



Norwegian University of
Science and Technology

Designing Mobility Systems for Urban Sustainability

A Case on Urban Complexity and Bicycling

**Gunter Tobias Barnes
Hofmeister**

Master in Industrial Ecology

Submission date: January 2017

Supervisor: Martina Maria Keitsch, ID

Co-supervisor: Førsteamanuensis Ida Nilstad Pettersen, IPD

Norwegian University of Science and Technology
Department of Design

Tobias Barnes Hofmeister

Designing Mobility Systems for Urban Sustainability

A Case on Urban Complexity and Bicycling






Master Thesis

Tobias Barnes Hofmeister
Norwegian University of Science and Technology
Department of Product Design
January 2017



To Marielle, Maximilian and Louis





“A lack of under-standing of the
precise nature of the relation
between spatial organization
and social life is the chief
obstacle to better design”

- Hillier & Hanson, The social Logic of Space, 1984, p. x

Multimodal infrastructure as one option
to promote different modes of transport

Abstract

Urban mobility faces significant challenges regarding its sustainability. Despite the availability of environmentally friendly modes of transportation a complex web of interrelationships constraints individual mobility habits. Urban structure, social norms, novel technologies, etc. play a decisive role in shaping mobility preferences, however, are rarely assessed holistically.

This thesis in the field of design theory addresses the complexities within these urban mobility scenarios, particularly focusing on cycling as sustainable mode of transportation. Through developing a model to analyze local cycling practice and subsequently a practice-oriented design process to foster transitions toward cycling this thesis provides a theoretical angle on how to approach mobility design.

The thesis is grounded upon an extensive literature review from the fields of urban studies, social practice theory, theories of structuration, design theory, human-computer-interaction, practice-oriented design, design for sustainability and systems theory. In a first step a case study on cycling practice conducted in Freiburg, Germany, and Trondheim, Norway, illustrated the local differences of cycling practice. The insights led to the development of a model capable to analyze how a practice interacts with its environmental constraints. In a second step this model is combined with case study results from the Changing Places group at MIT Media Lab investigating the effects of socially influencing systems on cycling initiatives. The final contribution of this thesis is the proposal of a concrete practice-oriented design process featuring various co-creation methodologies, practice as unit of design approaches and socially influencing systems.

Through theoretically approaching cycling mobility design this thesis has produced two publications presenting a framework for practice analysis and an applicable practice-oriented design process. While one paper has been presented the second one is under peer-review. In focusing on mobilities as integral part of complex urban systems, this thesis contributes to the discussion of scoping relevant areas for design and to developing application areas for practice-oriented design.



Masteroppgave for student Tobias Barnes Hofmeister

Designing Mobility Systems for Urban Sustainability: A Case on Urban Complexity and Bicycling

Cities and their mobility systems are under pressure particularly in introducing sustainability options for transport. This thesis explores the nexus between design, urban planning and the social sciences to better capture the complex relationships between urban mobility and sustainability solutions. As a thesis in design theory it will present a theoretical approach to the complex issue of sustainability options for transport. The thesis puts a special focus on cycling as part of urban mobility systems and will explore and analyze cycling practice with the help of exemplary case studies in Freiburg, Germany, and Trondheim, Norway. The goal of the thesis is twofold. First, to provide ways for more inclusive understanding by introducing a model that can contribute to designing mobility systems for urban sustainability. Second, to suggest design approaches for sustainable urban mobility systems.

The thesis content will comprise two papers. The first paper will investigate complexity in design and how social sciences can be applied to unravel multi-faceted situations and to identifying potential intervention points. Based on a literature review, the first paper will present a model to structure complex design problems. The model will be applied to two case studies on cycling conducted in Freiburg, Germany, and Trondheim, Norway, to illustrate a more comprehensive and inclusive understanding of mobility design.

In the second paper, the recurrent connection between urban space and human agency as analyzed in the first paper will be the starting point for the discussion. Based on these findings the second paper explores how socially influencing systems and co-creation methodologies can supplement practice-oriented design approaches. The two papers build upon each other in presenting an overarching context and subsequently targeting specific intervention points through design tools.

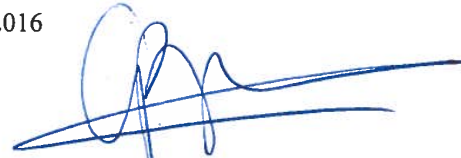
Oppgaven utføres etter «Retningslinjer for masteroppgaver i industriell design».

Ansvarlig faglærer: Martina Maria Keitsch
Faglig veileder: Ida Nilstad Pettersen

Utleveringsdato: 26. August 2016
Innleveringsfrist: 20. Januar 2017

Trondheim, NTNU, 19. August 2016


Martina Maria Keitsch
ansvarlig faglærer


Casper Boks
instituttleder

Contents

Abstract	vi
List of Figures	x
1 Synopsis	1
Chapter 1 The field of urban cycling	2
2 Framing complexity in design through social theories	7
Chapter 2 Cities as organisms of organized complexity	8
Chapter 3 Recurrent ties	13
Chapter 4 Material, meaning and competence	15
Article 1 Framing Complexity in Design through theories of Social Practice and Structuration: A comparative case study of urban cycling	19
3 Practice-oriented, persuasive and participatory design	35
Chapter 5 Practice-oriented design	36
Chapter 6 Persuasive design via socially influencing systems	39
Chapter 7 The field of participatory design and its tools	44
Article 2 Living mobility transitions towards bicycling: Designing practices through co-creation and socially influencing systems	51
4 Epilog	65
Chapter 8 Holistically designing mobilities	66
Appendix	71
Bibliography	72
Case Study Freiburg	78
Case Study Trondheim	88
Acknowledgements	107

Thesis Core Areas

Designerly approach to tackle
urban scale transportation
challenges towards sustainability
through practice innovation



List of Figures

Figure 1	Development of Cologne city street network 1845 - 1987, following organic patterns of organized complexity (source: gerhard Curdes)	9
Figure 2	Morphological layers of the city, allowing for emergence of non-linear phenomena across its multiple layers (source: Gerhard Curdes).	11
Figure 3	Busy street corner thriving upon a high level of institutional-organizational complexity (source: Richard Levine)	12
Figure 4	Recurrent relationship between the city's structure and citizen agency	14
Figure 5	Configuration of cycling practice with annotations for possible practice innovations to make cycling more feasible and attractive. (Source: whatsthepoint.com, October 23, 2016)	16
Figure 6	Practices-as-entities are composed of a multitude of elements and links. Individual performances of a given practice may involve different sets of elements and links. (Source: Kuijer, 2014)	16
Figure 7	Social practice as tool to analyze looking at the evolution of a practice over time displaying a varying degree of resource consumption. (Source: Kuijer, 2014)	17
Figure 8	Generalized methodology for practice-oriented design (Scott et al. 2012, p. 286)	37
Figure 9	Model to take practice as unit for design to generate new practices based upon opportunities for desirable change (Kuijer, 2014, p. 84)	37
Figure 11	Low fidelity and high fidelity practice prototype. While the low fidelity prototype represents a vague idea of the new practice, allowing for much emergent development, the high fidelity prototype stems from much deeper insight and allows for better prediction of the adopted version (Kuijer, 2014, p. 85)	38

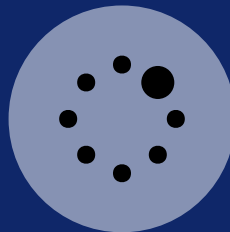
Figure 10	Integration of unfamiliar element into a practice, leading to its reconfiguration through an adjustment of strong and weak ties and their respectively connected elements (Kuijer, 2014, p. 76)	38
Figure 12	Socially Influencing Systems (SIS) framework (Stibe, 2016)	40
Figure 13	Mobile interface of frequent biking challenge, engaging through various levels of socially influencing systems framework (Wunsch et al., 2016)	41
Figure 14	Public displays showing the tourney ranking in order to visualize the performance of other members of the community (Wunsch et al, 2016)	42
Figure 15	Screenshots of the various ranking categories. The categories are chosen in a manner that they are engaging on a variety of different key indicators (Wunsch et al. 2016)	43
Figure 16	Tacit and latent knowledge can be tapped into through generative design sessions (Sanders & Stappers, 2012, p. 67)	45
Figure 17	Co-creation as a mindset is fundamental when approaching societal design challenges (Sander & Stappers, 2012, p. 31)	45
Figure 18	Collective weaving as co-creation method created spatial narratives. The participants can interact with other stories and ties theirs into them. Through creating them collectively these installations facilitate discussion and create mutual understanding. Further they can serve as visual narrative installation to be viewed by others in the aftermath of the workshop. (Chueng-Nainby et al., 2016)	46
Figure 19	Process of collectively weaving narratives in social innovation projects (Chueng-Nainby et al., 2016)	48
Figure 20	Staging mobilities framework in which mobilities are staged from above and equally acted out from below (Jensen, 2013)	67



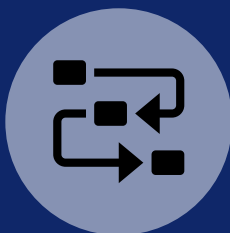
Mixed mode transportation,
subordinating the car to non-
motorized traffic participants

1

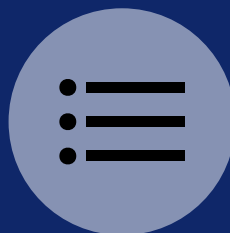
Synopsis



Introduction



Methodology



Results



Outlook

Chapter 1 The field of urban cycling

“Bicycle urbanism is an urban realm in which bicycles serve as the transformative tool for realigning built form to the human scale.”

- Florian Lorenz, Smarter than Car

Introduction

As design finds its way increasingly into shaping society on a systemic level, new tools and concepts need to be considered. Particularly the social sciences and technology studies including their application hold significant potential. While the social sciences provide analytical insight, and understanding of human behavior they have little to offer when it comes to changing it. On the contrary design is in many ways very application, intervention and iteration driven aiming to facilitate change in a particular direction. A combination of design and the social sciences could open avenues to explore transitions on a societal level. As behavioral patterns and habits are significantly shaping the everyday including modes of transportation, resource consumption, etc. tapping into altering these habits seems essential to achieve sustainability. This thesis explores how transitions towards bicycling as sustainable mode of transportation can be facilitated through practice-oriented-design.

The core of this thesis consists of two articles. The first article, published at ‘DRS2016’, explores complexity in design and how it can be addressed through social practice theory with respect to a case study on cycling in Freiburg, Germany, and Trondheim, Norway. The second article, currently under peer review for ‘Design for NEXT’, departs from the discussion of urban complexity and builds upon the previous case study as well as case studies done at the MIT Media Lab to propose a concrete practice-oriented-design process to foster urban cycling. In their succession, the articles build upon each other, starting with a framework for theoretical analysis of local cycling practice towards a concrete design process to foster practice transitions towards cycling.

Structurally this thesis consists of four sections. Section one provides a short introduction to the thesis topic, the used methodology and its results. Section two opens the discussion on urban complexity, social practices and their relationship to design. Section three draws upon practice-oriented-design, co-creation and socially influencing systems to foster changes in mobility practices. Section four summarizes on designing mobilities and its challenges in con-



Article 1 presents a framework to analyze the composition of local cycling practice. The framework aims to reveal the underlying complexity of urban design issues through leveraging social practices as tool for design. Through unravelling these complexities the framework allows insight into leverage points for design interventions.

Article 2 builds upon social practices in designing for urban transportation issues. It presents a concrete practice-oriented design process utilizing tools from co-design and socially influencing systems. As such the process fosters social innovation for practice design.

Going forward the developed framework and the practice-oriented design process need to be explored and iterated further through project deployment.

cluding the thesis. While the two articles compose the heart of the thesis the extra chapters in section two and three provide additional scaffolding and research insights as the scope this thesis encompasses an immense spectrum ranging from participatory design, to social theories, urban complexity and persuasive technologies.

The initial spark to study this topic of urban cycling through the lens of design emerged when I moved from Freiburg, Germany, to Trondheim, Norway. Always having been cycling I was intrigued by the differences of how people viewed and performed cycling. Especially the differences in urban design combined with everyday habits seemed to strongly influence the perception and acceptance of cycling. An extended summer internship at Miljøpakken in Trondheim further highlighted the challenges in promoting cycling merely through the development of cycling infrastructure and punctuated cycling campaigns. Thus, an academic interest arose to more holistically understand the interrelationships of cycling with everyday habits and the urban environment, with the following research questions.

RQ 1. How can sustainable mobility, and cycling in particular, be understood more holistically through design and social sciences?

RQ 2. How can design facilitate transitions towards sustainable mobility, through practice-oriented design interventions?

Methodology

The thesis addresses design theory and contributes through its articles towards the academic discourse around practice-oriented design and mobilities design. While practice-oriented-design is concerned with how social practices can be used as tools in design, mobilities design aims to holistically address mobility in its social, physical and technological dimensions. In addressing the fields of urbanism, transportation and everyday behavior this thesis draws on wide range of subjects. The literature studied for the two articles covers design theory, urban studies, theories of social practice, theories of structuration, practice-oriented design, design for sustainability, participatory design, persuasive design, human-computer-interaction, complexity and systems theory.

Both articles depart from a literature review. The first article concentrates on urban complexity, social practice theory, theories of structuration and de-

sign theory. Drawing upon research on social practice theory and theories of structuring the article introduces a framework to analyze local cycling practice and visualize its interdependencies. The four categories of the framework are material, meaning, competence and environment. The developed framework is subsequently used to holistically investigate the composition of cycling practice in Freiburg, Germany, and Trondheim, Norway. For this case study interviews were conducted with cyclists in both cities. Based on these interviews a local configuration of cycling practice in each city was derived. In order to gain insight into the interrelation of its elements to identify potentially most influential intervention points a matrix analysis was deployed. Through cross-correlating the four categories based on the statements from the email-interviews relationships could be identified.

The second article picks up on the result that particularly structure and meaning show strong interdependencies. This means that the urban environment and the perception of cycling are closely interlinked. Building upon this insight the literature survey focuses on urban complexity, practice-oriented-design, participatory design, persuasive design and human-computer-interaction. Resulting from the literature review the generalized methodology for practice-oriented design as articulated by Scott et al. (2012) is adopted as the basis for the development of a concrete practice-oriented design process to foster urban cycling. Subsequently participatory design methods and socially influencing systems are combined to present a comprehensive practice-oriented-design process. The socially influencing systems tools are adopted from research at the Changing Places group at MIT Media Lab who shared their ongoing research to broaden the application area of these novel socio-technical systems.

Results

The combined result of both articles is an analysis and intervention framework. The case study results of the first article indicate a correlation between the elements 'environment' and 'meaning' highlighting the necessity to holistically assess the physical and social dimensions of urban transportation. Further, the configuration of local cycling practice in Freiburg showed characteristics of being a mundane everyday thing people just do to get around the city. On the contrary the configuration in Trondheim showed much stronger signs of being a specific activity for health and status. Also, the different states of cycling infrastructure and levels of social acceptance and expectation made cycling in Freiburg to be perceived safer than in Trondheim. Thus, the frame-

work seems to allow holistic understanding of cycling practice and indicates areas of intervention. Through the lens of social practice theory and theories of structuration the framework allows to capture inherent complexities and merely disentangles them for the sake of better understanding instead of separating it into sub entities.

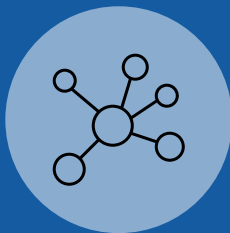
Research on socially influencing system at MIT Media Lab showed a remarkable impact on levels of cycling while the participants were exposed to these systems. However, socially influencing systems seemed to be lacking long term impact. On that basis, the second article proposes an integrated practice-oriented-design process that targets change in transportation practice. To facilitate discursive and practical modes of behavior change participatory design methods are integrated with socially influencing systems in an alternating and iterative process to harness reflection and experimental learning. This practice-oriented-design process builds upon design literature and appropriates its tools to facilitate transportation issues. Since socially influencing systems target individual behavior change and practice theory views the rather collective level the integration of socially influencing systems into the process steps of individual experimentation provides value to encourage individual transitions and insights. These insights and experiences can then facilitate discussion in the collective, co-creative steps of the practice design process.

