the foregoing planning theories on future-oriented and actor-led normative knowledge, which we expand on below, offers an alternative route for transition studies seeking to understand actors in space, especially with respect to different spatial dimensions and their interrelations in time.

Accordingly, in order to develop a framework for scaling that can be used to analyze the roles of physical places such as urban real-world labs, we combine a socio-psychological and a socio-spatial planning lens to better understand change mechanisms and to connect them to structure-agency dynamics underlying the MLP. For this purpose, we develop an interdisciplinary framework that builds on existing perspectives on actors and space, considering recent developments in the two fields, respectively, and that responds to the shortcomings of both disciplinary perspectives for socio-spatial analysis, as described above. We address the following research questions in our work:

- **RQ 1:** Which implications for scaling arise from actor and spatial perspectives?
- **RQ 2:** What limitations do the two disciplinary approaches have and where could they complement each other with regard to scaling perspectives?
- **RQ 3:** How can they be connected more closely and which implications for scaling derive?

In the following, we outline the actor-centered and the spatial perspective and their respective implications for scaling in more detail (Section 2). We take this as a basis for connecting the actor-centered and the spatial perspective in an interdisciplinary framework (Section 3). This integrative socio-spatial framework provides a mid-range framework capable of supporting analysis of transitions that connects different disciplinary perspectives. In Section 4, we use an illustrative case study and derive implications for how this can inform questions of scaling, particularly in the field of urban transitions and in the context of urban real-world labs.

2. Disciplinary perspectives on scaling sustainability transitions: actor-level and spatial approaches

2.1. An actor-level perspective on sustainability transitions and implications for scaling

While the importance of understanding agency in transitions is agreed upon (e.g. Genus and Coles 2008; Geels 2011; Köhler et al., 2019), the debate on how far transition studies have come with regard to its study is a point of discussion. Several authors have repeatedly claimed – from different perspectives - that agency remains an under-studied field in transitions (see e.g. Smith et al., 2005; Hörisch 2015; Bögel and Upham 2018; Svensson and Nikoleris 2018). Yet, others have pointed out that current transition models such as the MLP are “shot through with agency” (Geels 2012, p. 474; see Geels 2020 for a more recent perspective on this issue).

A key to understanding this debate and its implications for scaling lies in the definition of scales of agency in transition studies. This concerns in particular the difference between scales of individual and collective agency. Collective agency comes to be expressed through institutions and organizations and can, thus, be defined as actions of a group of actors, e.g. organizations (see e.g. Kivimaa 2014), or cities (see e.g. Geels 2012). It lends itself to explanatory accounts that involve shared, social processes and is, thus, close to a sociological perspective. The latter, in turn, underlie the key assumptions of socio-technical frameworks such as the MLP (Geels 2002). Most studies in the transitions literature address agency at the high (aggregate) level of such frameworks. In contrast, individual agency refers to the subjective experience and resulting actions of single persons. Here it can be agreed that individual agency is far less studied in transition research (Barnes 2019; Bögel and Upham 2018; Svensson and Nikoleris 2018).

2.1.1. Implications for scaling from an actor-level perspective

The scale at which agency is assumed to be exerted has substantive implications for thinking about how to scale sustainability and hence orchestrate transitions overall. Micro-, individual-level accounts, e.g. stemming from psychology, have focused their implications for scaling sustainability on the individual-level. Most often these address individuals in their role as consumers (see Bögel and Upham 2018 for an overview). Yet, individualistic psychology has been criticized for overestimating the power of the individual and neglecting the structural constraints of human action (see e.g. the ABC-critique by Shove, 2010). Approaches based on a collective understanding of agency, in contrast, tend to neglect the roles of individuals and their motivations, which have critical implications for steering transitions. The following section discusses reasons for the, so far, often missing links between the different disciplinary scales and scaling, perspectives and ways forward. This includes two key limitations of current approaches: (i) bridging approaches which connect the individual and collective scale of agency, as well as (ii) perspectives on how to embed the study of actors and their agency in their spatial context.

2.1.2. Implications for an interdisciplinary framework

Recent studies identify underlying paradigms (conjoined ontologies and epistemologies) as a key barrier for integrating these different – yet equally valuable – perspectives for the study of agency in sustainability transitions (Bögel and Upham 2018). Regarding the goal of bridging individual and collective levels of agency, the development of cross-over approaches between psychological and sociological perspectives is seen as a key element of further research (Bögel et al., 2019b). We return to this in Section 3, where we present a framework from social psychology that lies at the intersection of psychology and sociology and that aims to connect the individual and collective level of agency. While the socio-psychological approaches promise to improve our understanding of individual-level actors in and as an integral part of sustainability transitions, they have one key limitation: With their focus on the actor-level, they still tend to neglect the physical and spatial context (Bögel and Upham 2018; notable exceptions can be found in work

focusing on place and psychology, e.g. Scannell and Giffrod 2010). This is a particularly noteworthy limitation when considering transformative urban development, given the situated approach of transformative formats such as real-world labs and the important role of spatial context (Beecroft et al., 2018; von Wirth and Levin-Keitel 2020). In the following, we therefore discuss a spatial perspective on urban transitions, related implications from this perspective for scaling, and implications for the development of our interdisciplinary framework.

