Mobility Design

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Mobility Design

Shaping Future Mobility

Volume 2: Research

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Introduction

Mobility Design

Research on the Design of Climate-Friendly and Sustainable Mobility

Kai Vöckler, Martin Knöll, Martin Lanzendorf, Peter Eckart, Stefan Göbel, Petra Schäfer, Annette Rudolph-Cleff, and Ralf Steinmetz

Climate change and resource scarcity are making it all the more urgent to find new solutions for mobility. This is becoming particularly evident against the background of the high level of environmental pollution caused by traffic. The introduction to this publication therefore outlines how new, climate-friendly mobility can be achieved and how transdisciplinary research can contribute to this goal. Consequently, mobility design is defined as a transdisciplinary task—an understanding developed by the authors, who are partners in a joint research project.[01] The focus here is how design research can contribute to the development of multimodal, environmentally friendly mobility, in particular to redesigning mobility systems in a way that is oriented toward people and their needs. This publication presents the results of this research project, which was carried out in various constellations also involving practitioners. Included as well are contributions by internationally renowned mobility researchers, who share their expertise on distinct areas of future-oriented mobility design. Thus, the already existing first volume of the Offenbach publication series on mobility design, with its focus on design practice (Eckart and Vöckler 2022), is here complemented by scientific findings and the methods of future mobility design. Together, the two perspectives aim to add the dimension of user-centered mobility design to current discussions about the transformation of existing transportation systems. Above all, we would like to thank our guest authors who have supported this project with their expertise.

The Impact of Traffic on People and the Environment

Transportation plays a key role in society's transition toward a sustainable way of living. This particularly concerns the environmental impact caused by carbon dioxide emissions, which must be drastically reduced. Motorized mobility in cities is expected to double worldwide between 2015 and 2050, according to estimates by the Organization for Economic Co-operation and Development (OECD) (ITF 2017). Road-based transport, however, has so far been unable to reduce its share of greenhouse gas emissions despite all the technological innovations in motor vehicle power transmission and exhaust technology (see for example the data on developments in the European Union; destatis 2021). Additionally, air pollutants are not the only environmental problems caused by car-based transportation; road infrastructure seals off soil, and traffic contributes to noise pollution (UBA 2021).

Millions are on the road every day, and often alone in their own cars—in Germany, a passenger car is occupied by around 1.5 people, and in commuter and commercial traffic the figure is as low as 1.1 and 1.2 people (FIS 2019). The private car dominates traffic, takes up more and more space, marginalizes other road users, and puts a strain on people and the environment. This leads to considerable problems, especially in densely populated urban centers, and highlights a socially unjust use of space. In German metropolitan areas, about 50 percent of the parking spaces designated for cars are in public spaces, even though only 58 percent of households have one (or more) cars (Nobis and Kuhnimhof 2018: 35).[02] The other 42 percent, the car-free households, have to contend with the fact that the limited public space available is taken up by automobile use. In short, the question for these urban centers is how to achieve an improvement in the living and amenity quality that benefits all residents. The congestion caused by

01 The research project »Infrastruktur—Design—Gesellschaft« (2018 to 2021) was funded by the Landes-Offensive zur Entwicklung wissenschaftlich-ökonomischer Exzellenz (LOEWE) in the German Federal State of Hesse with the following lead project partners: the HfG Offenbach University of Art and Design (design; consortium lead), the Frankfurt University of Applied Sciences (transportation planning), Goethe University Frankfurt (mobility research), and the Technical University of Darmstadt (media and communication technology/architecture): www.project-mo.de.

02 The metropolitan areas referred to here are the sixteen largest German cities with a combined population of about 14.5 million; see Regional Statistical Area Type: https://www.bmvi.de/SharedDocs/DE/Artikel/G/regionalstatistische-raumtypologie.html.

individual motorized traffic, the dominant form of transport, must therefore be reduced—without restricting personal mobility. This will not be possible through technological innovations alone; it will require changes in behavior. In the future, we will get around differently and in a more environmentally friendly way. Accordingly, the future tasks of mobility design include the development of innovative methods, as well as of specific tools and strategies, that will positively promote socially and ecologically sustainable projects in the mobility sector. Furthermore, these must be made more efficient and more visible to increase their acceptance among the population.

Toward a New Networked and Environmentally Friendly Mobility

The way in which individual mobility needs can be met is essentially determined by the available transportation system with its modes of transport, supporting infrastructure, and associated control and supply systems. To facilitate use of a transportation system, access to it must also be both physically and cognitively barrier-free as well as economically feasible. In Germany, enabling mobility is largely the responsibility of the state. Local authorities, the states, and the federal government are legally responsible for providing transportation as part of the general provision of public services. Individual mobility should be possible for all, even for those who do not have a car (Schwedes 2011). To guarantee the minimum level of mobility, public transportation policy has been given the responsibility of providing collective transportation by bus and train.