Outlook

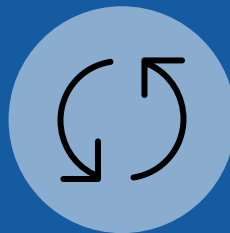
This thesis being a work of design theory, a larger scale application of the developed framework and practice-oriented-design process remains unexplored. The developed framework to holistically analyze local cycling practice primarily targets academics in the field of sustainable urban mobility as well as researchers working towards transportation policies. On the contrary, the practice-oriented-design process aims to be adapted by multi-disciplinary urban design teams working on large scale urban transformations. Equally researchers in the design field and the social sciences may take the process as basis to develop practice-oriented-design and relevant toolkits further. The process may also find application in teaching for architecture, urban design, transport engineering and human-computer interaction to educate the students about the necessary multi-layered perspective to shape urban environments. In their combination, the framework and the practice-oriented design process can benefit the toolkit for research-led and design-led urban consultancies.

2

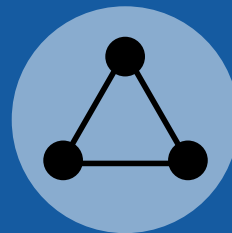
Framing complexity in design through social theories



Cities as Organism



Recurrent Ties



Social Practices

Chapter 2 Cities as organisms of organized complexity

“There is a quality even meaner than outright ugliness or disorder, and this meaner quality is the dishonest mask of pretended order, achieved by ignoring or suppressing the real order that is struggling to exist and to be served.”

- Jane Jacobs, *The Death and Life of Great American Cities*

In his book *Complexity, Cognition and the City* Portugali (2011) argues for cities being dually complex systems. As such, cities consist of two layers, the city's material components and the human components. While the cities material components might be complicated they represent simple systems. On the contrary urban agents, the city's human component, transform the city into a complex system “by means of their interaction – among themselves, with the city's material components and with the environment” (Portugali, 2004, p. 2). Hence, a city can be conceived of as dually complex system, since every urban agent in itself is a complex cognitive and biological system which contributes to the emergence of the complex system city. Historically cities have been conceptualized as machines, complex buildings or biological organisms (Marshall, 2009). In the view of cities as a complex organism Sennett (2013) describes its innards to be not working perfectly in sync creating valuable dissonances. This relationship between urban agents and the city can be described as recursively constraining as the city emerges from the in-

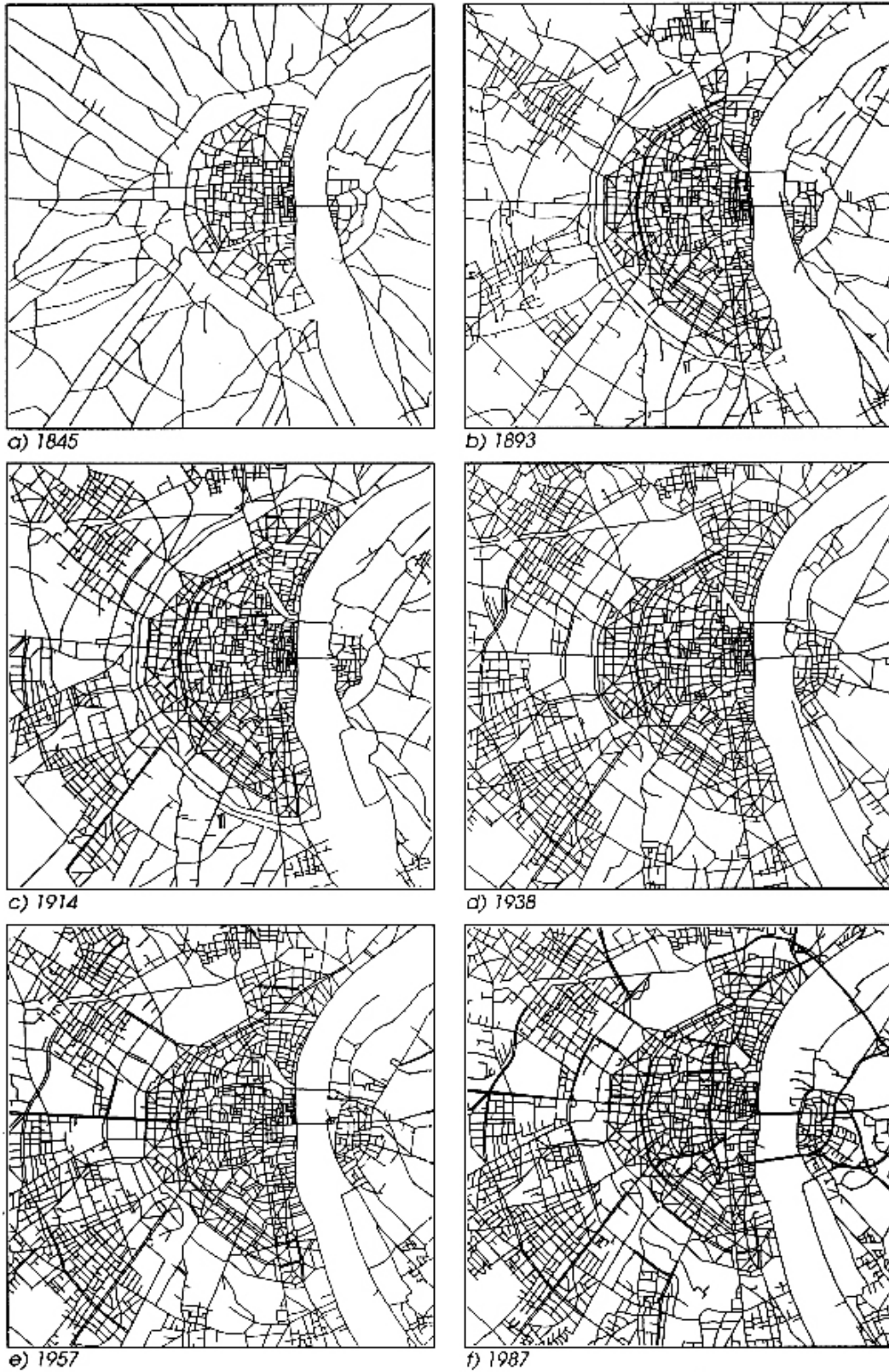


Figure 1 Development of Cologne city street network 1845 - 1987, following organic patterns of organized complexity (source: gerhard Curdes)

teraction of its agents, but once emerged sets limits to the modes of conduct for its agents (Giddens, 1984; Portugali, 2004). Figure 1 shows how the streets of Cologne are organically emerging, but once in place determine the further development of the city. In such fashion urban sprawl as enabled with the rise of private cars decentralized cities, which once functions of living, working and shopping were spread apart, created more demand for auto-mobility (Urry, 2004). Circular causalities reinforce prevailing mobility practices. Further, if not scrutinized circular causalities provide the unchallenged context informing on-going development of practices. Hence, to promote sustainable modes of transport, such as bicycling, it is vital to presence the institutional-organizational and experiential dimension of urban systems (Burckhardt, 2004; Ehrenfeld, 2008; Scharmer, 2008) and stimulate innovation of social practice (Scott et al., 2012; Shove et al., 2012; Shove, Wattson, Hand, & Ingram, 2007).

Research on complexity theories of cities has shown cities to be open, complex, bottom-up and chaotic systems (Portugali, 2004) in which human agency exists within a web of socio-technical regimes. Instead of viewing cities as mechanistic entities a network view as for biological systems provides more comprehensive understanding (Capra & Luisi, 2014). As open systems cities empower people to take action and ownership through dissonance and discourse (Sennett, 2006).

Despite their bottom-up nature the structure of cities is often seen to be the result of the tension field between spontaneous, bottom-up processes and top-down planned design interventions (Portugali, 2004). Due to its openness and scale (Figure 2) a designed city is always incomplete, since the final properties are determined by the users – the latent designers (Stolk & Portugali, 2011). Mobilities in such manner are staged from above through formal planning and design processes, yet equally importantly acted out, performed and lived bottom-up (Jensen, 2013c). Overcoming the divide between the material and the social as well as the technical and the human opens for an encompassing exploration of socio-technical mobility systems, considering assemblages of humans, objects, spaces and design (Jensen, 2014). This highlights the present complexity and wickedness in urban design issues (Rittel & Webber, 1973).

Portugali (2004) further suggests to treat planning and design as integral elements in the dynamics of spontaneous bottom-up processes since his own research indicates that latent designers, through nonlinearities typifying cities, carry more significance than formal planning processes. It is the everyday

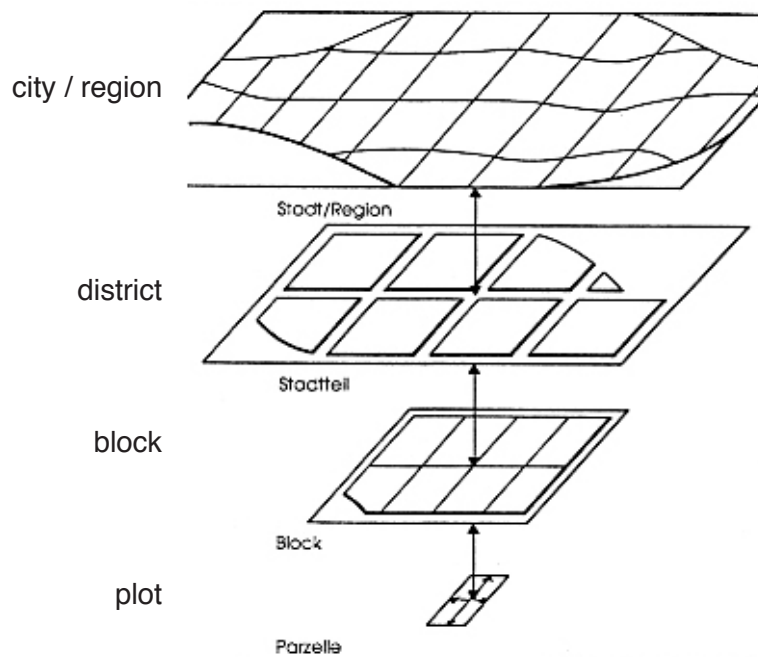


Figure 2 Morphological layers of the city, allowing for emergence of non-linear phenomena across its multiple layers (source: Gerhard Curdes).

practices of the human agents which shape the urban environment and which emerge within these given boundaries. Hence, practice-oriented design, by its nature a collaborative form of social innovation, holds an untapped potential for inclusive, holistic and complexity embracing urban design by providing ownership to latent designers – the city’s citizens. In the context of this thesis the participatory nature of urban structure and thereby its underlying social practices is one of the two pillars of the dynamic practice-oriented design process for mobility transitions towards bicycling.

While Jacobs conceptualizes cities with an organic metaphor Rittel and Webber (1973) describe complex and interlinked problems of social planning as ‘wicked’. In their nature ‘wicked problems’ despise clear formulation, in fact already depend upon the viewpoint from which they are presented, are essentially unique and can each be considered to be a symptom of another problem. Coyne (2005) suggests to speak of ‘wicked problems’ also as ‘human practice’, ‘contingency’ or ‘sociality’. This points the debate towards concepts developed within the social sciences.

Jane Jacobs propose to apply methodologies developed in the life sciences in order to grasp cities innate nature of organized complexity. She explains that classical science widely developed methodologies to deal with tame problems such as problems of disorganized complexity, in which the system as a whole possesses certain orderly and analysable average properties or problems of

simplicity, where the behaviour of one quantity can be described with sufficient accuracy by the behaviour of a second (Jacobs 1961).

Dissecting a street corner into its elementary components of streets, sidewalks, houses, etc., as exhibited by 20th century approaches to urban planning, is an attempt to tame such problems. Thereby it eliminates its innate institutional-organizational dimension allowing for micro-optimization, but consequently leading to a decline in systemic efficiency (Burckhardt 2004). Over the course of the last century this effect can be illustrated by the rise of the automobile, which “‘unbundled’ territorialities of home, work, business and leisure that historically were closely integrated, and fragmented social practices in shared public spaces” (Urry 2004, p.28). In such way urban form and architecture structure space and thus “provide the material preconditions for the patterns of movement, encounter and avoidance which are the material realization – as well as sometimes the generator – of social relations” (Hillier & Hanson 1984, p.ix).



Figure 3 Busy street corner thriving upon a high level of institutional-organizational complexity (source: Richard Levine)

Chapter 3 Recurrent ties

“Structure as the essential recursiveness of social life, as constituted in social practices: structure is both medium and outcome of reproduction of practices. Structure enters simultaneously into the constitution of the agent and social practices, and ‘exists’ in the generating moments of this constitution”

- Anthony Giddens, 1979, p.5).

Cities as complex organisms are created by the actions of its citizens, yet once created they enslave their behavior. As such the physical structure of the city and its human behavior within it are recurrently intertwined (Figure 4). Being created by its citizens the city becomes the physical representation of cultural values and norms creating a framework for social interactions and human life. Transportation as vital part of urban life plays a significant in shaping the urban environment. On the one hand transportation corridors provide the grid work along and within which cities develop (see Figure 1 with the example of Cologne grew along its transportation arteries). On the other hand, transportation technologies significantly influence how human interact with the city and its surroundings equally shaping its structure. The most prominent example is the rise of the automobile and its related system of auto mobility as written about by Urry (2004). The car enabled humans to bridge larger distances and allowed for personal independence. Through this, public functions, such as schools, grocery stores, work places, etc. became

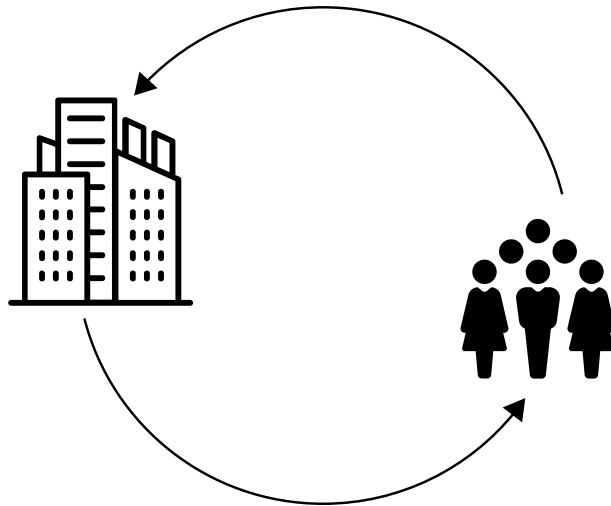


Figure 4 Recurrent relationship between the city's structure and citizen agency

spatially more distributed. The increased personal mobility allowed people to settle further outside the city. Issues with parking spaces in the city made large shopping mall with extensive parking facilities attractive and eroded the tissue of the inner city. However, once the public functions were decentralized and people had settled spread out the car became indispensable. As such human action eroded an urban setup which was accessible through public transportation and walking. The desire for increased personal mobility has altered the structure of the urban environment in favor of the car. This structure in turn conveys the need for a car, which is a constraint to the human agency to efficiently interact with their surroundings. The problem is that the build environment of a city acts as a sort of time capsule preserving the cultural values and modes of living for an extended amount of time.

Departing from such state of decentralized public functions it is challenging to promote bicycling as sustainable mode of transport without changing the perception of what is normal in terms of personal mobility. As the arrival of the car, as technological innovation, reshaped the structure of the cities, networked technologies and information systems seem promising in facilitating another wave of re-densification of urban areas making non-motorized, shared and public transportation the most attractive alternative. While these recurrent ties pose challenges they also provide immense opportunity to facilitate change through placing power in the hands of each and every citizen, who can through individual changes in their practice reshape the structure of the urban environment.