2.2. A spatial perspective on urban transitions and implications for scaling

The fact that space matters is increasingly becoming common ground in spatial sciences and in transitions studies (reflecting a spatial turn in the social sciences in general e.g. Goodchild and Janelle 2004; for transitions studies e.g. Coenen et al. 2012; Levin-Keitel et al., 2018). In transitions studies, so far, the spatial context is often considered when dealing with place-based solutions, place-making or apparently more innovative urban settings (e.g. Murphy 2015; Raven et al., 2012; Nevens et al., 2013). The spatial perspective is hereby represented in two different strands as outlined above: geography of transitions and spatial transformative planning.

For both strands, there is a call for more systematic and comparative research that aims to identify the influence of geographical conditions on transition processes and, in particular, the interrelations of changes in the physical world and their interrelations within a social or societal dimension of experimentation (Binz et al., 2020; Wolfram 2016a; Hodson et al., 2017; Köhler et al., 2019; Sengers et al., 2019). The latter is also a good illustration of why this kind of research is needed: Questions of scaling experiments quickly reveal the complexity of spatial influences that are far from the simple physical dimension: Changing places physically with transition experiments even in a local neighborhood can have crucial implications for an entire city or even a region on a societal level, due to learning processes and concomitant changes in practice; whereas national regulations as a societal dimension can determine local windows of opportunity and the ways in which places are constituted in a city or neighbourhood.

2.2.1. Implications for scaling from a spatial perspective

Scaling from a spatial perspective touches not only on physical aspects, but on a range of activities and actions. It becomes evident that other spatial dimensions such as innovative regulations, symbolic character or self-efficacy of actor groups become key questions of how innovations can be scaled in space beyond simply more in the same place. Major issues for scaling and its study evolve in two differing aspects, a content-oriented approach (in the analytical sense of scaling - e.g. a stronger network, or a larger network); and a process-oriented approach (in the processual sense - e.g. incrementally or synoptically – i.e. studying *how* a network strengthens and grows). The former plays a key role in the analysis of transitions, is often implicitly intertwined in other disciplinary approaches, but is rarely isolated as a spatial perspective. Examples include multi-level actor constellations also meaning actors on different spatial scales (city, region etc.); or the changed symbolic character of a site within the entire city. The latter, the question of how to actively scale (up or down) innovations for sustainability leads to a more procedural perspective, an action-oriented spatial perspective. In these kinds of procedural theories, spatial scaling can be seen as spatially grounded coordination of future innovations.

While the new field of the geography of transitions has emerged as a key contributor in this regard (see Binz et al., 2020), we extend this line of research by focusing on insights from the field of spatial planning. We see particular merit in opening up this, so far, less connected field of spatial approaches, as a planning approach puts particular emphasis on the process of place-making, co-production and the constitution of physical and social dimensions of space in different scales. This relates closely to our goal of studying the human-centered, social change processes in their place-based context.

2.2.2. Implications for an interdisciplinary framework

We see the need to ask where these coevolutionary processes take place, how to steer or navigate towards sustainable solutions, and how to create these various developments in a living democracy. While a spatial perspective on scaling in transitions promises to aid understanding of place-based, local-specific contexts in a more systematic way, its limitations lie in the lack of differentiation of actor groups, despite the plurality of (intra-) collective and individual perceptions of physical and social space. To date, in the transitions literature, actors tend to be characterized as (homogeneous) groups such as politicians, public administration, civil society etc., neglecting the plurality within these groups. Current theoretical approaches of planning theory start to take this into account by focusing on cultural and practice-oriented perspectives in actor groups (Othengrafen and Levin-Keitel, 2019). Yet, the individual level is still rarely addressed. This is where we see merit in combining spatial approaches with actor-level studies.

2.3. The need for an integrative perspective on actors and space in transition studies

Overall, both actor-level and spatial concepts are key research gaps in transition studies (Binz et al., 2020; Coenen and Truffer. 2012; Bögel and Upham 2018; Upham et al., 2020). We argue that instead of calling only for more separate inputs from each of the two perspectives, an integrated approach has much to offer with regard to our understanding of scaling in transitions. While actor-focused approaches to scaling often lack the contextual-spatial perspective, spatial theories, on the other hand, could benefit from socio-psychological and sociological insights on actors' individual and collective perceptions. Here our goal is to present a framework that aims to show the use of further concepts from the actor and spatial perspective in general and to highlight the value of integrating the two viewpoints.

3. Conceptual framework

For the purpose of developing an integrated socio-spatial framework, we first separately present a spatial and an actor-level framework. Second, these are combined into a socio-spatial framework on scaling in transitions. It should be noted that while we choose from the broad range of actor-centered (for recent overviews see e.g. Huttunen et al., 2021; Steg et al., 2021) and spatial frameworks (e.g. the TPSN by Jessop et al., 2008 or the conceptualisation of Graham and Healey 1999), our purpose is to illustrate the merits of combining spatial and actor-level frameworks and to lay the ground for a broader research agenda on socio-spatial perspectives on scaling in sustainability transitions, not to make a case for these frameworks over others. That said, to pave the way for this agenda, we have chosen frameworks that are in line with basic sociological foundations conceptualizing structure-agency dynamics in the MLP, that are readily applicable to urban transition case studies and, thus, that can easily travel between disciplines.