The focus of transportation policy was, and still is, on expanding the roadway system to provide a »free ride« for the privately financed automobile, the engine of the mass motorization of the postwar period. The aim is for traffic to flow as smoothly as possible so individuals can cover geographical distances, and thus change their locations, without any difficulty. It seems that individual, autonomous mobility can only be conceived in terms of the automobile. Having your own car guarantees a constantly available means of transport, with the implicit assumption that all of the necessary infrastructure is available, while ignoring the fact that even today the acquisition of a car is a major challenge for low-income households (as indicated by the low level of car ownership among the lower social strata—Nobis and Kuhnimhof 2018). However, owning a car also fulfills the need for privacy, autonomy, status, and enjoyment (Hunecke 2006), with an enduring effect on the experience of mobility. It literally embodies personal freedom and stands for being unconstrained in a self-propelled vehicle. It is flexible and comfortable to use. Not only that: the car as a product is a highly emotionally charged object that people identify with. It is a status symbol, part of memories, part of the family (Geuenich 2020). How one moves and with what is not a trivial question, for the automobile not only makes individual mobility possible but also helps people seek self-affirmation and personal experience (Vöckler and Eckart 2022).

The crucial question is therefore whether autonomous, individual mobility is only guaranteed by the car as a product or whether the transportation system, which is oriented toward individual automobility, can be transformed in such a way that the feeling of personal freedom can be transferred from the car as an object to the act of moving itself (as the experience of self-mobility—Rammler 2003; Eckart and Vöckler 2018). After all, from an overall societal perspective, against the backdrop of the societal transformation toward sustainability, the question arises as to how the transportation system can contribute to the »good life.« That is, not as the fulfillment of promises of individual happiness, but rather as participation in a transportation system that is economically feasible for all, as well as ecologically and socially viable. This requires an understanding of mobility that goes beyond the dichotomy of private (auto-) mobility versus public transportation and instead sees mobility as an overarching public task encompassing all forms and modes of mobility (Schwedes 2021)—a transportation policy challenge that still needs to be addressed.

The feasibility of intermodal and environmentally friendly mobility that links public transport services with sharing services, and includes walking and cycling, is due to a revolution in transport

technology based on the two principles of networking and sharing. With the availability of mobile internet via smartphones and tablets (and other digitally based information and communication devices in the future), new, intelligent forms of mobility are possible. We are no longer dependent on our own vehicle and in the future will easily be able to use a variety of different modes of transportation (including shared automobiles) on one route (intermodal mobility). Digitally supported mediation platforms make environmentally compatible and intelligent mobility technically possible: shared modes of transportation are more efficiently utilized. In this way, the focus is shifting away from the product toward usage, which is now no longer tied to a specific mode of transport. With innovations in usage linked to digitalization, product innovations focused on vehicle technology (such as electric power transmission technology) appear to be just one building block within a broader systemic transformation that begins with a new way of using transportation systems (Rammler and Sauter-Servaes 2013).

However, this brings into closer focus the mobility experience, which occurs on an individual basis in interaction with the transportation system. Mobility—understood as the individual's ability to move physically in space, whether on foot or by transport modes such as the bicycle, train, bus, or automobile—is a basic need and part of everyday life. Mobility stands for self-mobility, in contrast to the concept of transportation, which refers to the movement of people and goods (as an actual change of location). Mobility refers to the individual experience of interacting with other mobile people, as well as objects, information, spaces, and the infrastructure and technical systems that support them. This means that the existing transportation system with its mobility services is subjectively perceived, experienced, and evaluated, and thus cannot be understood in isolation from lifestyles, consumer desires, and behaviors (Götz et al. 2016). Mobility systems therefore not only consist of material infrastructures and modes of transport (the transportation system), but also of cultural concepts and symbolic languages that operate within them; they are based on social practices and associated forms of subjectification (Urry 2004; Vöckler and Eckart 2022). Therefore, the concept of the mobility system is understood here as a dynamic structure embedded in everyday culture, which only emerges when used by moving individuals (Eckart and Vöckler 2022b).

Consequently, the mobility system is to be understood in terms of use and from the individual's point of view. What are the practical benefits of my chosen mode of travel, and how can I use it without hindrance (instrumental utility)? What kind of experience will I have while using it, and how will my sense of well-being be enhanced (hedonistic utility)? What significance does this form of mobility have for me, and can I identify with it (cognitive utility) (Kelly and Sharot 2021)? To enable this new freedom of mobility, it is therefore necessary to have a seamless interaction between modes of transport (which is primarily a question of organization and planning). It also requires the comprehensive design of an environmentally friendly mobility system (including its digital expansion). And in doing so, people's needs must be taken into account, and these are not merely instrumental (Haustein in this volume). This is the key challenge for mobility design, which mediates between users and the mobility system (»Offenbach Model,« Vöckler and Eckart in this volume). How is access to the mobility system improved, how are experiences positively shaped, and how is identification facilitated?