Chapter 4 Material, meaning and competence

“Designers have an indirect but potentially decisive hand in the constitution of what people do. If material artefacts configure (rather than simply meet) what consumers and users experience as needs and desires, those who give them shape and form are perhaps uniquely implicated in the transformation and persistence of social practice”

- Elizabeth Shove et al. 2007, p.134

One way to think of social practices is to think of them being configured through the combination of three elements, namely ‘material’, ‘meaning’ and ‘competence’ as proposed by Shove et al. (2012). When viewed through the lens of social practice theory behavior is about the act of doing rather than the doer. As such the human being is rather seen as the carrier of any given practice. Such view allows to zoom in on the material aspects, social perceptions and required skills necessary to perform specific actions. Looking at cycling through such lens opens for an understanding of the involved materials and social norms that contribute to its integration, or the lack of it, into urban life. Gaining clearer insight into involved elements opens up for concrete intervention proposals of how to shift behavior through practice innovation (an example for cycling can be seen in Figure 5). It is critical to understand that the elements and links of practices are continuously evolving, thus, current elements are replaced with newly arising technologies or the meaning of a given activity shifts through cultural renewal. As such practices undergo an

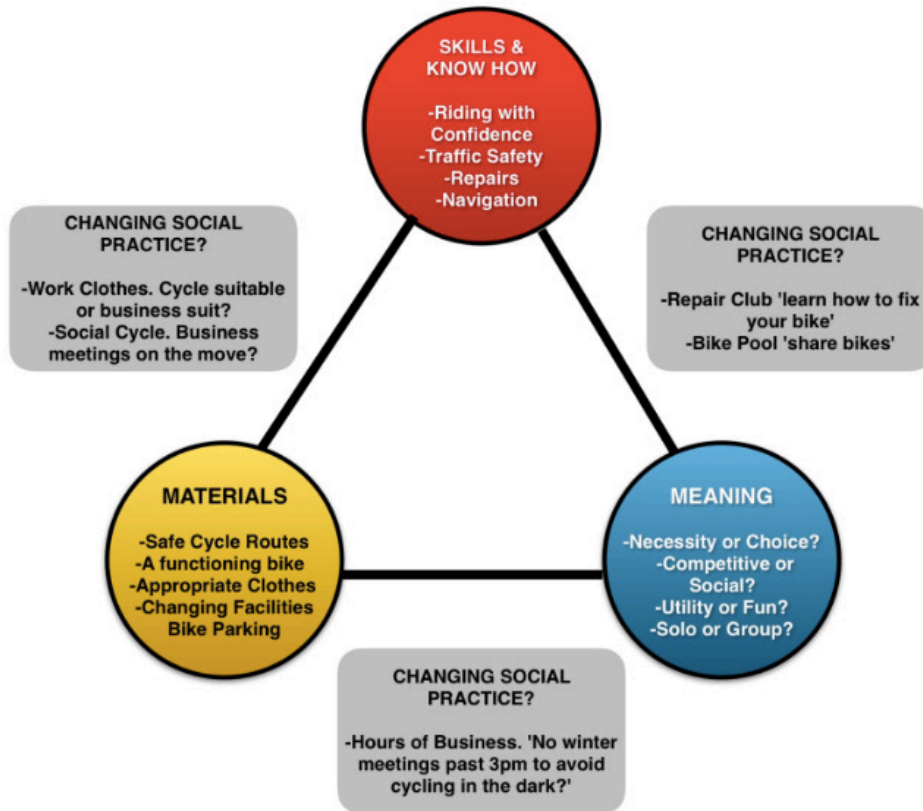


Figure 5 Configuration of cycling practice with annotations for possible practice innovations to make cycling more feasible and attractive. (Source: whatsthepoint.com, October 23, 2016)

everlasting evolution, since a practice only exists through integration of its involved elements. Thus, any enactment of a given practice provides room for innovation by bringing in new elements or making new connections. Figure 6 illustrates how each of the three elements ‘material’, ‘meaning’ and ‘competence’ is composed of a vast number of individual elements. In the case of cycling the element ‘material’ may consist of the bike itself, lights, a helmet,

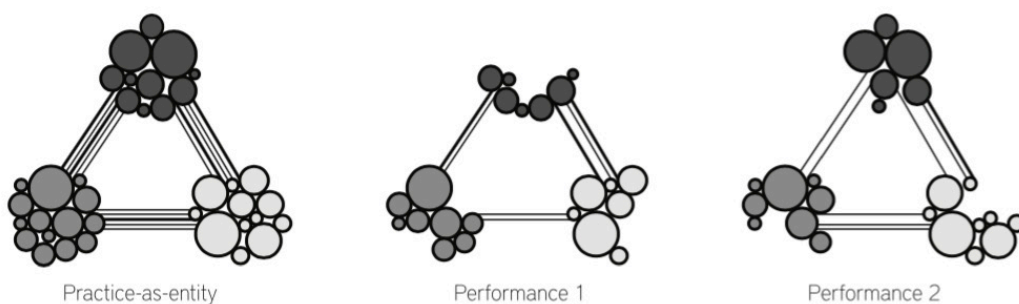


Figure 6 Practices-as-entities are composed of a multitude of elements and links. Individual performances of a given practice may involve different sets of elements and links. (Source: Kuijer, 2014)

an attachable bike bag, specific clothing, cycling facilities, bike parking and so forth. However, Figure 6 also illustrates that performing the practice of cycling may not include the same sub set of elements each time. For example, different weather conditions may require different clothing items or different people may prefer different types of infrastructure as some are confident cycling on the road while other prefer designated cycle lanes, etc. Yet, collectively all these performances can be recognized under the same umbrella of the practice of cycling.

Social practices can be viewed either as entity or as performance. As entity, a social practice is a sort of a block that can be filled out by a multitude of elements that compose this practice. As performance, a social practice is characterized by the repeated unique integration of various elements.

As practices undergo a continuous evolution capturing a specific practice can only serve as a snapshot in space and time. For example, cycling in the early part of the 20th century was considered merely standard practice of transportation. However, through the arrival of novel technologies it shifted to being a rather leisure or exercise activity. Thus, practice evolves over time in any given place. Equally different practices co-exist at any given time in various places. While cycling in the average north American city is merely an adventurous endeavor it is absolutely daily practice for any sort of demographic in cities such as Copenhagen or Amsterdam. Using practices as unit of analysis these historic developments can be made visible. As Figure 7 illustrates practice configurations can be used to track resource intensity of given practices. Further, it can be insightful to track the evolution of a practice in terms of its elements and links to explore relationships and investigate leverage points for practice-oriented-design interventions.



Figure 7 Social practice as tool to analyze looking at the evolution of a practice over time displaying a varying degree of resource consumption. (Source: Kuijer, 2014)



This article is authored by myself under supervision of Prof. Martina Keitsch. Throughout the writing process Martina Keithch provided valuable feedback as well as direction. Upon submission Martina Keitsch reviewed the article and polished the flow of its argumentation.



Article 1

Framing Complexity in Design through theories of Social Practice and Structuration: A comparative case study of urban cycling

Published and presented at DRS 2016

The parking lot of a cycling city:
Amsterdam

Framing Complexity in Design through theories of Social Practice and Structuration: A comparative case study of urban cycling

Tobias Barnes Hofmeister^{a,*}, Martina Keitsch^a

^a Norwegian University of Science and Technology, Norway

*Corresponding author e-mail: barneshofmeister@gmail.com

Abstract: Even if cycling is promoted as a new form of urban lifestyle, current car-centric approaches hold this type of mobility under gridlock. This article explores dissonances between visions, planning and execution in urban mobility and proposes a practice-oriented design model based on theories of Shove and Giddens. A model as a combination of mutual influences is developed, reflecting the complexity of urban design problems. The model is applied in a comparative case study on cycling in Freiburg im Breisgau (Germany) and Trondheim (Norway). In Freiburg cycling is of mundane, everyday character, while it carries traits of mere commuting in Trondheim. Applications of the model show strong connections between elements of structure, material, meaning and competence. The model can help planners and designers to grasp urban complexity within systemic relationships, thereby supporting steps towards a practice-oriented design.

Keywords: social practice, cycling, urban structure, design model

1. Introduction

Urban liveability increasingly ties to cycling. As Mikael Colville-Andersen, Copenhagen's bicycle ambassador, remarks “any liveable city will feature bicycles, great numbers of bicycles, on the urban landscape” (Colville-Andersen, 2010). Architects, are concerned with building “people-friendly cities”, which allow mobility for all (Kielgast, 2015). The Beijing-based research group *Smarter than Cars* even coined the term *bicycle urbanism* as paradigm shift away from current car-centric cities. Bicycle urbanism is described here as:

“...an urban realm in which bicycles serve as the transformative tool for realigning built form to the human scale” (Lorenz, 2014).



This work is licensed under a [Creative Commons Attribution-NonCommercial 4.0 International License](https://creativecommons.org/licenses/by-nc/4.0/).

Even if these snapshots hint at the increased relevance of cycling for contemporary urbanism cars dominate cities around the world, structure urban space and embody a decisive factor in the orchestration of human activity. Hence reshaping cities requires a rethinking of boundary conditions and working methodologies.

In terms of urban mobility Sennett comments, that today:

“...we experience an ease of motion unknown to any prior urban civilization ... we take unrestricted motion of the individual to be an absolute right. The private motorcar is the logical instrument for exercising that right, and the effect on public space, especially the space of the urban street, is that the space becomes meaningless or even maddening unless it can be subordinated to free movement (Sennett, 1977, p. 14).”

This outlines the degree to which transportation networks are determined by the system of auto-mobility self-expanding upon itself globally, in need of cars, car-drivers, roads, petroleum suppliers, novel technologies and signs, orchestrating human mobility. The rise of the car restructured time and space by allowing for intense flexibility resulting in unbundling urban territorialities of home, work, business and leisure, the basis for urban sprawl, which in turn again creates dependence upon the system of auto mobility (Urry, 2004). The car-centric nature of today's transportation system eroded an urban fabric of mixed-use proximity originating around walking and cycling. From the standpoint of design theory Lucius Burckhardt (2004) claims, that the invisible design component of car-centric urbanism not only destroyed cities, but equally society. Facing global sustainability problems, a paradigm shift is required and it is crucial to draw holistic boundaries around the interconnection of urban fabric and its embedded transport options.

Analysing the complex dualistic relationship between human activity and their urban habitat, this article initially discusses the critical importance of context. Insights from a literature review and a case study on cycling in Freiburg im Breisgau (Germany) and Trondheim (Norway) illustrate how social practice theory can frame urban complexity to gain understanding for design interventions. Shove's practice theory model composed of *material*, *meaning* and *competence* provides the basis for this analysis (Shove, Pantzar, & Watson, 2012). However, *structure* is introduced as fourth element in order to anchor the practice of cycling within its urban context, as proposed in Gidden's theory of structuration (1984). Conclusively the model is discussed with respects to the intention of unravelling the multitude of parameters and dimensions involved in shaping cycling practice providing entry points for interventions to urban designers.

2. Methodological approach

The article follows a two-tiered approach. In a first step, literature from the fields of social practice theory, design theory and urban studies is deployed in exploring the potential of theories of practice for informing design context. These initial insights culminate in an elaboration of the practice theory model proposed by Shove et al. (2012). A supplement to this model is based on the assumption that context and structure inform practice

(Burckhardt, 2004; Giddens, 1984). In a second step the expanded model is applied to urban cycling. By means of interviews, insights on cycling are gathered for Trondheim (Norway) and Freiburg im Breisgau (Germany). Using the previously established framework a predominant configuration of cycling practice is presented for the respective cities. The paper thereby illustrates how practice theory can be framed as tool to capture complex relationships and thereby provide rich design context. Methodologically the interrelation of the four elements of *meaning, material, competence* and *structure* allows unravelling individual aspects of cycling practice, opening avenues for design interventions, without neglecting their dynamic interdependence.

The interviews are conducted via email in which the respondents answered 16 questions related to the four elements of the model developed: *meaning, material, competence* and *structure* (also termed *environment*). The analysis is based on answers of 17 respondents in the study, from which eleven live in Trondheim and six in Freiburg im Breisgau. In both cities interviewees were students, employees, singles, couples and families with ages ranging from 22 to 34. The ratio of men to women is six to one. Auto-ethnographic observations accent aspects raised by interviewees. Interview results indicate that cycling in Freiburg is of mundane everyday character while its performance in Trondheim has traits of being a specific activity, which is further discussed in the conclusive part of the article.

3. Context and organized complexity

As Burckhardt argues (2004), the way of framing a system by setting it apart from its context greatly influences the amount of information it provides for its understanding. For instance, dissecting a street corner, into its houses, roads, sidewalks, cycle tracks and kiosks, allows to solely think in these terms, resulting in the limited design of improving these facilities. This refers to an invisible character of design, the institutional-organizational dimension, upon which the designer constantly decides, which however is concealed due to the common way of classifying the environment in terms of individual objects (Burckhardt, 2004). Thus, design has to grasp the complexity of the invisible entirety of the system composed of objects *and* its interpersonal relationships.

With respect to urbanism Jane Jacobs discusses complexity in her 1960's book *The Death and life of great American cities*. She identifies cities as *problems of organized complexity*. This quality makes them to organisms operating on the basis of unexamined yet perceivably interrelated and understandable relationships (Jacobs, 1961). However, cities are not one single problem of organized complexity, which if understood explains the whole organism. Rather cities can be examined via various frames providing a number of different, but interlinked problem sets of that kind. Despite the multitude of variables they are not chaotic, but merely emerge into an inter-related organic whole (Jacobs, 1961).

Dissecting a street corner into its elementary components of streets, sidewalks, houses, etc., as exhibited by 20th century approaches to urban planning, is an attempt to tame such problems. Thereby it eliminates its innate institutional-organizational dimension allowing

for micro-optimization, but consequently leading to a decline in systemic efficiency (Burckhardt, 2004). The importance of context is illustrated when comparing the spandex wrapped utility cyclist in Trondheim to the casually dressed citizen getting around via bicycle in Freiburg. While Trondheim offers a discontinuous network of cycling infrastructure Freiburg has cycling at the heart of its urban culture. Highlighting such complex, recurrent ties of spatial and social dimensions within cities, Hillier and Hanson note further:

“that a lack of understanding of the precise nature of the relation between spatial organization and social life is the chief obstacle to better design” (Hillier & Hanson, 1984, p. x).

Such conception encompasses notions of Burckhardt and Jacobs as discussed previously and shines light upon the necessity to integrate social sciences. Therefore this article expands the laid out framework onto theories of structuration as proposed by Giddens (1984) and theories of social practice as suggested by Shove (2012).

As Jacobs elucidates life sciences tackle organized complexity by identifying a specific factor or quantity and subsequently investigating its interconnections and relationships with other factors or quantities (Jacobs, 1961). Similarly practice theory identifies individual elements “that are integrated when practices are enacted” (Shove et al., 2012, p. 21) thus placing importance on the linkages. The most important aspects of thought borrowed from the life sciences in order to understand cities are: (1) thinking about processes, (2) working inductively, which means to reason from particulars to the general and (3) seeking for *unaverage* clues, implying to be alert to very small quantities which reveal the mode in which larger and more *average* quantities are operating (Jacobs, 1961). This list applies to social practice theory in the form that: (1) practices endure and are altered through performance; (2) practices are generated through composition and integration of their contributing elements and; (3) variations of elements culminate in distinct social structures, which in turn provide boundary conditions for the emergence of social practices (Giddens, 1984; Reckwitz, 2002; Schatzki, Knorr-Cetina, & Savigny, 2001; Shove et al., 2012). In such manner the life sciences as well as social practice theory focus on ‘deconstructing’ given situations without ignoring their context. From a design perspective this allows regressing from a solution to a context level on which legitimacy and relevance of context factors can be discussed, overcoming fixation due to the status quo (Hekkert & van Dijk, 2011). This way social practice theory presents itself as capable approach to capture complexity, yet disentangles situations to gain insight for design interventions.

Framing design problems in terms of involved social practices might therefore result in what Burckhardt (2004) calls ‘Socio design’, where solutions arise through attuning objects and roles, or what Shove (2007) refers to as practice-oriented design. She further elaborates:

“...that designers have an indirect but potentially decisive hand in the constitution of what people do. If material artefacts configure (rather than simply meet) what consumers and users experience as needs and desires, those who give them shape and form are perhaps uniquely implicated in the transformation and persistence of social practice” (Shove et al., 2007, p. 134).