3.1. Spatial framework

Sustainability transitions require an understanding of space that views the latter not only as a physical container for our activities, but as a social space, in recognition of its constitution of past and future actions as well as cultural, regulative and physical processes. The constitution of such space has been elaborated by thinkers from Euclid to Foucault and many others in different disciplines concerned with spatial processes (see e.g. Yeung 2005 from a geography perspective; see Goodchild and Janelle 2004 for social sciences in general). The work of Lefevbre (1974) in particular should be mentioned in this context. Lefevbre argued that space is a social product and a complex social construction affecting spatial practices and perceptions. He introduced the analytical shift of focus in geography from space per se to the processes of its production, the plurality of spaces made productive in social practices, and the focus on the contradictory, conflictual, and, ultimately, political character of the processes of production of space. He developed a holistic societal theory on the production of space which deeply influenced current urban theory, mainly within human geography.

Yet, when selecting a concept of relational space as a framework, we require here a more readily operationalisable concept, while at the same time acknowledging that simple frameworks cannot do justice to the depth of space, place and place-making discussions behind such approaches. In sustainability transition studies there is a recently published conceptual study that offers a promising framework for a spatial perspective on urban transitions by von Wirth & Levin-Keitel (2020). The framework by von Wirth & Levin-Keitel (2020) offers an approach to evaluate sustainability experiments in their local embeddedness beyond a general local context. It allows the study of the effects of local experiments for an entire city and the different mechanisms of change could be analysed in more detail.

The latter framework, particularly developed for studying urban real-world labs, comes with certain advantages for our purpose: First, the framework is based on the relational space approach and, thus, builds on the common foundations outlined in the introduction. (von Wirth and Levin-Keitel 2020). Second, and in line with this first argument, is the close relation of the framework to other on-going work in transitions. The four dimensions outlined below can be found in comparable work, e.g. in approaches connecting spatial studies and institutional theory (see Strambach and Pflitsch 2020). Third, notable for our purpose is particularly its roots in the sociology of space (Löw 2008) which fits well with our purpose of deepening the agentic dimension of spatial research by connecting it to socio-psychological human-centered change mechanisms.

The framework builds on four analytical dimensions. It emphasizes the mutual dependence of all of the dimensions on the others, but also the necessity of an analytical separation as an independent facet (Läpple 1991, 196f; Sturm 2000, 199f). With a focus on urban transitions, the following four dimensions are characterized as following:

(I) physical dimension

The physical dimension - originally material-physical dimension - covers all that can be touched and directly perceived in a space. It refers to the concept of container space and includes all tangible and immediately visible elements. While physical refers to the concerned nature (such as physical geography), material rather includes "products of human beings that have become objects of life and settlement" (Sturm 2000, p. 200, own translation), as local artifacts or structures. Often this is referred to as built environments where transitions take place.

(II) cultural dimension

The originally called cultural-symbolic spatial dimension represents the spatial system of signs, symbols and representation connected with the material-physical spatial dimension. As spatial artifacts, they mirror processes and results of social action (socio-cultural aspect) as well as crystallized history and collective symbolism (symbolic aspect). For example, government or company buildings serve as symbols of power or the changing usage of a highly symbolic castle square as a real-world lab.

(III) actor and agency dimension

This perspective deals with the social practice of production, use and distribution of space by people as social actors (Läpple 1991). Local traditions and identities play an important role here as these actions are on the one hand constituted by the physical space and on the other hand constitute this space by their actions. The complex interrelations of this dimension is often fruitfully used in real-world labs, as with relatively simple changes of usages and functions of a site temporary transformations can be initiated (e.g. changing sites physically takes a lot more effort). Accordingly, in this dimension practices and current uses of spaces are in the focus. Identity is seen as a key mechanism, especially in regard to the social production of space and the discussion of place-making in spatial sciences (Goodchild and Janelle 2004).

Fig. 1. Socio-spatial framework.

(IV) regulative dimension

This dimension is a mediating link between the material-physical and the action-related-procedural spatial dimension. It defines rules and norms. These social regulatory systems can be comprised of forms of ownership, power and control relationships, legal regulations, or social and esthetic norms. These processes regulate the handling of space-structuring artifacts (Läpple 1991). From a transformational point of view, the regulative dimension can be considered as a useful starting point for real world labs, as the latter can temporarily change the regulations for a specific site, such as opening up private grounds to the public, or allowing temporary pop-up shops or play-spaces in streets (Spielstrassen). Covid-19 also helped to temporarily legitimate the relaxation of various regulations, e.g. regarding street-dining, and institutionalize new practices (pop-up cycle lanes).

3.2. Socio-psychological framework

While psychological concepts are present within the four spatial dimensions above (e.g. identity, norms), they are, as yet, undertheorized. We propose the following framework to address this. For this purpose, we choose a framework from Elliott & Wattanasuwan (1998) on identity and social-symbolic consumption. A key reason for choosing this framework is that: (i) it lies at the intersection of psychology and sociology, connecting individual and collective agency and (ii) combines aspects of agency and structure (see Bögel and Upham 2018; Bögel et al., 2019b). It is these combinations that makes it more accessible to the sociological, collective accounts mostly underlying transition studies in general and spatial approaches to transition studies in particular. This concerns e.g. the above-mentioned processes of identity building in the spatial framework, which take place on the individual and the collective level. In this regard we also reflect the insights of Marston (2000), who argues that social reproduction and consumption require acknowledgement as part of the thesis that contemporary scale and space increasingly reflect the globalizing and globalized dynamics of capitalism. While being designed to study consumption, the framework can be extended to the interplay of other resources and processes, too. We focus in the following description of the framework on our context of urban transitions.