Mobility Design

Mobility design follows the guiding principle of user-oriented and environmentally friendly transmodality.[03] It views mobility as an entirety, which manifests itself as the need and ability to move in space. Both the individual basis for action and the spatial and structural context determine mobility capacity and behavior. As a significant aspect of

03 The following definition is based on a working paper written jointly by the research partners already mentioned in the introduction to the previous volume (Mobility Design, Vol. 1, Practice) (Vöckler and Eckart 2022: 16–17). Concordances are not explicitly indicated here.

social participation, the ability to move must be granted to as many population groups as possible. Mobility design contributes to this significantly as an interface between people and spatial structure.

The prerequisites for designing environmentally friendly mobility are the availability of environmentally friendly mobility services, sufficient infrastructural provision, and the smooth organization of functional processes within the mobility system. The design of mobility systems, of movement processes in complex mobility spaces, opens up a new dimension of the sustainable design of social transformation processes. In this context, the concept of design is understood in transdisciplinary terms as mobility design (Blitz et al. in this volume). Traditional scientific fields of investigation such as transportation planning, urban development, information and communication technology, and the social sciences are linked to design research on mobility. However, mobility design always includes the subject-specific design of user interaction with the mobility system. The design of new sustainable and networked mobility is thus divided into two different, but interrelated fields of action:

– in a transdisciplinary, comprehensive design of the mobility system that considers its organizational and institutional logic, as well as the political parameters including ecological, economic, and social factors;
– in a design-specific configuration of user interaction with the mobility system. Here, the focus is on intermodality, that is, how different forms of mobility can be linked with each other in a frictionless manner according to user needs.

Mobility systems encompass the mobility needs of users, the existing transport infrastructure, and all available means of transport. Mobility design determines the interaction of users with the mobility system, which consists of time- and movement-based usage processes, the physical form and organization of products and spaces, the digital interface, the logic of information dissemination, and the underlying technical systems. This requires mobility design to be systemically oriented: this approach necessitates the pooling of diverse mobility-related expertise. Mobility design should therefore be seen as an interdisciplinary task. Design is the integrating element since it mediates between people and mobility systems through design decisions and shapes user experiences (Vöckler and Eckart in this volume).

The design-specific configuration of mobility is based on the mobility needs of the individual user. It

– affects attitudes, values, and perceptions, and thus behavior and perception, through design decisions;
– focuses on the influence of semantic design aspects on the perception and use of mobility systems beyond the functional aspects;
– enables access, facilitates orientation, communicates meaning, builds familiarity through recognizability, and generates acceptance through quality (comfort and value).

Individual appropriation and evaluation are decisive factors for acceptance. Therefore, when the existing transport system is transformed into a multimodal mobility system, this must be understood as a function. And acceptance is only achieved if concrete use leads to a positive mobility experience.

Chapters and Themes in this Publication

The contributions in the first section address the tasks and challenges of mobility design as a field of research. By way of introduction, Ole B. Jensen (Aalborg University) summarizes the beginnings of the »mobility turn« in sociology and human geography, as well as the shift toward »mobility design« in architecture and design. Beginning with the physical interaction of a subject with the mobility system and the accompanying multisensory and affective experience, this chapter outlines how this interaction is characterized by the design of affordances and atmospheres. Following this, the model of human-centered mobility design developed at HfG Offenbach University of Art and Design is presented. Thus, for the first

time, a systematic and conceptual modeling of the requirements for the design of intermodal, environmentally friendly mobility systems will be available for discussion (Vöckler and Eckart). The transdisciplinary perspective on mobility design is illustrated in the next contribution through interdisciplinary collaboration between mobility research, urban and transportation planning, and design in the implementation of bicycle lanes. By bringing together different disciplinary approaches, theoretical assumptions, and methods, it is possible to achieve an overall increase in knowledge for mobility design (Blitz, Lanzendorf, and Müggenburg). Finally, the concept and development of the digitally supported, interactive »Mobility Design Guide« is introduced. This guide prepares the relevant contents for a future mobility design for the target group of planners and designers as well as decision makers from politics and business; it also documents the results of the interdisciplinary research project (Krajewski, Reitmaier, Vöckler, and Eckart).