4. Theories of practice

Practice theory emerged during the late 1970's with the ambition to overcome the prevailing divide between traditional structural ideas, explaining human behaviour in terms of external social and cultural forces, and approaches of interactionism, characterizing all forms of human action on the micro-sociological level of interpersonal interaction (Ortner, 2006). Theories of practice aim to comprehend the relationships between social structure and human action by recognizing them as recursive in which structure and action co-constitute one another (Giddens, 1984).

Contrasting other social conceptions, which place the individual as focal point:

“theories of practice decentralise the individual, instead placing the practices which constitute individual lives at the centre of analysis” (Watson, 2012, p. 490).

The individual functions as mere carrier or host who participates in the practice, integrating its various elements. Following Reckwitz a practice is:

“... a routinized type of behaviour which consists of several elements interconnected to one another: forms of bodily activities, forms of mental activities, ‘things’ and their use, a background knowledge in the form of understanding, know-how, states of emotion and motivational knowledge” (Reckwitz, 2002, p. 249).

In this manner Reckwitz conceives of a practice as:

“block whose existence necessarily depends on the existence and specific inter-connectedness of these elements” or as “a pattern which can be filled out by a multitude of single and often unique actions reproducing the practice” (Reckwitz, 2002, p. 250).

Illustrating this conception, cycling consists of a variety of different bicycles, related equipment, such as helmets, cycle lanes, roads, forms of bodily competence to ride and manoeuvre in traffic, as well as the meaning to the ones who cycle, but also to other traffic participants and so forth. As such cycling exists as a recognizable conjunction of elements forming an entity, which can be spoken of and which provides a repertoire to be drawn upon when cycling.

Simultaneously practice exists as a performance.

“It is through performance, through the immediacy of doing, that the ‘pattern’ provided by the practice-as-entity is filled out and reproduced.” (Shove et al., 2012, p. 7)

For a practice to endure over time its individual elements have to be repeatedly reintegrated sustaining characteristic interdependencies. In such manner cycling endures over time only through repeated enactment by practitioners, each reproducing the practice's characteristic interdependencies. However, each performance allows the practitioner to alter the practice, incorporating new elements or abandoning present ones, thereby reconfiguring the practice-as-entity over space and time. For example the emergence of bicycle helmets did not only alter the equipment cyclists use, but also its meaning in terms of safety (Colville-Andersen, 2010). Beyond that for instance, cycling in Trondheim today highly differs from

cycling in today's Beijing or how it was performed in Trondheim in the 1950's, when cyclists were still riding in the middle of the road with cars slowly following.¹ In this way the conception of practice-as-entity and practice-as-performance form a holistic unit.

The article departs in its analysis from Shove's ideas on the dynamics of social practice. She condensed the multitude of thought in the field of social practice in a representation, configuring each practice in terms of three recursively interrelated elements, *material*, *meaning* and *competence* as illustrated in Figure 1 (Shove et al., 2012). Only through linkage of these three elements a practice emerges. To sustain such practice the links have to be reproduced through repeated enactment. Once reproduction ceases, the links decay and thereby the practice itself. As long as the elements are linked, however, they are subject to recursive interdependence, meaning that change in one element triggers change in the other elements and ultimately in the practice as a whole. For instance the emergence of e-bikes alters the image of cycling to be less strenuous and faster, increasing its range and thereby allowing a wider demographic group access to it. Shove describes the three elements as follows:

Material refers to objects, infrastructures, tools, hardware and the body itself. In terms of cycling this includes but is not limited to bicycles, helmets, specialized gear, cycle lanes, road networks, locking facilities, bike shops, tools, and the cyclist itself.

Meaning encodes the social and symbolic significance of participation in a practice at any point of performance. It draws upon emotions and motivations. With respects to cycling this might include, environmental, economic, health or lifestyle concerns amongst other. Schatzki (2010) furthermore introduces the concept of 'timespace' in order to stress that people's actions have a history and a setting while simultaneously being oriented towards the future making the practice itself the bridging element.

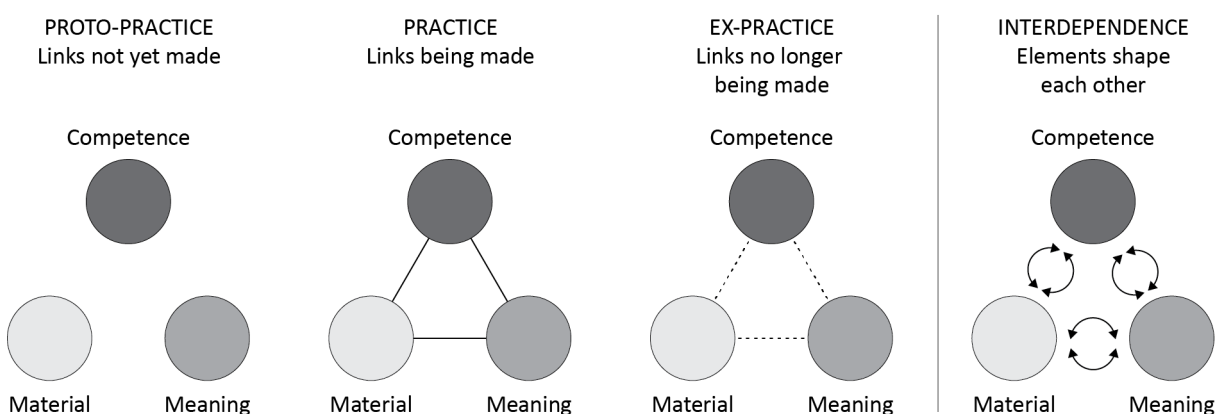


Figure 1 Emergence, maintenance and decay of a practice and the mutual interplay of various practice elements (Shove et al., 2012, p. 25).

¹ Interview with Richard Sanders from Syklistenes Landsforening, 24. 04. 2015

Competence accounts for know-how, background knowledge and understanding, which are required to perform a certain practice. In regards to cycling for instance, the skill to balance on a bicycle, fitness, awareness of traffic rules, signalling in traffic, repair skills, etc.

This arrangement provides useful framing and visual understanding of practices and their dynamics. However, it lacks explicit links to the structure it is embedded in. Giddens explains structure as:

“... the essential recursiveness of social life, as constituted in social practices: structure is both medium and outcome of reproduction of practices. Structure enters simultaneously into the constitution of the agent and social practices, and 'exists' in the generating moments of this constitution” (Giddens, 1979, p. 5).

In Giddens conception structure entails social institutionalized structure in the sense of rules and resources, but also the environment in which a practice is performed.

“The physical environment conditions, or sets limits to, the modes of conduct formed within societies, but it is the cultural system which most directly regulates them.” (Giddens, 1984, p. 265) Since “every complex social situation, institution or event is the result of a particular configuration of individuals, their dispositions, situations, beliefs and physical resources and environment” (Giddens, 1984, p. 215)

urban cycling is more holistically understood by expanding Shove’s model with a fourth element, *structure*, as illustrated in *Figure 2*. In the scope of this article *structure* is primarily concerned with properties of the physical and build environment only touching marginally on the dimensions of the cultural system.

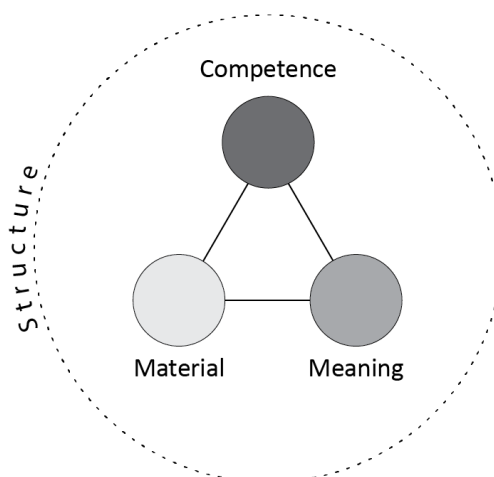


Figure 2 The interrelated elements of a practice as proposed by Shove embedded in its context, the structure, as proposed by Giddens

5. Configuration of cycling practice

This section draws together the insights gained from studying cycling practice in Trondheim and Freiburg relating to the structural analysis and the findings from the interviews. In a comparative manner similarities and differences are pointed out in respect to individual elements, which once integrated as practice culminate in distinct characteristics. The previously expanded model is used to visually present the configuration of cycling in each city. In further analysis elements are correlated to each other in form of a matrix shown in *Table 2* at the end of the chapter, which highlights dominant relationships, allowing insight for design interventions. Throughout the text the individual statements extracted from conducted interviews are numbered (x). These numbers reappear in the matrix, visually decoding how respective elements are linked. However, since practices change over time and space this assessment can only serve as current snapshot of cycling practice in the respective urban areas.

The practice of cycling in Freiburg appears to be of mundane everyday character while it carries a distinct notion of commute in Trondheim. While both cities are of comparable size in terms of inhabitants they highly differ with regards to its population density as well as terrain and prevailing weather (*Table 1*), which appear to contribute as influential environmental factors. As interviewees from Freiburg point out especially short distances and a well functioning, diverse public transport system allow to manage a majority of everyday activities via bicycle. Particularly long distances between home, work or kindergartens emphasized with hilly terrain and bad weather in the sense of snow, ice and rain rank among the most often named environmental hurdles for cycling in Trondheim. Rain however, is also a common complaint amongst interviewees from Freiburg. Yet the flat relief of the city combined with its high quantity of sunshine hours counteract this.

Table 1 Structural properties of Trondheim and Freiburg.

Property	Unit	Trondheim	Freiburg
Population	[pop]	183,96	220,286
Area	[km ²]	321, 81	153, 07
Population Density	[pop/km ²]	570	1439
Average Temperature	[°C]	5.9	11.8
Average Sunshine Hours	[h/y]	1347	1775
Average Rain Days	[d/y]	147	174
Precipitation	[mm]	836	855
Average Snow Days	[d/y]	31	27
Terrain		Flat centre surrounded by hills	Overall flat

Commonly in both cities sharing the road with cars is perceived as troublesome, even though it appears to be of more competitive nature in Trondheim where cyclists and cars rival for space (1). This is partly due to a less developed cycle network compared to Freiburg resulting in cyclists commonly needing to share the road or sidewalk. One respondent points out:

“I feel that there is not really a place for bicyclists a lot of places. This makes me feel that I am in the way of someone, when either being on the road or the sidewalk.” (Male, 23, Trondheim, 05.06.2015) (2)

Following Trondheim’s hilly terrain mountain bikes with front suspension and 18 to 21 gears dominate the picture also featuring few retro and commuter bikes (3). In contrast Freiburg exhibits a wide variety of bicycles, many of them being second hand. From city bikes, over race bikes to Holland-style bikes the spectrum stretches out to unusual bicycles such as tall bikes or recumbent bikes. Inverse is the variety of additional equipment. While a large part of cyclists in Trondheim wears helmets, light reflecting, waterproof clothing and specific cycling apparel including clipless pedals, Freiburg’s cyclists prefer casual everyday clothing and outdoor-jackets with a minority using helmets. This difference in apparel reflects the level to which cycling is integrated in normal day to day activities such as shopping, going to work, meeting friends, picking up children from school or kindergarten or simply getting around town versus being a mere means of commuting combined with exercise (4).

Wearing a helmet is yet also an indicator of perceived safety. A well developed infrastructure with special traffic lights and mirrors as well as a multitude of small streets with either low speed limits or even restricted car-access as existent in Freiburg creates such environment (5). Contrary the confusing and segmented infrastructure in Trondheim requires cyclists to often switch between road and sidewalk resulting in higher exposure to fast moving traffic (6) as one interviewee pointed out.

Despite these differences in terms of material the meaning of cycling is astonishingly similar. Since both cities are prominent university towns cycling is a main transport mode for students (7). It is considered environmentally friendly, allows for autonomy and independence from public transport as well as provides flexibility of route choice and thereby being less affected by traffic. Beyond that cyclists in both cities are perceived as caring about their physical shape and expenses. In Freiburg cycling, however, also has the connotation of being a normal and safe mode of transport for a wide range of demographics (8), while in Trondheim children and seniors seem to be underrepresented. One interviewee in Trondheim points out that the repeatedly mentioned overrepresentation of middle-aged men might be primarily induced by their more visible choice of apparel.

„Gender wise I don’t have the impression the differences are significant. This said middle-aged men might not even be over represented, just easier to see in their yellow jackets.“ (Male, 31, Trondheim, 12.06.2015)

Regardless of origin, this perceived imbalance and the fact that elderly and children are underrepresented is another indicator for a lack of perceived safety amongst cyclists in Trondheim (9).

In terms of competence Freiburg and Trondheim show further similarities in the need of knowing traffic rules, being able to communicate with other traffic participants, exercising caution around cars and being acquainted with short cuts. However, environmental aspects like tram tracks in Freiburg or the bicycle lift in Trondheim require specific skills (10).

Furthermore, Trondheim's hills and winter conditions demand fitness and will power to cycle uphill as well as good balance for icy downhill rides (11). Resulting from much shared road use in Trondheim are also skills in making oneself visible as well as taking a place in the lane which is neither too passive nor too aggressive (12). This competence finds manifestation in forms of yellow apparel, covers for backpacks or helmets in signal colour or bright lights (13).

Freiburg presents itself as eco-city, which provides the framework for having cycling at the heart of public attention. This seems to have particularly implications in terms of lacking risk awareness, since cyclists assume that cars have them in mind. In contrast Trondheim's cyclists show widely defensive behaviourism when in traffic (14). Further, the existing transport systems were mentioned as important factor for choosing to cycle. Since Freiburg is embedded within a well developed, diverse network of transport systems respondents had no need for cars if wanting to go somewhere else. However, in Trondheim it was mentioned by one interviewee that in order to manage a larger part of everyday life by bike:

„...the bus connections to the mountains would need to be better and the cost for having a carpool would need to be lower. Beyond that I would need to have some way to transport goods, for example using a car pool.“ (male, 25, Trondheim, 21.05.2015) (15)

Regardless of city image or state of the public transport system in both cities cycling was mentioned among students due to economic reasons, often coinciding with cheap or second hand bikes, while commuters primarily exhibit a lifestyle, resulting in more sophisticated bicycles and additional equipment (16). Beyond that having a family appears to reduce the likelihood for everyday cycling in both cities (17).

This comparison shows how differences in the structure of the environmental structure configure a practice differently in terms of material and thereby in its competences and meanings. Equally meanings like awareness of exposure to car traffic or health alter the materials cyclists use, such as helmets, apparel in signal colours, powerful lights or watches to monitor heart rate (18).