As outlined, the framework examines two kinds of resources (materials and symbolic) and two kinds of processes (individual and social) in the construction of meaning and identity. The start of the analysis is the self-concept of a person, including broad life history and current situation. In the context of urban transitions, this could be, for example, a current living situation, such as an apartment or neighborhood that may offer an environment more or less prone to a sustainable way of living (e.g. by facilitating cycling). This also includes current self-symbolism, e.g. car ownership as a status symbol, and personal norms. The meaning and construction of meaning involving these material goods is shaped by three processes: lived experience, mediated experience and discursive elaboration (Elliott and Wattanasuwan, 1998). These offer potential to deepen the study of actor-related processes in the spatial framework as follows:

(I) individual level: lived experience

Lived experience means for example the experiences people actually make with resources. An example of this could be an electric car, e.g. limited range or search for refueling stations but also maybe the pleasure of having a quieter car and less guilt when driving. For our context of urban transitions, this refers especially to the lived experience we make with urban places and structures. This goes from experiencing a new bike lane to experiencing entire new neighborhoods.

(II) social level: discursive elaboration

Discursive elaboration describes the negotiating of symbolic meaning and self with relevant others, e.g. friends, family and colleagues. It results in a concretized meaning. Discursive elaboration is influenced by and itself influences social norms and values.

(III) societal level: mediated experience

Mediated experience relates to the presentation of symbolic resources. Regarding urban transitions, this could e.g. be the symbolic meaning of cars but also the meaning assigned to certain city districts.

3.3. Integrated socio-spatial framework on scaling in transitions

In the socio-spatial framework, the spatial perspective is used to analyze the context in which actions take place. Within this spatial context, the socio-psychological processes take place. The socio-psychological dimension contributes with regard to agentic dimensions and deepens our understanding of both how the spatial context shapes these processes but also how they, in return, shape the surrounding (see Fig. 1).

In the following matrix, we outline these intertwined social-spatial processes. Building on this matrix structure, a systematic analysis can be carried out that reveals how, in a specific empirical case, mechanisms of change emerge at the intersection of different social and spatial dimensions. Observing more in-depth how new ways of doing, thinking, organizing emerge in a specific context and actor constellation provides clarity with regard to the role of different case-specific influencing factors, and a more abstract reflection on whether and how urban transition initiatives and experiments can contribute to processes of upscaling, challenging and altering dominant regimes shaping urban systems.

3.4. Implications for scaling

In setting out the above, we are concerned primarily with socio-spatial conditions and their implications for scaling, not with a definition of 'scales', nor the social construction and fluidity of scales (Binz et al., 2020), nor with 'multi-scalarity' in the sense of

Table 1
Socio-spatial framework (Matrix).

Spatial dimensions	Socio-spatial framework	Socio-psychological dimensions
Physical	**Physical-Individual:** Which physical changes do the individuals recognize, e.g. energy transitions becoming visible through photovoltaic modules in urban contexts? **Physical-Social:** Are the physical changes reflected in discussion with friends and family, e.g. does the experiment of a car-free street become recognized and addressed in everyday conversations? Does it lead to new forms of interaction and activities carried out in a changed physical setting together with others? **Physical-Societal:** Are the physical changes adopted or taken up in broader planning processes and different locations? Are they addressed in media communication, e.g. photos of car-free streets used by playing kids?	lndividual Social Societal
Cultural	**Cultural-Individual:** Do individuals change the perceived symbolic meaning of objects, of e.g. cars in the city (from symbols of freedom to potential health risks)? **Cultural-Social:** How is the change in symbolic meaning addressed in private conversations (if at all), e.g. does it become a point of critique to use the car? Can we observe the formation of e.g. civil society initiatives around changing cultural meanings of mobility? **Cultural-societal:** Do the changes in symbolic meaning on the individual and social level in real-world labs transfer to changes in media coverage, and to new policy discourses and planning cultures?	Individual Social Societal
Agentic	**Agentic-individual:** How do individual perceptions of the usage of objects, e.g. streets being reserved for cars or as playgrounds, change? How do role perceptions and individual practices change, e.g. from consumer to prosumer in urban energy transitions? **Agentic-social:** Are these changes addressed in discourse with friends, family and colleagues, e.g. between neighbors as part of urban experimentation? Does this lead to changing roles in social constructs, e.g. women being more involved and engaged in energy transition projects? **Agentic-societal**: Are these changes in actors 'perceptions and behavior picked up in the broader societal discourse and institutional structures, e.g. resulting in novel future narratives on urban life in the media and as the basis of political decision-making?	Individual Social Societal
Regulative	**Individual-regulative:** Which regulative dimensions affect individuals' actions? Do they take actions to change them, e.g. in cooperation with planning departments? **Social-regulative:** Are individuals addressing these challenges in their everyday conversations and maybe joining forces for changing regulations? **Societal-regulative:** Does this lead to broader societal discussion on current regulations, e.g. on the scale of household-scale produced renewable energy to the grid, and is this reflected in changes in formalized regulations?	Individual Social Regulative

inter-linked scales (Bauer and Fuenfschilling, 2019). In the geography of transitions literature, these and other issues are highlighted by Binz et al. (2020) as promising directions for further work that stand in contradiction to fixed notions of scale or level. Yet, for analytic purposes, fixed notions of scale have value. Just as Huttunen et al. (2021) argue for the value of plural perspectives in the context of analyzing agency in transitions, so we also see the analytic value of ontologically-fixed levels as scales, while fully acknowledging that in practice, social and indeed sociotechnical processes often involve relational and performative dimensions that span such scales. Individuals are a part of societies and are part of cultures - as categories, a form of nested hierarchy. The processes operating at each level are different but connected.