The second section focuses on »Connective Mobility.« The contributions assembled here address central aspects of the design of new mobility structures. To introduce the section, Sonja Haustein (Technical University of Denmark) provides an overview of the most important psychological theories of behavioral changes toward transportation, and how these mechanisms of change are linked to the sociocultural and physical environment. This contribution is followed by a presentation of the long-term focus group method; this research project was supported by focus groups across a four-year period. Participant feedback (as knowledge transfer from laypersons) was incorporated into further work (Schäfer, Stolte, and Reinfeld). In the next chapter, from the perspective of urban design and planning, the question is explored as to which methods and processes need to be established in order to transform the car-oriented city into the livable city. Using Copenhagen as an example, this study demonstrates that integrated holistic concepts are needed to establish quality agreements for the city as a whole, and to develop solutions tailored to the place and the users. It is therefore less of a spectacular single solution and more a holistically oriented planning culture that enables successful transformation (Rudolph-Cleff and Hekmati). Focusing on practice-led design research, the following chapters present the specificity of the design methodology within its situational, systemic, and contextual orientation. Using examples of the design of transit situations in public transport, it is shown how innovations become possible via a systemic and user-oriented design approach (Moeckl, Schwarze, Eckart, and Vöckler). The final chapter here shows how design research can anticipate and experimentally develop new, intelligent intermodal mobility services (on the basis of current technological developments)—in order to foster discussions on the development of future mobility (Moeckl, Schwarze, and Eckart).

In the third section, »Active Mobility,« the contributions discuss urban planning principles, strategies, and devices that promote physically active mobility (walking, cycling). These authors thus broaden the view of mobility design as an important factor in strengthening health and quality of life in growing urban regions. Ralph Buehler, Denis Teoman, and Brian Shelton (Virginia Tech) begin with a comparative study of the urban, political, and organizational structures and initiatives that have positively influenced cycling in the cities of Washington, DC, and Frankfurt am Main over the past twenty years. In their conclusion, the authors illustrate how both of these auto-oriented cities (without long cycling traditions) succeeded in moving toward integrated planning in small increments, where the adaptation of infrastructure was combined with other support measures (including speed limits for motorized traffic). Martin Knöll's essay picks up from here at the level of urban design. He examines the question of which new instruments are necessary and beneficial to the optimization of temporary traffic experiments in keeping with the sustainable, healthy development of the urban core. Focused on the year-long closure of Frankfurt's Mainkai, this essay recognizes that the promotion of health and physical activity is generally well-anchored in the city's long-term urban concept and master plan. However, there is a considerable deficit in terms of strategic

planning, communication, scientific evaluation, and sufficient participation of temporary experiments, which has so far impeded a more far-reaching realization of urban transformation processes. The contribution by Jenny Roe and Andrew Mondschein (both University of Virginia) continues the thread by calling for much greater consideration of people's mental health and cognitive capabilities when designing future streetscapes. They present a new model that adds qualitative aspects such as well-being, experience, perception, and social interaction to the traditional quantitative factors of »active travel« (focused on length and frequency of distance traveled), while integrating these with assessment methods such as EEG testing, as well as pulse and perspiration measurement. Even though studies that address design interventions in urban spaces and scientific evaluation using mobile sensor technology are still rare, the authors present a convincing way of making investments tangible through measurable effects on the quality of mobility and mental health.

This section concludes with three chapters examining practice-led research and design projects. The example of cycle street configuration demonstrates the need for designs based on user perspectives. In collaboration with social science mobility researchers, design decisions are evaluated using surveys, and the results incorporated in further developments, thus providing a model approach (Albrecht and Blitz). Based on the example of the bicycle, the next chapter illustrates how bicycles can be approached in a systematic way, not only as a commodity and a mode of transport that is a product of design, but also as a component within an environmentally friendly mobility system seen from the user perspective—which in turn leads to innovative redesign. This approach can also be applied to transport infrastructure such as bicycle bridges (Moeckl, Schwarze, and Eckart). Finally, Lakshya Pandit presents the results of a study on the Mainkai in Frankfurt, where 30% more cyclists and 1150% (!) more children were counted on bicycles while it was closed to motorized traffic in 2020 (Pandit et al. 2020). After it was reopened to motorized traffic in 2021, the number of bicyclists dropped to an even lower number than what had been recorded before the experiment, back in 2019.