A visual representation of cycling practice in terms of the expanded model for each city is shown in Figure 3. Such illustration allows for capturing practice characteristics. Table 2 on the other hand represents the relationships of various elements in the respective cities. The statements from the text are coded with circles when referring to Freiburg and respectively with squares for Trondheim. In case a statement applies to both cities a circle encompassed by a square is used. Columns featuring the respective cities frame the four practice

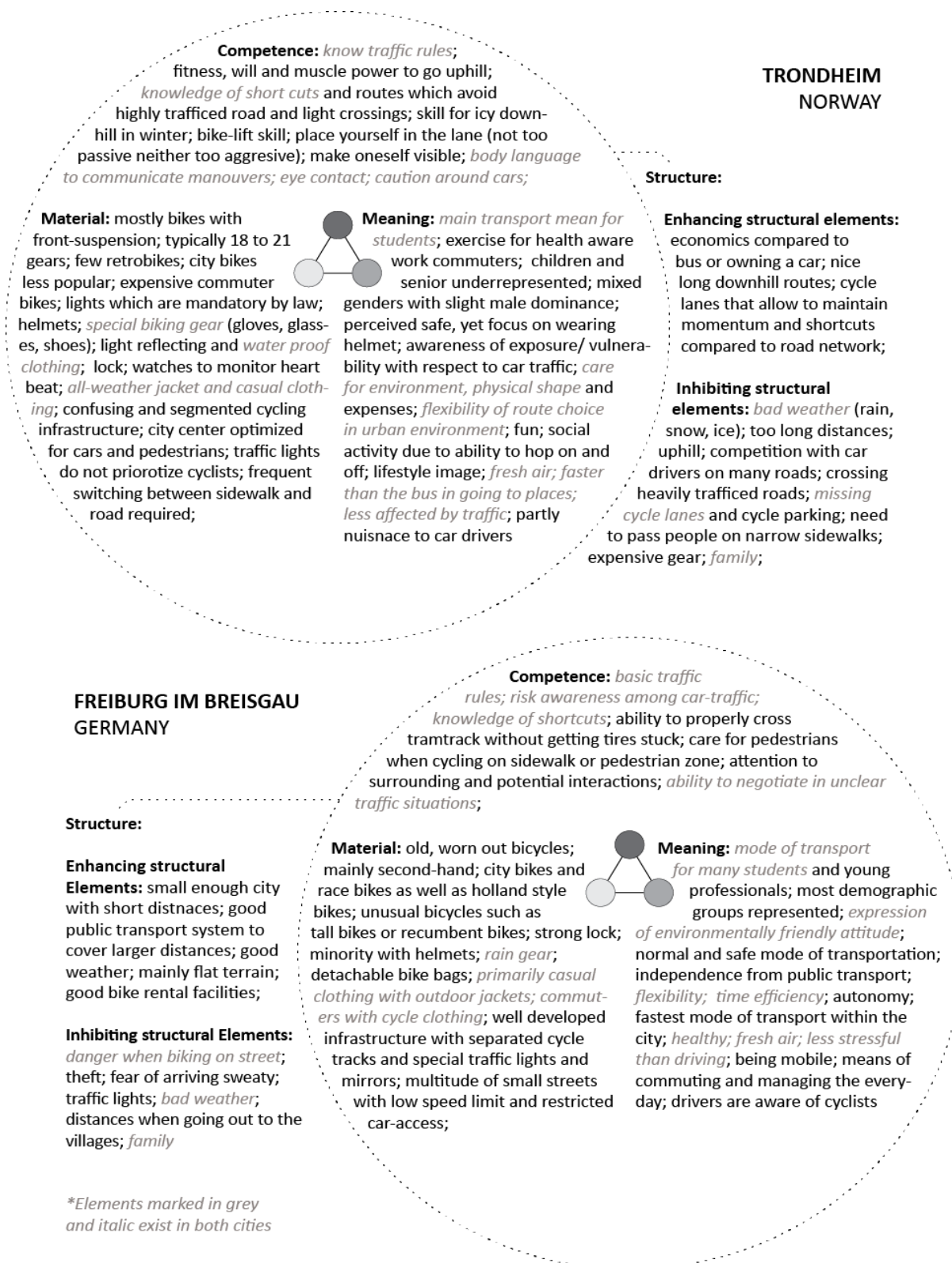


Figure 3 Visual representations of the elements and their interrelation configuring cycling practice in Trondheim and Freiburg in their characteristic manner as found through interviews. Aspects in black writing are place specific, while grey writing indicates its existence in both cities.

Table 2 Matrix representation of how various practice elements relate to each other. Circles indicate relationships in Freiburg, squares stand for Trondheim and squares encompassing a circle denote relationships present in both cities.

<div style="background-color: #444; color: white; padding: 5px; text-align: center;">●</div> FREIBURG	MATERIAL	MEANING	COMPETENCE	STRUCTURE	<div style="background-color: #444; color: white; padding: 5px; text-align: center;">■</div> TRONDHEIM
MATERIAL		(16) 18		13	
MEANING	5 (4) 2 6 8		9	(1) 7 (14) (15) (17)	
COMPETENCE				(10) 11 12	
STRUCTURE					

dimensions in the middle. The information reads from column to row. For instance, statement 18 illustrates how meaning impacts material in Trondheim, while statement 7 shows a connection of structure to meaning present in both cities.

Meaning appears to be the central element, exhibiting most connections, encoding the very nature of locally performed cycling practice. Particularly strong are ties between structure and meaning, which seem to dominate in both city cases. This suggests that avenues to changing cycling practice are most prominent in altering the structure cycling is embedded in, such as urban design, transport planning, governance etc. Cycling practice in Trondheim seems highly influenced by structural components across *material*, *meaning* and *competence*, more pronounced than in Freiburg, which due to better weather conditions and flat terrain seems naturally more conducive to cycling. Urban structure and geographical conditions as temporarily static constraints leave *material* as next most influential element shaping *meaning*. Particularly in this domain design practice can contribute significantly.

6. CONCLUSION

As this study illustrates cycling practice is embedded within a complex web of relationships. Yet, framing it in the context of social practice theory allows gaining insight into its various contributing elements and their recurrent ties. It seems particularly relevant to incorporate *structure* as fourth element, since mobility is the human response to its environmental conditions. The representation of the practice configurations in form of a matrix illustrates that. The research further illuminates that cycling in Freiburg appears of mundane, everyday character while it carries distinct traits of commute in Trondheim.

From a design perspective this research presents how exploring problems framed via practice theory disentangles the individual elements in a ‘deconstructing’ fashion opening for contextual understanding. Simultaneously being aware of other elements can lead to designs with practice in mind. This relates to enabling design practice to grasp the complexity of the invisible integral system composed of objects *and* its interpersonal

relationships, as Burckhardt initially pointed out. Ultimately the model builds upon Shove's ideas in developing approaches for practice-oriented design.

It has to be noticed though that the practice of cycling, itself is part of systems of practice, in terms of mobility most notably the practice of driving (Watson, 2012). Therefore designing mobility solutions in terms of bicycle urbanism might require expanding the boundary condition beyond cycling practice itself. Future research could for instance consider methods such as giga-mapping or rich design spaces (Sevaldson, 2008, 2011) to cover complex structures and corresponding interactions relating to *material, meaning and competence*.

7. References

- Burckhardt, L. (2004) *Wer plant die Planung? Architektur, Politik und Mensch*. (J. Fezer & M. Schmitz, Eds.). Berlin: Martin Schmitz Verlag.
- Colville-Andersen, M. (2010) *Why we shouldn't bike with a helmet*. Denmark. Retrieved from <http://tedxtalks.ted.com/video/TEDxCopenhagen-Mikael-Colville>
- Giddens, A. (1979) *Central Problems in Social Theory: Action, Structure, and Contradiction in Social Analysis*. University of California Press.
- Giddens, A. (1984) *The Constitution of Society: Outline of the Theory of Structuration*. Cambridge: Polity Press.
- Hekkert, P., & van Dijk, M. (2011) *Vision in Design: A Guidebook for Innovators*. Amsterdam: BIS Publishers.
- Hillier, B., & Hanson, J. (1984) *The Social Logic of Space*. Cambridge: Cambridge University Press.
- Jacobs, J. (1961) *The Death and Life of Great American Cities*. Random House.
- Kielgast, L. (2015) THE CITIES OF THE FUTURE ARE PEOPLE-FRIENDLY CITIES. Retrieved July 21, 2015, from <http://denmark.dk/en/green-living/bicycle-culture/the-cities-of-the-future-are-people-friendly-cities/>
- Lorenz, F. (2014) Bicycle Urbanism. Retrieved April 1, 2015, from <http://sustainablecitiescollective.com/florian-lorenz/223671/welcome-bicycle-urbanism>
- Ortner, S. B. (2006) *Anthropology and Social Theory: Culture, Power, and the Acting Subject* (Vol. 2006). Duke University Press.
- Reckwitz, A. (2002) Toward a Theory of Social Practices: A Development in Culturalist Theorizing. *European Journal of Social Theory*, 5(2), 243–263. doi:10.1177/13684310222225432
- Schatzki, T. R. (2010) *The Timespace of Human Activity: On Performance, Society, and History as Indeterminate Teleological Events*. Plymouth: Lexington Books.
- Schatzki, T. R., Knorr-Cetina, K., & Savigny, E. von. (2001) *The Practice Turn in Contemporary Theory*. London: Routledge.
- Sennett, R. (1977) *The Fall of Public Man*. London and Boston, MA: Faber and Faber.
- Sevaldson, B. (2008) Rich Design Research Space. *Form Akademisk*, 1(1), 28–44.
- Sevaldson, B. (2011) Giga-mapping: Visualisation for complexity and systems thinking in design. *Nordes '11: The 4th Nordic Design Research Conference*, 137–156.
- Shove, E., Pantzar, M., & Watson, M. (2012) *The Dynamics of Social Practice: Everyday Life and How it Changes*. London: SAGE Publication Ltd.
- Shove, E., Wattson, M., Hand, M., & Ingram, J. (2007) *The design of everyday life*. Oxford: Berg.

Urry, J. (2004) The “System” of Automobility. *Theory, Culture & Society*, 21, 25–39.
doi:10.1177/0263276404046059

Watson, M. (2012) How theories of practice can inform transition to a decarbonised transport system. *Journal of Transport Geography*, 24, 488–496. doi:10.1016/j.jtrangeo.2012.04.002

About the Authors:

Tobias Barnes Hofmeister is Research Assistant in the Department of Product Design, Norwegian University of Science and Technology, Trondheim. He is currently working with sustainable practices and the relationship of urban planning and transportation framed through the lens of complexity.

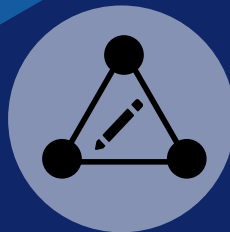
Dr. Martina Maria Keitsch is Associate Professor in Design, Norwegian University of Science and Technology, Trondheim. She has worked for over eighteen years in the sustainable development field, mainly with eco design, and -architecture, urban planning and stakeholder inclusion.



Early adoption of cycling as basis to shape transportation practices.

3

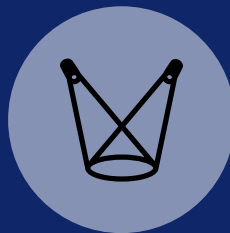
Practice-oriented, persuasive and participatory design



**Practice-Oriented
Design**



Co-Creation




Staging Mobilities



**Socially Influencing
Systems**

Chapter 5 Practice-oriented design



“Change is omnipresent and continuous in practices but not initiated by anyone in particular or directed in any particular direction, while design is about initiating and facilitating change in preferred directions. [...] The type of enduring, large-scale change aimed for in sustainable design implies change in the practice-as-entity; the overarching organizing structure of the practice.”

Lenneke Kuijer, 2014, p. 76

Practice-oriented-design as emerging field between design and the social sciences seems promising in providing a novel angle to large scale societal design issues. As proposed by Scott et al. (2012) and Kuijer (2014) practice-oriented-design processes are inherently iterative (see Figure 8 and Figure 9). Scott (2012) stresses the importance of an iteration between modes of practical and discursive consciousness (Giddens, 1984) in order to design new practices through reflection on current practices as well as experimentation with novel practices. Kuijer (2014) approaching practice design from a similar viewpoint, highlights practices as unit of design. As such an iterative practice-oriented-design process transforms the opportunities for desirable change into a practice configuration that works (Figure 9). In her dissertation Kuijer (2014) elaborates on how practice can be shaped through either replacing elements in existing practices (Figure 10) or through bottom up design of novel practices via low and high fidelity practice prototypes (Figure 11). As Figure 10 illustrates introducing an unfamiliar element into an existing practice might result

in a reconfiguration of further elements and links. In such way the introduction of the electric bike as material element has begun to alter the meaning of cycling by making it convenient for a wider demographic, but also changed how people interact with their bike, as for example needing to remove the battery to recharge it or protecting it from being stolen. In such way it is possible to reshape practices significantly if pivotal elements are identified and replaced. Frequently new elements in the realm of the material composition of a practice seem to show influence on competences and meanings.

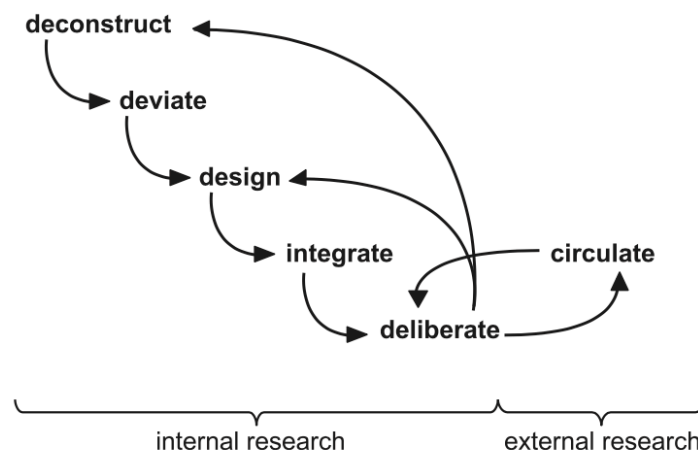


Figure 8 Generalized methodology for practice-oriented design (Scott et al. 2012, p. 286)

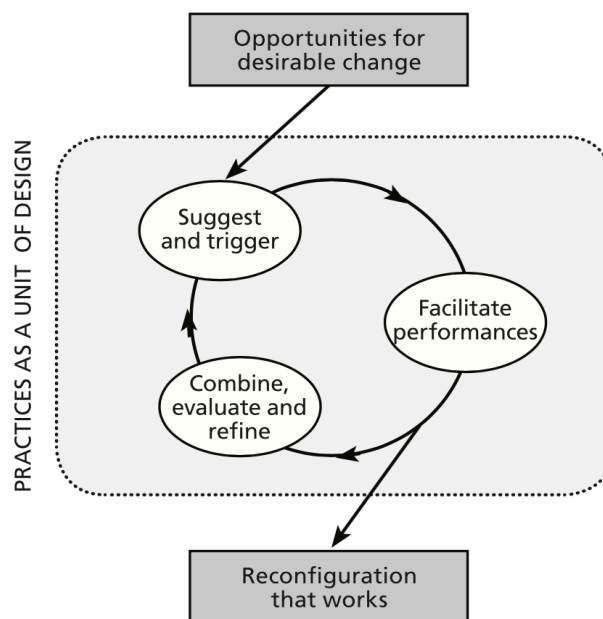


Figure 9 Model to take practice as unit for design to generate new practices based upon opportunities for desirable change (Kuijter, 2014, p. 84)

It is however, equally possible to design novel practice through low or high fidelity prototypes. In both cases the actual practice will be more complex than the prototype, allowing it to be adapted by each individual. When designing a novel practice its prototype will become increasingly more refined the more iterations it undergoes and the more insight about vital elements can be gained. Since any practice undergoes continuous transformations it is impossible to fully design a practice. As such practice-oriented-design can provide impulses for change through adequate practices which will take on a life of their own once adopted and adapted into the lives of the public.