For the practice and analysis of scaling in the sense of societally embedding new practices, ways of thinking and organizing, our framework has particular implications. Attending to the interplay of social and spatial structures means attending to the types of issues raised in Table 1. It means viewing transition processes as individually, socially and culturally rooted, legitimizing more detailed analysis that attends to the micro-foundations of transitions (Geels 2020), while preserving the value of the larger scale analytic frameworks that the literature offers.

This intertwined socio-spatial perspective constitutes a novel perspective on scaling transitions: Since upscaling is defined as new ways of doing, thinking, organizing being embedded in dominant societal structures, we need to empirically trace dynamics and translations between niche and regime levels from the perspectives of involved individual and collective actors and in relation to the specific spatial dimensions. From this perspective, there is a need to analyze situated structure-agency dynamics, i.e. the way that social and spatial structures are interpreted, translated and re-framed by actors, individually and in larger social contexts. Observing these dynamics emerging from a specific niche experiment or initiative reveals potential for identifying relevant processes and strategies for challenging, altering or replacing established structures and patterns of 'how things are normally done'.

In the next section, we look further at how the framework can be applied to urban real-world labs using the illustrative case of "Utopiastadt" and follow-up with further implications of our socio-spatial framework for scaling in (urban) transitions based on the case study results.

4. Illustrative case study: Utopiastadt

4.1. Case study

The illustrative case presented here is an urban transition experiment. It is part of a real-world lab in Wuppertal, Germany, and led by a transdisciplinary team of researchers from the project UrbanUp and the urban transition initiative "Utopiastadt" ("Utopia City"). A main activity of Utopiastadt is the restoration of an old railway station building and its development as a cultural center. Over the past years, cultural events and particularly sustainability-oriented activities, ranging from food-sharing, urban gardening, bike rental and

repair to open workshops, co-working and a hacker space have been established. Recently, Utopiastadt has acquired a brownfield site adjacent to the old railway station and is in the process of developing this as a livable urban space, shielding it from gentrification processes, and aiming to increase quality of life in the city and this particular neighbourhood.

The experiment addresses the question of how livable urban space can be developed to support shared and community-oriented use concepts. Concrete objectives were to find out how Utopiastadt as the property owner can realize their community-oriented vision while also dealing with economic pressures and institutional framework conditions. With a view to the role of Utopiastadt in its neighbourhood and its transformative potential in general, another objective was to understand how groups of actors who usually are not involved in Utopiastadt could be included and what tensions or conflicts as well as positive learning processes would be induced by this.

The experiment centered on the provision of two empty shipping containers, to try different concepts for reviving the space. The experiment ran from June to October 2019. An open call for participation was communicated via various channels, offering anyone who had a business, social, cultural, artistic or other idea for the Utopiastadt site the opportunity to use a container for a period of up to eight weeks. The participants were selected jointly by the transdisciplinary team. The containers were used by a diverse range of actors ranging from local businesses, artists, start-ups, social entrepreneurs and a local politician. The overall purpose of this experiment was to uncover the varied meanings and functions ascribed to this specific place, to induce a reflexive learning process regarding potential ways and concepts for developing this space in the future and the roles that different types of actors could or should have in this process (the civil society initiative owning the space, old and new user groups or visitors, the surrounding neighborhood, the city as a whole). The case is in many ways a typical urban transition experiment in that it centers on new ways of doing, thinking, organizing and the question of whether and how these can be scaled, i.e. embedded in and resistant to potentially challenging dominant structures.

4.2. Data collection and analysis

The case study was used for a broader research program on urban transitions. The overarching purpose was to study the role of experimentation in real-world lab settings in comparison to more traditional urban planning approaches (Palzkill and Augenstein, 2021a). User perspectives on the role of local transition initiatives and their experimental settings in urban transitions played a key role in this regard as well (Palzkill and Augenstein, 2021b). This implied that for the research program extensive data on actors' perceptions of spatial development in this case were collected. We re-analyzed this data in order to examine the urban transition experiments from the socio-spatial perspective of scaling.

Regarding the data and its analysis, 39 semi-structured interviews were undertaken with participants of the container-experiment and visitors to the site. The material has been transcribed and analyzed independently by two researchers. Data analysis involved content analysis, combined with the qualitative analysis tools of coding, memo writing and categorizing. From the material, personal stories have been extracted that reflect the lived experience of actors in relation to a specific place and how they interweave their identities with physical space shaped by its institutionalized context and symbolic meaning. Participatory observation on site provided additional insights into the motivation and concerns of the actors involved. This data was used to triangulate findings and to analyze discursive elaboration through individual stories exchanged between actors negotiating and creating symbolic meaning around a physical space. This was complemented by a limited analysis of media reporting of the experiment to observe mediated experience as reflected by different types of media, showing how at a collective level symbolic meaning is attached to a physical space (see Table A1 for an overview on cited media articles). Fig. A1 provides an overview of the coding scheme.