The contributions to the section »Augmented Mobility« focus on the transformation of existing transportation systems through the possibilities afforded by digital information exchange, as well as through the application of digitally supported investigation tools. Weert Canzler and Andreas Knie (Wissenschaftszentrum Berlin) explain how public transport can be reorganized through digitalization in concert with the integration of (partially) autonomous on-demand shuttles, thus making the system considerably more efficient and user-friendly—provided that appropriate policy regulations are implemented. The next chapter describes how »serious games« and »gamification« can be deployed to promote environmentally friendly mobility behavior. In this way, users can be motivated to change their mobility behavior (Göbel, Tregel, Müller, and Steinmetz). In the contributions that follows, interdisciplinary collaboration between cognitive psychology and design suggests that virtual reality simulations can provide an empirically valid means of assessing the impact of designs and plans, even before they are implemented (Schwarze, Vöckler, Hinde, David, Le-Hoa Võ, and Eckart). Finally, an essay on the development of a game app, a collaborative effort between media and communication technology, design, and transportation planning, illustrates how a mobile, context-sensitive game can promote climate-friendly behavior (Reitmaier, Müller, Reinfeld, Tregel, Krajewski, Schäfer, and Göbel).

In the last section, »Visionary Mobility,« the future prospects of new mobility are addressed. At the beginning of this section, Claire Gorman, Fábio Duarte, Paolo Santi, and Carlo Ratti (MIT Senseable City Lab) present research projects that demonstrate novel possibilities for traffic optimization based on data linkage and analysis. The starting point here is no longer the physical product but the digital network, which enables a new, more flexible adaptation of traffic to usage. The following chapter explores how the impact of changes in user expectations resulting from digitalization may influence the possible design

of mobility systems. It then discusses the contribution that future mobility design could make to societal transformation processes (Krajewski and Reitmaier). Finally, in his essay Stephan Rammler (IZT—Institute for Futures Studies and Technology Assessment) explores the challenges that can be expected in the configuration of socioecological mobility transformations through design. He sees mobility design as an intermediary discipline at the interface between a wide range of urban, spatial, and transportation-related sciences on the one hand, and design and planning practices together with the user experience on the other.

Outlook

This publication outlines a new perspective on the transformation of existing transportation systems into networked and environmentally friendly mobility systems, which are consistently developed from the user perspective: that is, Mobility Design. Based on user needs, the conclusions that are drawn with respect to planning, design, and scientific evaluation are presented for discussion. The interdisciplinary orientation of most of the chapters gathered here shows how knowledge can be produced that transcends disciplinary boundaries in the context of problem-oriented applied research—here, on climate change and the resulting essential ecological transformation of transportation systems. Interdisciplinary collaborations resulted in mutually interacting cognitive methods that, in our view, provide the basis for a yet-to-be-developed transdisciplinary mobility design. The essays presented here in the context of research collaborations among the authors go beyond fundamental scientific research and are aimed at supporting societal transformation toward sustainability.

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Designing and Researching Intermodal Mobility

Peter Eckart and
Kai Vöckler

The implementation of intermodal mobility—the interlinking of diverse forms of mobility along a single route—initiates a revolution in mobility technology that is based on the principles of networking and sharing. Environmentally sustainable and intelligent mobility is becoming technically more feasible as users are able to access the internet en route, linking digitally supported intermediary platforms; transport resources that are shared collectively are simply more efficient. From a user perspective, all these mobility options—walking and cycling, bus or rail, shared automobiles—should be conceived as an interconnected, intermodal mobility system that needs to be flexibly adaptable to individual mobility decisions. Only design can convey the significance and value of these new, progressive modes of mobility to users with immediacy and while they are moving. What is necessary, therefore, for purposes of design work is a systemic perspective that bears in mind all components of the mobility system: from bicycle racks to transport vehicles, and all the way to station concourses. Each of these individual elements communicates to users forms of access to the mobility system as a whole, including its linkage with digital information and communication. The task of design is to mediate between the human individual and the mobility system to have a positive impact on user experience. Design optimizes access while enabling identification (the »Offenbach model«).

Accordingly, the focus of design research is on the quality of the mobility experience of users during their interaction with the intermodal mobility system. In order to arrive at well-founded assessments of the impact of design decisions, dynamic two-dimensional visualizations are utilized on the basis of transport system data to develop mobility scenarios, which are in turn tested and evaluated in virtual-reality test situations. With the integration of various user groups (participatory design), this research approach allows us to conceptualize fundamental and empirically grounded design approaches. The results can then flow into the development of design guidelines and concepts. A further resource for design research is the development of concepts in relation to concrete problematics that anticipate desirable developments, which then become possible through the design artifact. Fundamental, always, is a systematic approach that consistently conceptualizes the intermodal mobility system as a dynamic system that is configured through active use by mobile individuals (connective mobility). The design artifact, then, is to be understood as a mediating element within the larger mobility system. A particular challenge for designers of intermodal mobility systems is the configuration of mobility hubs. For environmentally friendly mobility, particular attention must be devoted as well to the considerable importance of nonmotorized mobility (active mobility). And emerging together with the formation of a digitally supported information and communication space, not least of all, is an extension of the mobility system (augmented mobility), one that opens new perspectives for designing modes of interaction between the human individual and the mobility system, which in turn require further investigation.