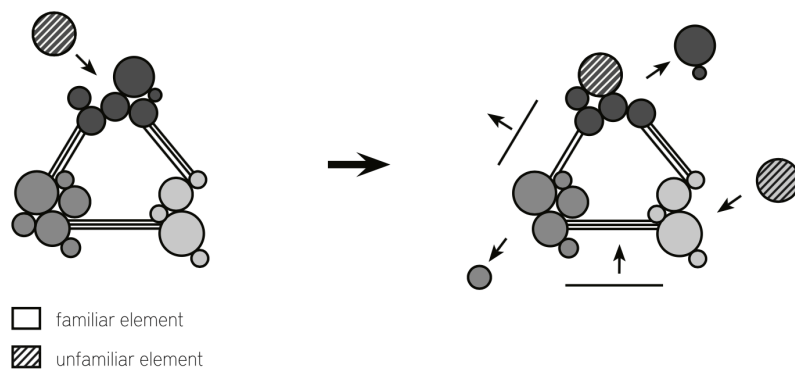


Figure 10 Integration of unfamiliar element into a practice, leading to its reconfiguration through an adjustment of strong and weak ties and their respectively connected elements (Kuijer, 2014, p. 76)

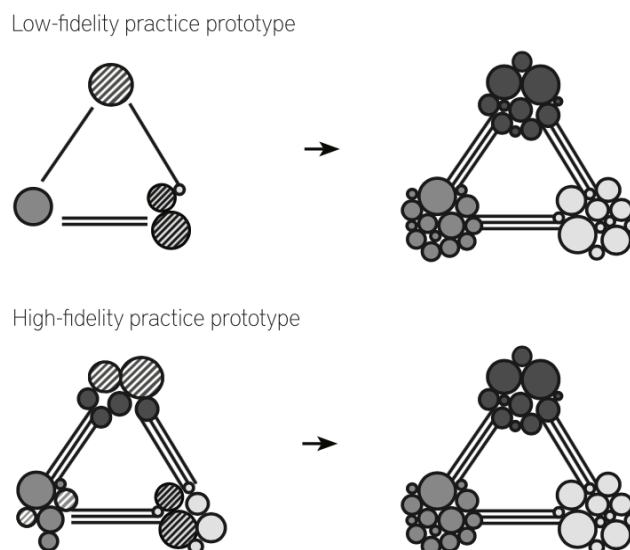


Figure 11 Low fidelity and high fidelity practice prototype. While the low fidelity prototype represents a vague idea of the new practice, allowing for much emergent development, the high fidelity prototype stems from much deeper insight and allows for better prediction of the adopted version (Kuijer, 2014, p. 85)

Chapter 6 Persuasive design via socially influencing systems

“If you want to teach people a new way of thinking, don’t bother trying to teach them. Instead, give them a tool, the use of which will lead to new ways of thinking.”

- R. Buckminster Fuller

Whenever implemented, socially influencing systems (Stibe, 2015) empower individuals to observe others and see their own performance among the members of their communities. By design, socially influencing systems can have any number of social influence principles incorporated as features into computer-supported interventions. Stibe (2016) suggests that seven social influence features can be used to achieve desired behavioral and attitudinal changes, including a combination of social facilitation, cooperation, and competition in the context of bicycling.

The framework of socially influencing systems (Figure 12) explains how the seven principles are interlinked and have potential to exert stronger effects depending on the context of a particular behavioral or attitudinal challenge. Normative influence and social comparison can be more effective to achieve involvement of the target group as the two principles focus on attitudinal changes. Cooperation and social facilitation can be more effective to make

Whenever implemented, socially influencing systems (Stibe, 2015) empower individuals to observe others and see their own performance among the members of their communities. By design, socially influencing systems can have any number of social influence principles incorporated as features into computer-supported interventions. Stibe (2016) suggests that seven social influence features can be used to achieve desired behavioral and attitudinal changes, including a combination of social facilitation, cooperation, and competition in the context of bicycling.

The framework of socially influencing systems (Figure 12) explains how the seven principles are interlinked and have potential to exert stronger effects depending on the context of a particular behavioral or attitudinal challenge. Normative influence and social comparison can be more effective to achieve involvement of the target group as the two principles focus on attitudinal changes. Cooperation and social facilitation can be more effective to make individuals participate and do the envisioned future behavior even without a formed attitude towards it. Competition and recognition can be more effective in engaging the target group to do the future behavior as the principles

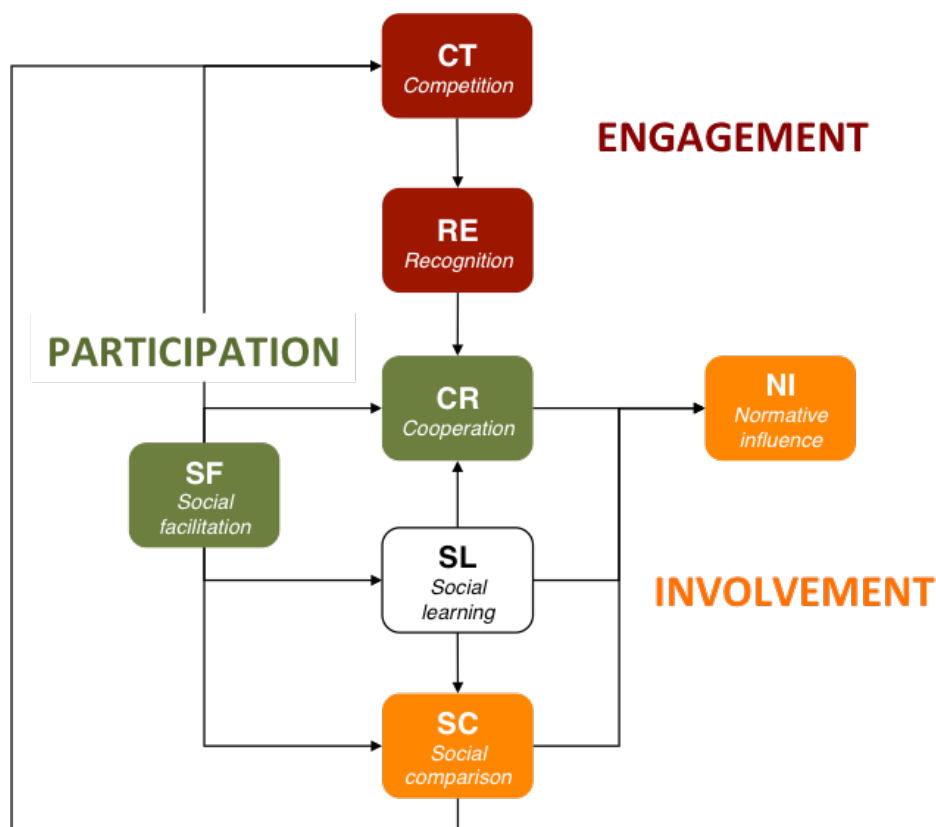


Figure 12 Socially Influencing Systems (SIS) framework (Stibe, 2016)

focus on both attitude and behavior simultaneously. For example, the effects several socially influencing principles have already been studied in the context of bicycling (Wunsch et al., 2016).

Designers of future socially influencing systems for bicycling purposes might find the framework quite instrumental and easy to use. For example, in the presence of others (social facilitation), people can begin to learn from others, to compare themselves with others, and to cooperate or to compete with them. Similarly, the arrow from social comparison to competition implies that when people are able to compare themselves with others they are likely to be prompted to compete with those who are better than them, which also might create a sense of social norms. The arrow from competition to recognition explains that people who are ranked higher naturally receive some kind of public recognition as others can see how well they have performed. Meanwhile, those who receive public recognition can become more motivated to keep up their excellent performance, which means that they would continue contributing to a collective goal in a cooperative context. Social learning has

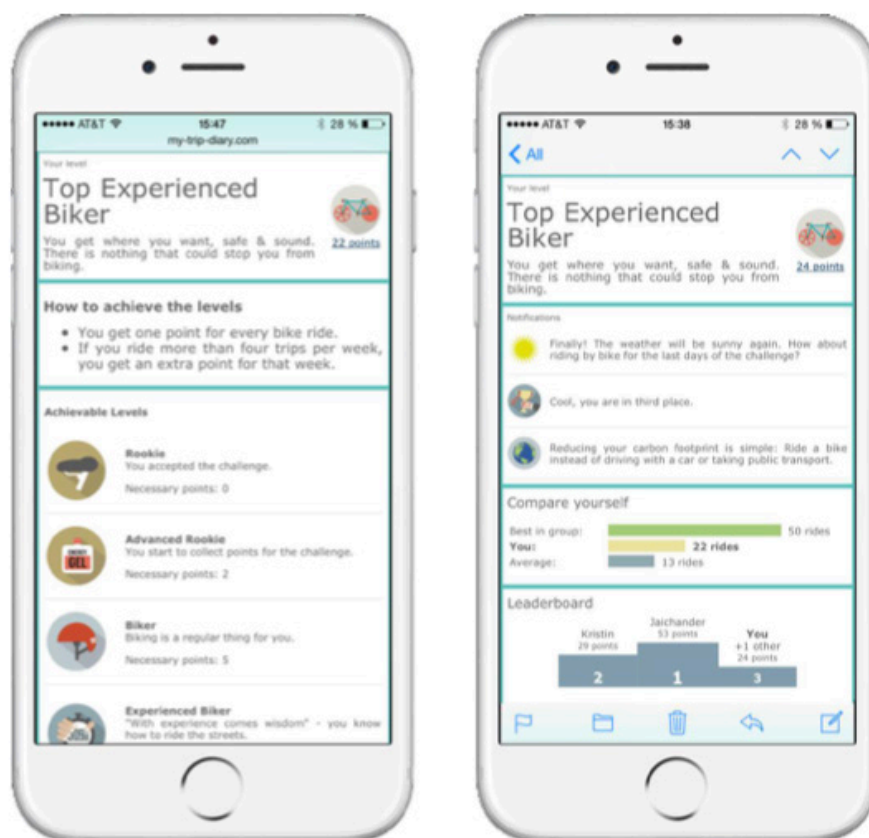


Figure 13 Mobile interface of frequent biking challenge, engaging through various levels of socially influencing systems framework (Wunsch et al., 2016)

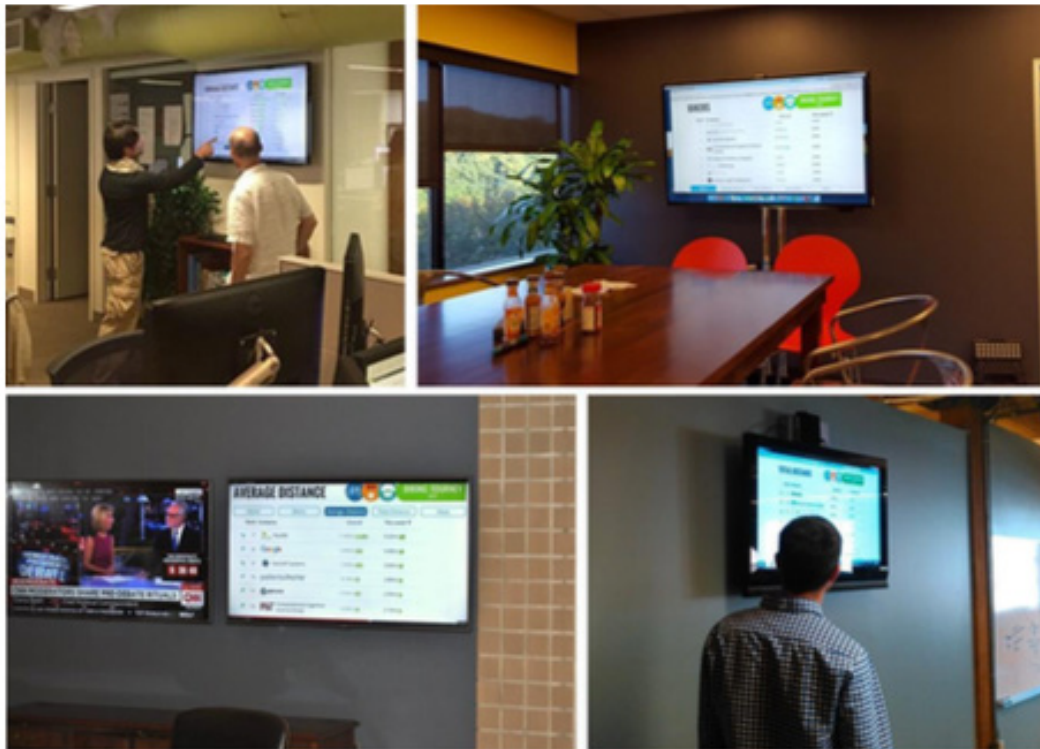


Figure 14 Public displays showing the tourney ranking in order to visualize the performance of other members of the community (Wunsch et al, 2016)

always played an important role in the evolution of mankind. The framework presents that in a social context people can learn how to compare themselves to others, cooperate, and read or create an understanding about social norms. Besides, the more people cooperate the more likely they will experience cooperation as a norm for the particular occasion. So, properly designed socially influencing systems can be very effective in reshaping social practices at scale, thus fostering emergence of persuasive cities for sustainable wellbeing (Stibe, 2016)

Studies by Wunsch et al. explored the application of socially influencing systems for urban cycling. Figure 13 shows the interface of a mobile application gamifying the daily commute to work, encouraging the transition to cycle more often. Figure 14 and Figure 15 illustrate how socially influencing system were used to encourage cycling during a cycling campaign, displaying different performance levels of participating companies in various disciplines on public displays. Such arrangement stimulates competition between teams and organizations as well as cooperation amongst team members.



Figure 15 Screenshots of the various ranking categories. The categories are chosen in a manner that they are engaging on a variety of different key indicators (Wunsch et al. 2016)

Chapter 7 The field of participatory design and its tools

“Cities have the capacity of providing something for everybody, only because, and only when, they are created by everybody.”

- Jane Jacobs, *The death and life and Great American Cities*

Cities as entities of collective life are designed collectively through the action and interaction of all its citizens amongst each other and their environment. However, formal planning and design processes often disregard the inherent complexity and citizen participation (Portugali 2011). Leveraging participatory design methods provide tools to include the collective creativity of citizens into the design of urban systems, such as transportation. The *Convivial Toolbox* by Sanders and Stappers (2012) provides a substantial collection of available tools and elaborates on the rationale of participatory methods in design. As Figure 16 illustrates participatory methods allow access to tacit and latent knowledge of the participants. In such way it is possible for the designer to gain insight into what people know, feel and dream. Being involved in participatory design session furthermore provides the individual participants with a sense of ownership that makes any outcome of these sessions more easier to be accepted amongst the members of the involved communities. Sanders and Stapper (2012) elaborate as shown in Figure 17 that co-creation

as a mindset is particularly relevant when approaching societal issues. Especially throughout the pre-design, discover as well as the design and make stages it is fundamental to keep a co-creative mindset in order to consider the complexity of various interests. In these early stage of the design process co-creation as a mindset has the most potential to have positive effects on the lives of people.