4.3. Results

Findings from this experiment are used to illustrate how in our proposed framework spatial and socio-psychological dimensions are interlinked and the implications for scaling. The Utopiastadt site used to be a brownfield site adjacent to an abandoned railway station and former railway line. When the former railway line was developed as a bike lane and when the civil society initiative Utopiastadt started to renovate the old railway station building, these changes affected the lived experience of citizens (*physical-individual dimension*). The bike lane has become a central piece of infrastructure and a traffic axis connecting a number of districts across the city. It has also evolved as a widely used recreational area with Utopiastadt as an attractive location as a part of this new infrastructure. The physical changes (*physical-social dimension*) are reflected in conversations and interviewees report of how they talk to neighbors and friends about the site as a place to meet or how they introduce it to visitors and guests as an attractive physical location in the city: "I usually tell people that it is an old railway station at a bike lane, there are a lot of different projects, but I usually talk about how it is just a very nice place to go, especially in the summer". The physical changes are also prominently featured for instance in images for the press (see Table A1) advertised by the city marketing agency (*physical-societal dimension*).

With the physical location and its surroundings changing, the symbolic meaning of the site changed as well: from an "invisible" piece of undeveloped land to a multi-functional (and contested) urban space. From the interviews, seven specific functions of the site could be identified, reflecting its symbolic meaning (*cultural-individual dimension*): 1) experimental free space, 2) a place to meet people that contributes to social integration, 3) a place to go out and enjoy gastronomic offers, 4) a central location for networking among artists, the cultural scene and local sustainability initiatives, 5) a place with a high quality of stay without the need to engage in consumption activities, 6) a place of retreat and rest for residents, 7) a recreational area that attracts tourists and contributes to improving the city's overall image. Interviewees reported conversations they have with others about what the place essentially 'is' and these conversations also reflect the contested nature of the space (*cultural-social dimension*). For example, an elderly couple discussed whether it is a place for a younger alternative scene ("hipsters walking barefoot") or a "place for everybody to participate in social and

cultural life". The development of the physical characteristics of the site were closely intertwined with processes of meaning making through discursive elaboration and also mediated experience (*cultural-societal dimension*): Members of Utopiastadt managed to reframe and re-interpret the former brownfield and abandoned building as an important location for urban development and a space for innovation and experimentation. This new storyline was taken up by local and national media (see Table A1), presenting Utopiastadt under headlines such as "From railway station to societal experiment". The city administration strategically used the site as a flagship for city marketing. Interviewees related back to this mediated experience: Visitors and locals emphasize how the site is perceived as an attraction, as a result of infrastructural change and activities by Utopiastadt.

The experiment carried out on the Utopiastadt site was initiated through an open call for participants who wanted to use the two containers as an attempt to find out what kinds of actors would be interested in contributing with their ideas and concepts to the development of the space, what their motivations were and how these align with the overall idea of shared and livable urban space. While the participants all shared some kind of personal connection or ambitions and goals with Utopiastadt, they had a varied range of entrepreneurial, artistic, social and political roles and goals they wanted to pursue during their container experiment (*agentic-individual dimension*). Participants owning local businesses or those wanting to test a business idea particularly understood the location as an alternative kind of market place, where they could sell their products outside their shops and where they could meet potential customers and find inspiration. However, in reflecting their experience, the participants expressed a more nuanced or changed understanding of their roles in the context of the experiment, as expressed by one participant: "in economic terms it was not successful (…) but the way I function at my job has improved due to the experience here (…) confronting economic thinking with the way things are done here is fruitful''. What all of the participants shared was an understanding that Utopiastadt and the container project provided them an opportunity for experimenting outside of their usual circumstances. The characteristics of the physical space (open, chaotic, improvised) and the exchange with other participants (*agentic-social dimension*), e.g. artists and local business people in a process of discursive elaboration offered a space for reflection, meaning-making, re-interpretation of individual goals and motivation. Communication among actors involved conflicting logics, such as economic and community-oriented logics: one participant recalled a situation where a visitor was alienated by an economic logic: "as soon as I started talking about money, turned on her heels and left". The local media in particular picked up on varied and sometimes conflicting role perceptions among the participants of the experiment (*agentic-societal dimension*). The experiment, its participants and their different motivations were, for instance, reported in this light in a local TV news story (see Table A1).

The regulative dimension relevant in this case centers around the issue that the Utopiastadt site is a hybrid form of public space that is privately owned by the initiative. The experiment aimed at creating ideas for the development of the site and a central aspect in the interviews was the question of how and by whom the development of urban space is - and should be - carried out. Some of the participants reflected on whether and how they have power to influence local politics and urban development (*individual-regulative dimension*), with one participant realizing that "there is a kind of contradiction in the fact that the city is planned and developed by elected representatives and at the same time there are always places where people begin to do this on their own''. Many interviews reflected a negative perspective on the local administration, which was perceived as hindering proactive engagement by local citizens.

Based on the experiences of some in joint projects and discussions in Utopiastadt (*social-regulative dimension*), a vision of the future was expressed whereby the city is created and shaped by proactive citizens, and in which urban space can be developed by and according to the needs of its residents. This, in turn, would ideally be supported by local politics and the administration. In this narrative, Utopiastadt is seen as one example of a specific place offering an opportunity to develop this vision. It was emphasized that citizens need opportunities to become engaged, to experience self-efficacy and an understanding of the political power they can develop. Based on these experiences, citizens would then formulate their needs and their willingness to contribute more clearly and engage in a dialogue with local politics. Such more general debates are taken up by the local media and illustrated with the case of Utopiastadt (see Table A1). They are also communicated strategically in the context of a national network where Utopiastadt and similar initiatives engage in political activities and communication (*societal-regulative dimension*).