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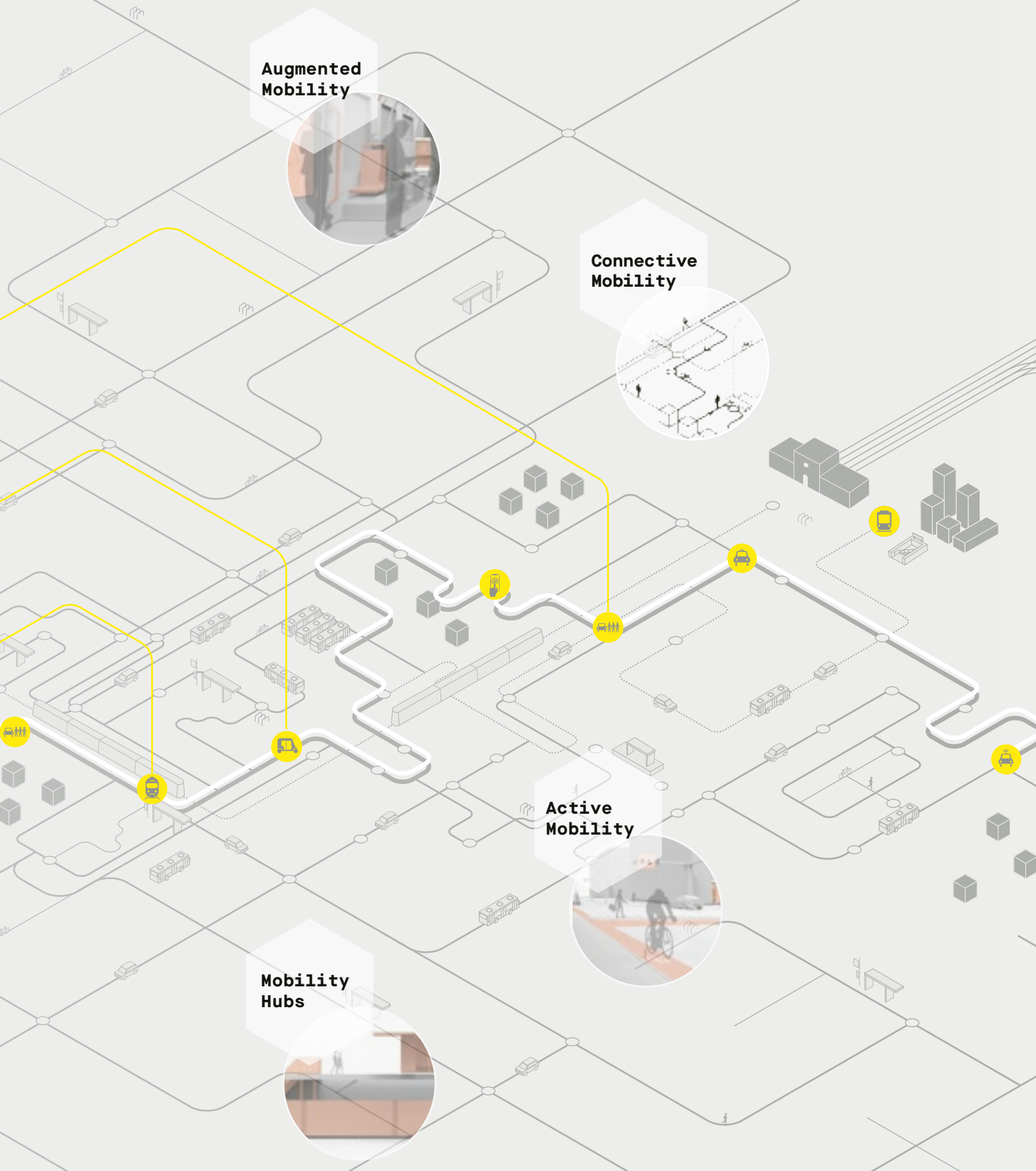
Augmented Mobility
Connective Mobility
Active Mobility
Mobility Hubs

Mobility Design

Mobilities Design

Affordances, Atmospheres, Embodiments

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This chapter introduces the new research area of mobilities design. It situates the development of mobilities design in relation to transportation and urban planning, urban design, and architecture while also connecting it to the humanistic and social sciences that it embraces. Some of the pivotal concepts within the mobilities design research field are affordance, atmosphere, and embodiment. The chapter will explore the relationship between these key concepts, specifically, and discuss how they form an important foundation to the mobilities design field. The chapter ends with some key pointers for future research within this emerging and growing field.