Figure 18 and Figure 19 show the process of collective weaving as applied by Chueng-Nainby et al. (2016) in village regeneration and transportation projects. Through spatially assembling stories the process of collective weav-

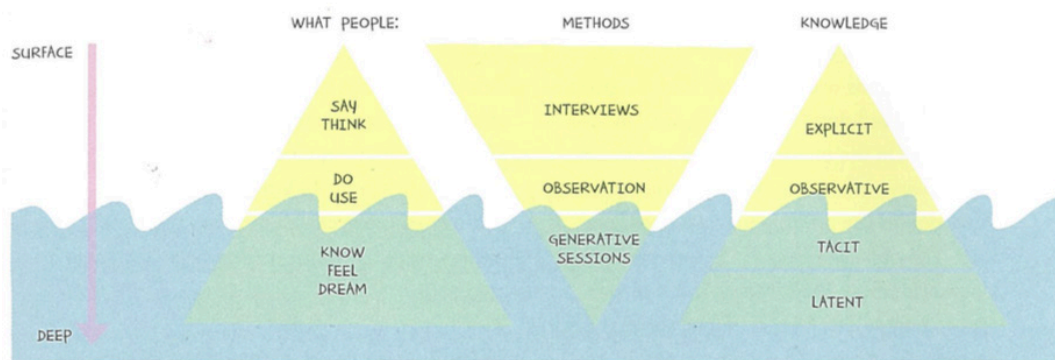


Figure 16 Tacit and latent knowledge can be tapped into through generative design sessions (Sanders & Stappers, 2012, p. 67)

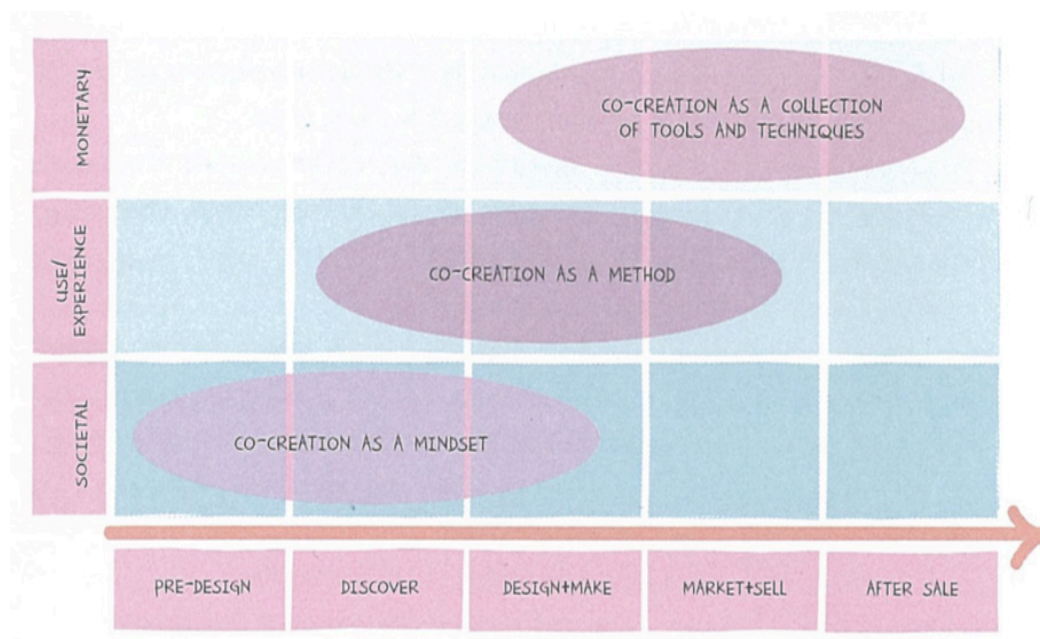
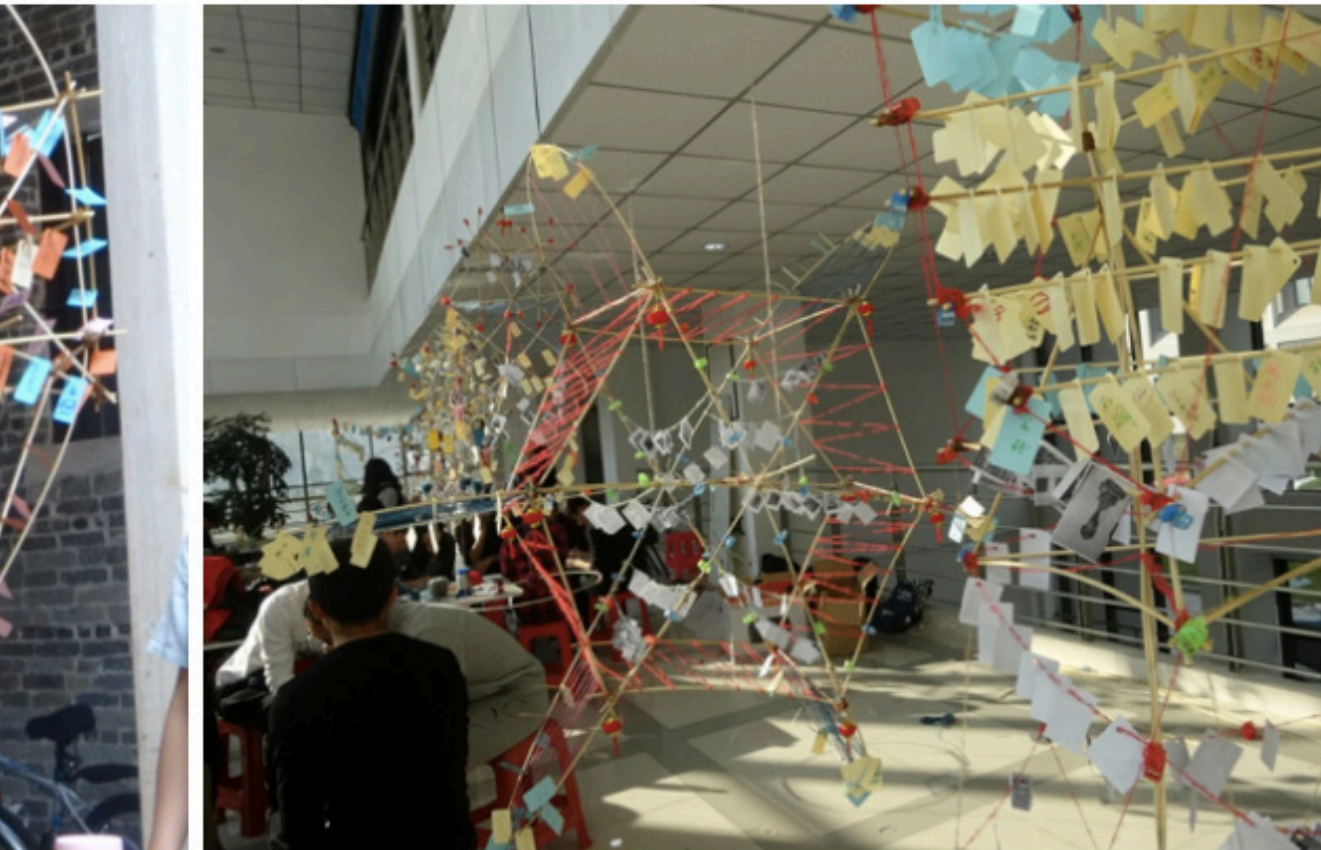


Figure 17 Co-creation as a mindset is fundamental when approaching societal design challenges (Sander & Stappers, 2012, p. 31)



Figure 18 Collective weaving as co-creation method created spatial narratives. The participants can interact with other stories and ties theirs into them. Through creating them collectively these installations facilitate



discussion and create mutual understanding. Further they can serve as visual narrative installation to be viewed by others in the aftermath of the workshop. (Chuang-Nainby et al., 2016)



Figure 19 Process of collectively weaving narratives in social innovation projects (Chueng-Nainby et al., 2016)

ing facilitates a conversation between different community members while they share their personal experiences. Building this structure representing the conversational content focusses the conversation around an emerging item allowing all participants to contribute their ideas. Further these spatial installations allow for members of the wider community to explore these stories in the aftermath of the workshop. Assembling stories and experiences in such manner allows to visualize connections and their density. Further these spatial installations provide an opportunity to cross link between stories highlight-



ing common themes on the path to identifying pivotal aspects. Particularly when approaching transportation related issues collective weaving stands out as spatial toolkit structuring journeys and organizing them within space. The produced “sculptures” as the result of the workshop provide a unique object to facilitate presentation of the achieved results and can subsequently be analyzed digitally for patterns and pivotal nodes. Such analysis can feed into the process of identifying pivotal elements within the design of desired practices.



This paper is authored by myself under supervision of Prof. Martina Keitsch with additional feedback from Ida Nilstad Pettersen. Agnis Stibe contributed with discussion and insights into his research. He submitted two paragraphs about the nature of socially influencing systems, which however, due to clearer focus on the design process are no longer part of the final version of this paper. Due to his initial contribution he is still listed as co-author.



Article 2

Living mobility transitions towards bicycling: Designing practices through co-creation and socially influencing systems

Under peer review for EAD12, DESIGN FOR NEXT

Cycling as deeply integrated into
everyday practice independent of weather
conditions, as here in Copenhagen

LIVING MOBILITY TRANSITIONS TOWARDS BICYCLING. DESIGNING PRACTICES THROUGH CO-CREATION AND SOCIALLY INFLUENCING SYSTEMS

Tobias Barnes Hofmeister^{a,*}, Agnis Stibe^b

^a Department of Product Design, Norwegian University of Science and Technology

^b MIT Media Lab, Massachusetts Institute of Technology

*Corresponding author e-mail: barneshofmeister@gmail.com

Abstract: The urban environment informs the behavior of its inhabitants and their actions in turns shape this environment. These recurrent, circular causalities make cities to be of complex, nonlinear nature reinforcing prevailing mobility practices. Thus, a city's final characteristics are not determined by designers and planners, yet rather their citizens, who can be seen as latent designers. Acknowledging potentially decisive impacts of citizen behavior for urban transformations, this article explores a methodology of involvement and social persuasion to foster bicycling. The analysis draws on social practice theory and explores how co-creation methodologies and socially influencing systems, persuasive information systems building upon social influence, can supplement practice-oriented design interventions. Social practice theory focuses on the integration of meanings, materials and competencies into routinized everyday habits linking structure with agency. The article presents a methodological approach to alter mobility practices and maintain their new composition through identifying pivotal practice elements to be subjected to socially influencing systems.

Keywords: complexity, practice-oriented design, socially influencing systems, co-creation, urban mobility

1. Introduction

Cycling is frequently proposed as one lever to face the urban sustainability crisis. On a personal level cycling strongly links to lifestyle and quality of life (Crane, Rissel, Standen, & Greaves, 2014; Spencer, Watts, Vivanco, Gaza, & Farley, 2014). However, the urban environment as configured throughout the development of the 20th century, with its zoning laws, urban sprawl, focus on private auto-mobility, etc. is in many ways not conducive to bicycling. Systems thinking and complexity theory recognize cities as webs of connections and interrelations. This highlights the need for holistic,

systemic interventions to prepare an environment from which cycling can emerge as a viable mode of transportation. In this way solely improving cycling infrastructure fails, rather the focus must shift towards innovating mobility practices. As mobility practices are staged from above, through spatial organization, legal regulations, zoning laws, time tables, traffic lights, etc. they are acted out from below by the individual urban citizens, when traveling through the urban environment, choosing routes, preferred seats, interacting with fellow citizens, etc. (Jensen, 2013a). However, it is not only immediate interaction with the urban environment and fellow citizens that shape mobility practices, but increasingly a mediation through networked technologies (Jensen, 2013b). As such the “understanding of the interdependence of technologies and mobilities is essential to understanding how place increasingly becomes mediated and thus ‘produced’ by technologies” (Jensen, 2013b, p. 4). That sort of multilayered interaction between the physical design artefact city, the cognitive abilities of its inhabitants and the influence of networked technologies leads to cities emerging into dually complex systems (Portugali, 2011).

At the intersection of design and sociology practice oriented-design recognizes how material artefacts not only meet user needs, but play a significant role in the creation of everyday habits (Shove, 2006). Thus, taking social practices as unit for analysis or intervention practice-oriented design draws attention in explorations towards fostering sustainable consumption through design (Hargreaves, 2011; Jaeger-Erben & Offenberger, 2014; Kuijer, 2014; Kuijer & Jong, 2009; Sahakian & Wilhite, 2014; Spaargaren, 2003, 2011). While social practices approach behavior change from a systemic perspective covering the physicality of the city and the human in the above discussion, persuasive technologies address behavior change on the individual level taking into account the potential of networked technologies (Fogg, 2002).

Rooted in systems thinking and complexity theory of cities this article explores a combination of practice-oriented design and persuasive technologies to foster sustainable mobility. The developed methodology is based upon practice-oriented design processes articulated in Scott, Bakker and Quist (2012) and Kuijer (2014). While recognizing the effectiveness of participatory design tools, as done by Scott (2012) and Kuijer (2014), parts of the process are augmented through persuasive technologies. Leveraging research on socially influencing systems for persuasive mobility the proposed process outlines an actionable practice-oriented design process for mobility transitions towards bicycling.

2. Methodology

The article ties together literature from design theory, social practice theory, urban studies, complexity theory, systems thinking and human computer interaction. In doing so the article synthesizes findings from previous studies on the relationship of urban space and the local practice of cycling (Barnes Hofmeister & Keitsch, 2016) and the impacts of socially influencing systems on the rate of cycling (Wunsch et al., 2015; Wunsch, Millonig, et al., 2016). Initially the article reviews literature and condenses results from previous case studies on urban cycling practice and computer mediated cycling campaigns performed by the authors. These case studies are further introduced in chapter three.

In order to develop an applicable practice-oriented design process for sustainable urban mobility the article introduces a complexity perspective of cities and the social life within them. Following, practice-oriented design methodologies as proposed by Scott, Bakker and Quist (2012) and Kuijer (2014) lay the foundation for an augmented design process. This process is based on insight from the previous case studies investigating urban context and socially influencing systems with respect to urban cycling. While leveraging the benefits of participatory design methods as recognized by Scott

et al. (2012) and Kuijer (2014) socially influencing systems are proposed as instrumental tools in an alternating practice-oriented design process of collective and individual experimentation and learning. Such process is alternating between co-creation methodologies to foster interaction and collective creativity to challenge existing practices through workshops, and socially influencing systems to empower individuals to adopt new practices on their own via mediation through socio-technical environments.

In visualizing on how to structure and which tools to apply in each stage of the process the goal of this article is to make practice-oriented design tangible to practitioners in the fields of urban development and design. It is further the goal to suggest a multi modal approach of group sessions, individual experimentation, participatory design tools for co-creation and persuasive design tools in form of socially influencing systems as effective combination to promote novel practices through direct engagement of the participants.

The article is structured as follows. The first three sections introduce results from previous case studies, establish a systems thinking and complexity perspective on cities and review practice-oriented design. The fourth section explains the steps of the generalized methodology for practice-oriented design of Scott et al. (2012) and visually combines it with the process proposed by Kuijer (2014). The fifth section applies this unified methodology to bicycling and proposes an array of tools drawing on co-creation methodologies and socially influencing systems. The final section concludes the article with suggestions for implementation and future development of the proposed practice-oriented design process.

3. Previous Case Studies

The Changing Places group at MIT Media Lab approached mobility behavior change through socially influencing systems. Such systems are persuasive information systems, which build upon social influence to enhance individual engagement mediated through socio-technical environments (Stibe, 2015). Biking Tourney, as research project based upon socially influencing systems to increase commuter cycling, has been investigated in three case studies of different size on city level in Boston and country level in Austria, ranging from 44 to 498 participants (Wunsch et al., 2015; Wunsch, Millionig, et al., 2016; Wunsch, Stibe, et al., 2016). Throughout the intervention period the socially influencing systems approach has shown significant increase in cycling rates amongst participants (for instance 77.6% of occasional bikers cycled more often) (Wunsch et al., 2015). However, the conducted long-term surveys show that the altered travel behavior returns to its initial condition after the end of the intervention period. This suggests that cycling has not been sufficiently incorporated into the participants everyday practice. On the contrary it suggests that socially influencing systems are effective in stimulating specific routines if the systems are in place.

Research at the Department of Product Design at the Norwegian University of Science and Technology (NTNU) investigated the complexity of urban cycling through social practice theory and theories of structuration (Barnes Hofmeister & Keitsch, 2016). Social practices as articulated by Shove, Pantzar and Watson (2012) emerge through the integration of three elements: material, meaning and competence. Using this framework, an analysis of cycling practice composition in Freiburg, Germany, and Trondheim, Norway, revealed the influential nature of the encompassing urban structure (Barnes Hofmeister & Keitsch, 2016). As introduced by Giddens (1984) structure is means as well as outcome when reproducing practices and thereby stands out as primary entry point for design interventions. However, structure as exerted through the institutional-organizational dimension of everyday life is often concealed by the common way of classifying the environment in

terms of individual entities (Burckhardt, 2004). It is therefore vital to conceptualize everyday practices through a systemic view of interrelation.

The case studies of both institutions outline conditions and tools for mobility transition towards bicycling. In this article they serve as places of departure for the development of an integrated methodology through recognizing their unique leverage points. Socially influencing systems coming from the angle of social psychology and the analysis of local cycling practice coming from the angle of social practice theory complement each other in the framework of a dynamic practice-oriented design approach. The generalized methodology for practice-oriented design as articulated by Scott et al. (2012) recognizes these dynamics of communal and individual practice innovation. Hence, it serves as outline for an actionable practice-oriented design process building upon key insights from the case studies at MIT Media Lab and the Department of Product Design at NTNU.