5. Discussion

With our **research questions 1 and 2**, we asked what different understandings of scaling are implicit in spatial and agentic perspectives on sociotechnical sustainability transitions, what their limitations may be and how they might complement each other if brought together. We have shown that while socio-psychological perspectives focus on individual, social and societal scales and emphasize the role of agency in upscaling, spatial perspectives focus on relational space and procedural aspects of governance. Against the background of a level-based ontology consistent with MLP-based transitions thinking, we showed how these two perspectives can be complementary in the ways that they consider the roles of space and agency.

Coming back to **research question 3,** we asked how to connect them more closely, and what this would imply for scaling. As a basis for our framework, we provided an overview of the literature, highlighting that both actor-centered and spatial perspectives recently gained more attention in transition research (Horlings 2015; Upham et al., 2020). The focus of each is usually treated as context for the other. Here, as spatial analysis can be used to "examine[s] data in cross-section" (Goodchild and Janelle 2004), we have built an integrative framework that brings socio-psychological categories into spatial dimensions.

Reflecting on our illustrative case using the novel socio-spatial framework and what it teaches us with regard to **implications for scaling**, it can be shown that the framework applied here can shed a light on whether and how new ways of doing, thinking, organizing emerge that challenge or even alter dominant logics and structures. The case shows that a potential for transformative impact can be found where dominant structures (as they become tangible in concrete local contexts) are being challenged and innovative strategies are being developed based on a reframing of problems and reflexive learning processes. The case shows that urban transformation can

be fostered by civil society initiatives that offer a perspective that falls in-between public service or economic investment considerations - which is understood here as a new way of doing, thinking, organizing introduced in mainstream structures and politics of urban development. The appropriation of physical space and reframing its symbolic meaning (through lived experience of individuals, changing perceptions and mediated experience, and through discursive elaboration involving different groups related to a space) can offer possibilities for specific groups to negotiate alternative ideas of urban development in the political context.

Although we have proposed a framework intended for applicability across contexts, attempts to systematize the complexity of urban contextual factors do need to consider the influence of ideas and meaning shaping the local perception and governance of sustainability challenges (Hodson and Marvin, 2017; Hodson et al., 2017). Studies drawing on urban sociology have shown that "differences between places in terms of discourses, cultural frames and identity result to be [sic] critical factors for transition governance" (Wolfram and Frantzeskaki, 2016 p.8). We can learn about the way that individual motivation and local discourses emerge in relation to the physical space as well as broader discourses on societal challenges. The framework proposed here helps us trace how in particular local contexts and actor constellations, new ways of doing, thinking, organizing emerge (thus opening up the black box of upscaling, see for instance von Wirth et al. 2019, p. 231). The comprehensive and interdisciplinary perspective of the framework prevents oversimplified conclusions about why and how a particular case matters and how it could or should be scaled, e.g. simply copying actor strategies to other cases or focusing exclusively on particular types of spaces.

Overall, the analytical framework presented here shows that an interdisciplinary analysis of cases of urban transitions can provide valuable insights with respect to scaling. We show (1) that local experiments change the perceptions of thinking, doing and organizing on a societal level beyond a more of the same; (2) that scaling transitions is not necessarily a matter of bigger experiments and upscaling of single bottom-up initiatives, but a learning process from a local intervention and knowledge being transferred to another societal level, as the city society; (3) that it might be more a question of generating more impact based on good local examples than simply copying them or overstraining them with inappropriate growth.

The fact that we were able to re-analyze the data of this case seems for us an indicator that our framework shows potential for the application to a broad range of existing cases and offer insights on scaling potentials across inter- and transdisciplinary approaches and research designs. The framework offers an analytical perspective, in the sense that it allows for a richer description of case studies in urban transitions (as illustrated above) by spelling out context-specific factors in a systematic way and allowing for a deeper understanding of *how* changes emerge along the four dimensions through agentic processes.

To conclude the discussion, it should be noted that while we propose that these (two) perspectives can contribute to work on scaling (see related also Dignum et al., 2020 regarding socio-spatial conditions for urban experimentation), they should also be understood as an impulse for further interdisciplinary work on the same. We argue for a more informed dialogue between disciplinary perspectives (deepening sustainability transition research with respect to theory-building), a focus on shared research questions, which then allows us to go beyond "established" frameworks (see Hopkins et al., 2020).

Conclusions and further research

Often disciplinary paradigms seem incompatible and one of the main challenges of interdisciplinarity in sustainability transition studies is to connect different rationales, find a shared language and a joint research perspective that permits a plurality of approaches (see Hopkins et al., 2020). Here we have worked towards this in the context of scaling in transitions. While doing this, we had two goals in mind: First, we see our work as an illustration of the merits of connecting disciplinary viewpoints in general as well as actor-centered and spatial approaches in particular for developing our understanding of scaling in transitions further. We view the two chosen frameworks as illustrations for an interdisciplinary approach on how to combine spatial as well as agency-based knowledge in a joint framework. It is our hope that this may inspire further cross-cutting work on scaling in transitions from both a socio-spatial perspective and beyond. This is intended to complement emerging spatial and actor-centered approaches in transition studies (Binz et al., 2020; Upham et al., 2020; Huttunen et al., 2021).