Introduction

Humans are mobile animals. We walk and run by our own bodily force, and our mobility technologies have shaped the way we live in ways not to be underestimated. Sailing, flying, driving across space and time at scales from neighborhoods to the globe (and these days even beyond with the »billionaires' race to space«), we are indeed »homo movens« (Vannini 2010). Our cities have over the last century taken shape after the most influential of all mobilities modes: the car. The ways in which flying has contributed to cultural exchange and globalization (and carbon dioxide emissions) is also hard to underestimate. We are mobile as a species in our »naked capacities« (Ihde 1990). However, the artificial landscapes of urban infrastructures that now has become »second nature« are also only inhabitable via mobility.

In the early days of the »mobilities turn« most disciplinary resonance was found in sociology and human geography. However, for more than a decade a turn to architecture and urban design has enabled the establishment of the research area of »mobilities design« (Jensen 2013, 2014; Jensen and Lanng 2017). Paying attention to the role of design in the making of the infrastructural landscapes of contemporary mobilities was only one dimension hereof. Another was a turn to the concepts and vocabularies within architecture and design enabling researchers to develop a sense of materials, spaces, volumes, voids, shapes, forms, and so forth. Learning from the design fields has also meant being inspired by the critical and creative approaches to shaping and making cities. To broadly simplify the matter, the social sciences developed a fine-tuned sense of problems, but it takes the architecture and design fields to enhance a sense of potentials. Mobilities design merges the critical sense of problems with the creative understanding of potentials in a research strategy that is much better equipped to understand the mobile life conditions of contemporary urbanites.

This chapter is structured in the following manner. After the introduction, a section follows explaining the shift from transport to mobilities and then further on to mobilities design. To explain in more detail the capacities of mobilities design research, three key terms are then related in the framing section. The notion of affordances, atmospheres, and embodiments constitutes the rough contours of a theoretical framework for understanding mobilities design. The chapter ends with some concluding reflections and thoughts about future research.

From Transport to Mobilities (Turn 1) to Mobilities Design (Turn 2)

The multiple movements across and between cities have deep repercussions for who we are and what relationships we can engage in. This discussion is already well known under the rubric of transport (Shaw and Hesse 2010). Movement from point A to point B has shaped the form of cities and nation-states and has become a huge and globe-spanning logistics operation. Getting people, goods, and information from A to B in the shortest possible span of time, via the quickest routes, or most cost-efficiently has become the territory of transportation engineering and planning. However, there is more to mobilities than movements between A and B! The ways in which mobilities shape identities and societies has been the key interest of the »mobilities turn,« which emerged within social science around the millennium (Jensen 2015; Sheller 2021). Moving »beyond societies,« as Urry (2000) titled his agenda-setting book *Sociology Beyond Societies*, meant focusing on mobility and immobility in networks rather

than on static structures. The turn to mobilities has roots back in the early social sciences (Jensen 2015; Simmel 1994), but with the emergence of a new interdisciplinary way of thinking about cities and societies in the light of mobilities across sociology, geography, planning, and anthropology a new agenda was shaped. Mobilities research is thus an important rethinking of the role that movement and transportation have in making societies. It moves beyond the instrumental and into the more complex questions of identity, belonging, and situatedness of human practice.

We might say that transport has been about instrumental movement from A to B in efficient and safe ways. Opening up to mobilities does not remove those concerns, but rather adds two vital dimensions: experiences and aesthetics; and power and sociality. If we think of these four dimensions—instrumentality, safety, experience, and sociality—then the turn from transport to mobilities can be said to add the latter two to the first two. In the last ten to fifteen years, mobilities design has made a second turn, exploring the meticulously detailed relationships between the »made« (or designed) spaces, infrastructures, and technologies, and moving human bodies. The lesson learned from engaging with design »sensitizes us to the detailed entanglements with matter, surfaces, volumes, physicality, etc. that we know are important for the sensorial experiences of mobile subjects enrolled into various Mobilities systems and infrastructures« (Jensen 2016, 594).

The habitats of contemporary urbanites are huge artifacts. Urban networks and infrastructural landscapes are »made«; hence, the focus on design as something that explores »making« (Gänshirt 2021). As mentioned, there are two dimensions to mobilities design research. One is the enhanced understanding of the role of materials, spaces, and artifacts. The other is concerning the processes within design. It is what some research environments have come to see as critical and creative approaches to look for potentials as well as problems (Jensen and Lanng 2017). The argument for mobilities rather than transport is thus well explained. However, why term it mobilities design and not, for example, »traffic architecture« (as proposed by Buchannan 1964). The argument here reaches back to the situated and pragmatic focus on the mobile situation (Jensen 2013). What is of interest is that which affords a specific mobile situation. Honing in on architecture is simply not precise enough. We might face cases where the mobile situation is shaped by algorithms of traffic-light coding or the service design of ticket systems. These dimensions are hardly architecture, so the pragmatic research interest is much better taken care of if we use the broader notion of design. To put in one line: we are exploring mobilities, not transport; design, not architectures:

Affordances, Atmospheres, Embodiments: Framing Mobilities Design Research

The key question to mobilities design research is: »what design decisions and interventions afford, enable, or prevent concrete mobile situations?« (Jensen 2016, 590). To explore this, a number of relevant and interesting theories and disciplines might be mobilized. This chapter focuses on three key concepts that will enable us to get closer to understanding the actual, situated, and practical dimension of mobilities. In short, we need concepts for a vocabulary that enhances our understanding of what enables the mobile practices by humans (see Jensen and Lanng 2017 for a more elaborate argument).

Affordances The concept of *affordance* was coined by environmental psychologist James J. Gibson (1986). The affordances of an environment are what it »offers« the animal, what it »provides« or »furnishes« (Gibson 1986, 127). Gibson argued that:

> Air affords breathing, more exactly, respiration. It also affords unimpeded locomotion relative to the ground, which affords support … water is more substantial than air and always has a surface with air. It does not afford respiration for us. It affords drinking. Being fluid, it affords pouring from a container … a horizontal, flat, extended, rigid surface affords support (Gibson 1986, 129–35).

Affordance is a relational term. This means that we are looking at what a ramp or a bench may do or enable in relation to a human body. This is precisely why the situational mobilities research has found value in the notion of affordance (Jensen 2013). With its focus on the staging of mobile situations, the notion of *mobility affordances* was articulated to capture »how the specific relation between the moving body and its material environment opens up (or narrows down) to particular modes of mobilities, different speeds, trajectories etc.« (Jensen 2013: 120). Mobilities design research explores mundane mobilities practices that could be:

> a fine-grained asphalt floor of a road (one of the most ubiquitous types of pavement in spaces of mobilities), which affords frictionless and smooth car rides; or a traffic signal, which affords the ruled organization of intersecting mobilities and sets the scene for embodied and interactional mobile situations, such as waiting in a crowd with other pedestrians. Affordance is thus a concept that enables us to target the performative effects of mobile situations through the relational mobile subject—body—materiality couplings (Jensen et al. 2016, 30).

Much more could be said about affordances, but hopefully its relevance to mobilities design research is clear.

Atmospheres The second concept that we will introduce as a cornerstone of mobilities design is the notion of *atmosphere* (or ambience). This is a vital concept to engage with the added dimensions we saw with the first turn from transport to mobilities. If we are to understand how mobilities relate to experiences, aesthetics, power, and sociality we need concepts like atmosphere. Bissell argues that »affective atmospheres are central to everyday conduct whilst on the move since different atmospheres facilitate and restrict particular practices« (Bissell 2010, 272). And Borch points to the fact that atmospheres exercise a »subtle form of power« where people's behaviors, desires, and experiences are managed and controlled without their awareness (Borch 2014, 15). Atmospheres shape a »manifestation of the co-presence of subject and object,« and are characterized as the »prototypical ›between‹ phenomenon« (Böhme 1998, 114). And a final quote to include from one of the founding figures of the mobilities turn, John Urry: »Atmosphere is in the relationship of peoples and objects. It is something sensed often through movement and experienced in a tactile kind of way, what Thrift terms ›nonrepresentational‹ practices (1996)« (Urry 2007, 73).

We register atmospheres in airports, on streets, on the freeway, and all other places where we are on the move. From research into how hostile architecture or »dark design« is excluding homeless people in cities via spikes in the ground under bridges or leaning benches affording lying bodies to fall to the ground, we see a connection between mobilities and atmospheres (Jensen 2019). When homeless people move through the city in search of night shelter, the increasing number of dark design interventions orchestrates what has been termed an »atmosphere of rejection« (Jensen 2020). What this means for mobilities is that the city's rejecting response to the homeless creates »go and no-go areas« in the city and over time contributes not only to a specific atmosphere for the shelter-seeking, but also to a »jigsaw puzzle« of spaces to avoid and spaces that are attractive due to their affordances (Jensen 2019).

Embodiments The bridge from affordance and atmosphere to embodiment is not hard to see. Anderson argues that atmospheres emerge in the relational »assembling of the human bodies, discursive bodies, non-human bodies, and all other bodies that make up everyday situations« (Anderson 2009, 80). *Embodiment* means including the multisensorial and affectual experiences of the moving subject. Too little attention is given to the crucial question, »How does it feel?« within the transportation. However, we all recognize that the air quality, the temperature, and the kinesthetic and haptic experiences that shape our mobilities experiences are more than simply objective dimensions. We realize this whether we are flying in different sort of aircrafts (Jensen and Vannini