Second, we wanted to develop a socio-spatial framework in a way that offers an easily accessible way to reflect and monitor the impact of real-world lab projects on scaling urban sustainability transitions from an integrated, interdisciplinary socio-spatial perspective. For our illustrative empirical case study, a main lesson has been that an integrated socio-spatial perspective enables greater reflexivity with regard to niche-regime interactions and structure-agency dynamics in concrete, local-level cases: dominant structures become tangible in the perceptions and symbolic meaning that actors attach to spatial dimensions. At different levels of individual and collective agency, concrete space is the boundary object allowing for reflection and reframing of sustainability challenges. This comprehensive perspective offers new insights and a starting point for a more theoretically-informed discussion about scaling, ideally building on a broader basis of cases and comparisons.

Keeping that goal in mind, we have put particular emphasis on developing a framework that - while acknowledging and discussing the epistemological and ontological differences - is also ready for use for further case studies. While we have applied the framework in this article retrospectively to an urban transition case study, we are currently testing the framework in on-going real-world labs and are developing it further with regard to both its theoretical foundations and its practical use, e.g. regarding ways of data collection which fulfills the requirement of the framework and is still manageable in transdisciplinary project settings.

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

Table A1 and Fig. A1.

Table A1
Overview of excerpts from the media analysis

Physical changes featured in media images (***physical-societal dimension***)	https://www.wuppertal-marketing.de/presse/bilderservice/bilderservice/die-nordbahntrasse
New storylines represented in local and national media (***cultural-societal dimension***)	https://www.deutschlandfunkkultur.de/kreativprojekt-utopiastadt-in-wuppertal-vom-bahnhof-zum.1001.de.html?dram:article_id=460448 https://www.youtube.com/watch?v=-1Hi5dNfwE8
Role perceptions reflected in local media (***agentic-societal dimension***)	https://www1.wdr.de/mediathek/video/sendungen/lokalzeit-bergisches-land/video-lokalzeit-bergisches-land—246.html
Political and strategic communication in local and national media and networks (***societal-regulative dimension***)	https://www.wz.de/nrw/utopiastadt-campus-als-vorbild-fuer-stadtentwicklung_aid-56725687 https://www.wz.de/nrw/wuppertal/utopiastadt-in-wuppertal-mehr-als-ein-heruntergekommener-bahnhof_aid-54941751 https://www.netzwerk-immovielien.de/immovielien/utopiastadt-wuppertal-2

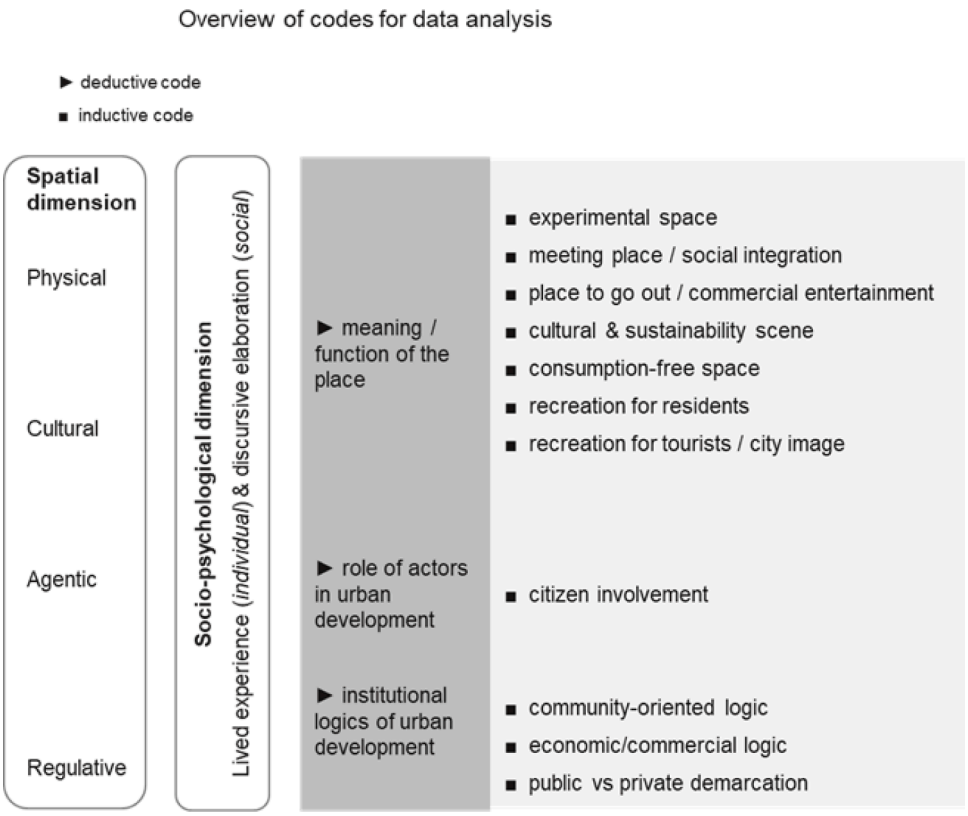

Fig. A1. Overview of codes for data analysis.

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