4. The physicality of cities and social practice

Since urban structure significantly influences the composition, development and persistence of mobility practices, practice-oriented design processes need to emerge from a systemic, complex perspective of cities (Barnes Hofmeister & Keitsch, 2016; Jensen, 2014). The relationship between urban agents and the city can be described as recursively constraining as the city emerges from the interaction of its agents, but once emerged sets limits to the modes of conduct for its agents (Giddens, 1984; Portugali, 2004). Circular causalities reinforce prevailing mobility practices. Further, if not scrutinized circular causalities provide the unchallenged context informing on-going development of practices. Hence, to promote sustainable modes of transport, such as bicycling, it is vital to presence the institutional-organizational and experiential dimension of urban systems (Burckhardt, 2004; Ehrenfeld, 2008; Scharmer, 2008) and stimulate innovation of social practice (Scott et al., 2012; Shove et al., 2012; Shove, Wattson, Hand, & Ingram, 2007). Mobilities in such manner are staged from above through formal planning and design processes, yet equally importantly acted out, performed and lived bottom-up (Jensen, 2013c). It is the everyday practices of the human agents, the latent designers, which shape the urban environment and which emerge within these given boundaries (Portugali, 2004). As Scott (2012, p. 284) explains: „Indeed, practice-oriented design means enabling a form of social innovation to occur, where communities of practitioners challenge existing norms to create new ways of living and doing.“ Hence, practice-oriented design seems promising in holding an untapped potential for inclusive, holistic and complexity embracing urban design by providing ownership to latent designers – the city’s citizens.

5. General methodology for practice-oriented design

Practice-oriented design as initially introduced by Shove (2006) recognizes the potentially decisive hand of designers in defining the practices of which human experience and social order are constituted. As such practice-oriented design exceeds user-centered design by not only focusing on how design can create value for users, but rather how design can leverage cycles of production, consumption and use to shape society. It recognizes the flow of meanings, competencies, purposes and products in which designers intervene. Following Kuijer (2014) practice-oriented design differs from other forms of design through taking its starting point in intervention in a practice, followed by a design process resulting in a desired reconfiguration of the practice in question. Despite great ambition practice-oriented design is still very much in its infancy. Mainly due to a lack of practicable design processes making the concept of practice-oriented design tangible to designers (Scott et al., 2012).

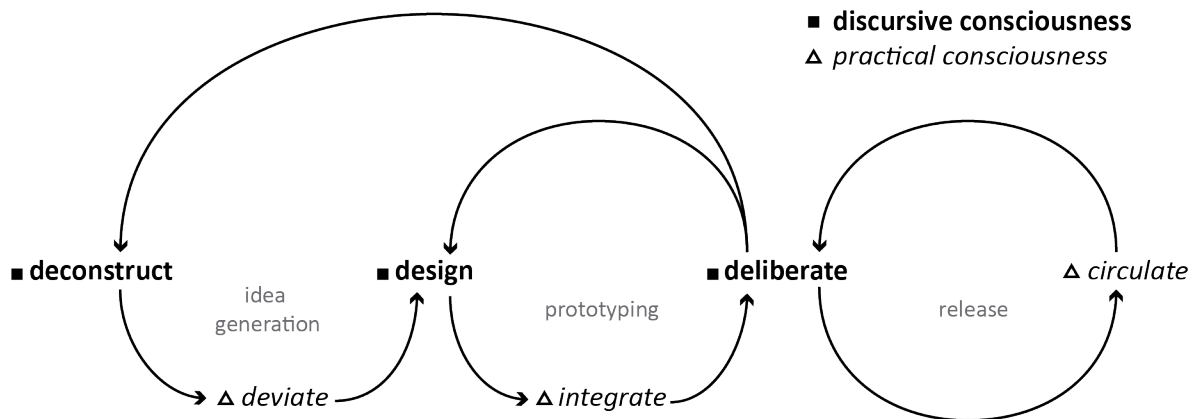


Figure 1. Iterative practice-oriented design process alternating between modes of discursive consciousness, reflecting on practice and its elements, and practical consciousness, trying out new behaviors in everyday routines. (proposed by Scott (2012, p. 286))

Scott et al. (2012) and Kuijer (2014) have addressed this void in design literature by proposing practicable practice-oriented design processes applied to issues of consumption, in particular to bathing and staying warm. In both cases the design process for new practices follows an iterative pattern in which new practice configurations are devised, tested and evaluated before being circulated to a wider audience for further evolution. The design process shown in Figure 1 is proposed by Scott (2012, p. 286), verified through research of Kuijer (2014, p. 84).

For the development of a practice-oriented design process Giddens (1984) distinguishes between two modes of performance: discursive and practical consciousness. While discursive consciousness describes the ability of people to reflect, necessary to perceive, consider, evaluate and restructure their own behavior, practical consciousness refers to the habitual performance of practices based upon largely engrained, familiar and tacit patterns (Scott et al., 2012). In order “to enable a deliberate change in practice, emphasis and assistance should be given to a continuous alternation between discursive and practical modes” (Scott et al., 2012, p. 285) as shown in the design process in Figure 1. The six stages of the process after Scott (2012) are as follows:

Deconstruct: Analysis of practice in focus, such as commuting or in particular bicycling. The goal is to explore the barriers for change through exposing taken for granted factors of a practice such as social norms, expectations, behaviors, taste, conventions and so forth. In doing so the boundaries for change shall inspire innovation through awareness of strong and weak elements and links forming the respective practice.

Deviate: Through deliberate departure from habitual behaviors into novel practices more insight can be gained regarding boundary conditions, practical requirements or leverage points.

Design: Gained insights are merged into new practices. The designed practice prototypes “are devised to provide the tools, methods, furnishings, and conceptual support to make real life implementation possible” (Scott et al., 2012, p. 287). It is critical to thoroughly consider the implications onto all three elements of a practice and to keep flexibility to allow further adjustment.

Integrate: Performance of practice prototypes over a longer period of time in daily life. Through attempting to integrate the new practice into every day routines the participants gain further insight on how the practice manifests itself and how effective it is in achieving a desired goal.

Deliberate: Evaluation of the practice prototype with respects to its effectiveness and unanticipated side effects. Depending on its success the new practice can either be circulated or needs further iteration through deconstruction or design.

Circulate: The new practice is circulated outside the research environment for broader experimentation and commercial opportunities. This is also the point when it will evolve further through the individuals, newly recruited to perform this new practice. Insights from this can again be taken into consideration when further evolving this practice in an experimental environment.

As “a practice-oriented approach strives for a form of open design in which variety and change over time are facilitated” (Kuijjer, 2014, p. 97), it seeks a balance between the designer’s anticipation and steering as well as interpretation and adaptation by each involved individual. Thus, practice-oriented design is highly applicable to urban issues, where balance needs to be found between the designers intentions and the city’s adaptation through its residents, its latent designers (Stolk & Portugali, 2011). If now practices evolve through processes of structuration, the design of cities and its functions, which are a physical representation of the recurrent influence between individual action and social norms, has to emerge with practices of urban life in mind. Transportation as key factor in cities has one of the highest negative impacts on environmental indicators (Tukker et al., 2006). Hence, the following section illustrates how practice-oriented design as already drawing on participatory design methods and augmented by socially influencing systems can foster transitions towards bicycling.

6. Practice-oriented design for bicycling: A framework

The starting point for changing transportation behavior is to raise awareness of how this practice is configured, which elements play a role and which social constraints hold it in place. Before introducing a concrete practice-oriented design process Figure 2 to Figure 4 visualize the effects of discursive and practical consciousness on the individual. Each of these figures shows on the left side the individual embedded in its social context. On the right side, it shows the social practice of transportation as embedded in the urban context. Following Shove et al. (2012) a practice can be characterized through the three elements *material*, *meaning* and *competence*. The dotted line encompassing the practice symbolizes the urban context in which the practice is embedded, exerting structural forces perceived by the individual (Barnes Hofmeister & Keitsch, 2016).

Figure 2 visualizes a state in which the individual performs a certain practice. If not interrupted through systemic failure, social confrontation, changes in external conditions, etc. everyday practices are tacitly embedded (Ehrenfeld, 2008). The boundaries creating this context are often not explicitly known to the individual, indicated through the usage of dotted lines in Figure 2, yet the discursive nature of co-creation can raise this awareness. As Scott explains “practice-oriented design means enabling a form of social innovation to occur, where communities of practitioners challenge existing norms to create new ways of living and doing” (2012, p. 284). Through participation in urban life each urban dweller or latent designer, as termed by Stolk and Portugali (2011), is a social participant in creating normal modes of living. Such systemic perspective enables to work within instead of fighting against practice dynamics of urban life, leveraging co-creation and co-design in supporting practice-oriented design for mobility transitions (Julier, 2007; Scott, Quist, & Bakker, 2009; Shove et al., 2007). Figure 3 visualizes what Giddens (1984) refers to as discursive consciousness: the ability of the individual to reflect upon their own behavior. Since the design of novel practices requires to confront well-established social norms workshops involving a diverse group of participants provide the individual with legitimacy to step outside their usual boundaries (Scott et al., 2012, 2009).

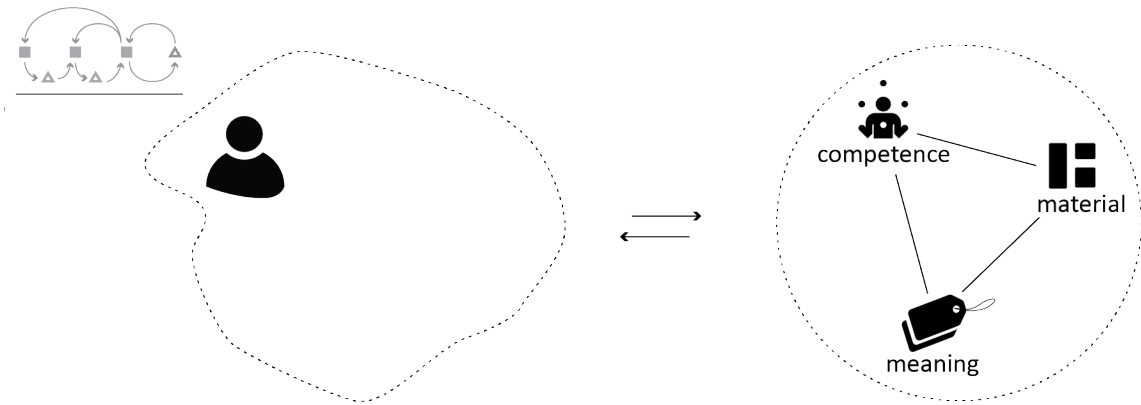


Figure 2: Initial situation in which human agency is constrained by social structure and every practice is engrained, governed by habit and tacit. The human actor is not aware of the social boundary conditions (indicated through dotted line) governing its everyday routines.

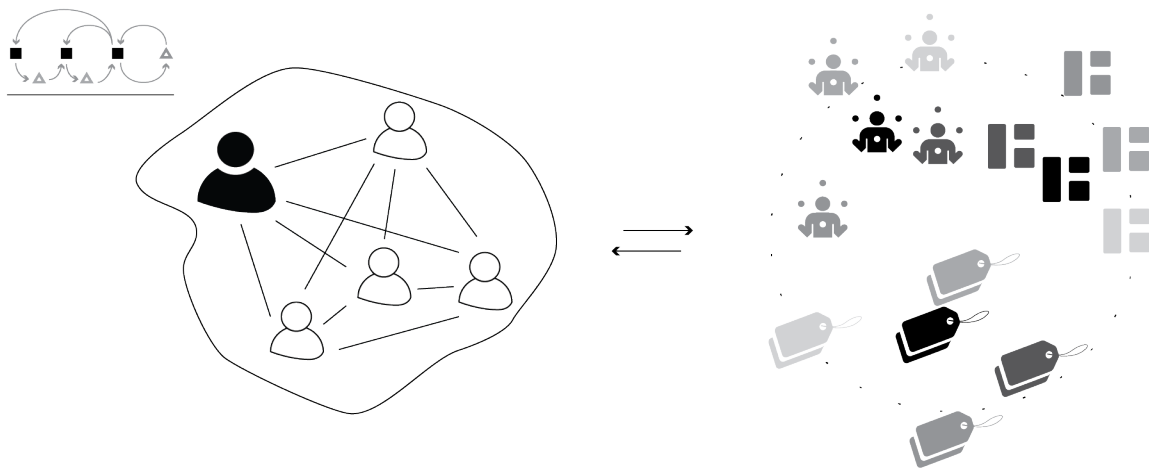


Figure 3: Through co-creation a set of stakeholders can share individual practices, discuss social boundary conditions and their legitimacy, collectively innovate and break existing social practices into its elements. By thinking of desired practices existing or new elements can be integrated into novel practice prototypes. This collective approach lowers the significance of social forces and allows to critically review everyday practices.

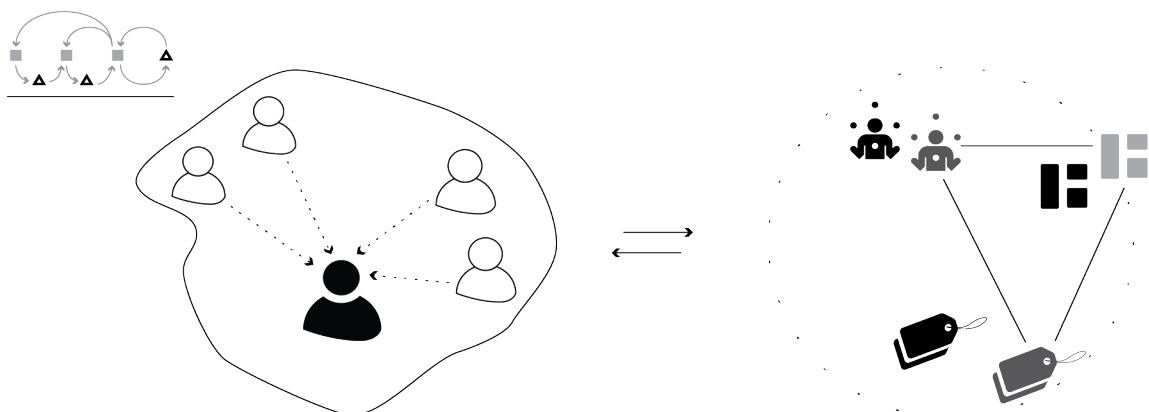


Figure 4: After designing/envisioning novel social practices links between old elements have to be broken and novel links need to be formed. To support this process of experimentation whether envisioned practice prototypes are promising, socially influencing systems can raise awareness and create visibility of a desired behavior through a relevant peer group. By means of peer group visibility social boundaries and previously perceived practice boundaries can be taken under personal scrutiny.

Through becoming aware of the social boundaries, signified by the solid black line in Figure 3, the social and urban context for constraining the individual's practice weakens, represented by the sparsely dotted line around the practice elements. The diversity of the workshop participants will result in a multitude of different compositions of *materials*, *meanings* and *competences* constituting their individual practice of cycling. Figure 3 depicts this variety in possible cycling practice compositions through various grey tones. While some of the practice elements lie within the individual's original social and urban constraints others lie outside of it, leading to the need of confronting personal beliefs, habits and ways of life. This state of discursive consciousness in a group setting is the primary mode during the process stages *deconstruct*, *design* and *deliberate* underlining the necessarily social process of transitioning to novel practices (Scott et al., 2012). However, in order for a new transportation practices, such as cycling, to take hold its elements must be repeatedly integrated to become familiar and habitual (Kuijjer, 2014; Sahakian & Wilhite, 2014; Shove et al., 2012). Following Giddens (1984) this mode of performance is practical consciousness. In Scott's (2012) generalized methodology for practice-oriented design practical consciousness is prevailing during the stages *deviate*, *integrate* and *circulate*. It is in these stages that socially influencing systems can support experimentation with new practice configurations to foster cycling. Sahakian and Wilhite (2014, p. 38) note "transferring knowledge through demonstrations of new practices is a powerful way to stimulate change". As Figure 4 illustrates practical consciousness can be supplemented through socially influencing systems in the form that these socio-technological environments empower individuals to observe others and see their own performance among the members of their community (Stibe & Larson, 2016). In such fashion socially influencing systems help create awareness of a desired social boundary, such as active travel, (solid line in Figure 4) and dissolve previously perceived social and urban constraints (sparsely dotted line) on cycling practice by encouraging a transition to an integration of new *meanings*, *materials* and *competencies*. As indicated through various grey tones the elements of the newly designed practice are of different origin, being the result of the social innovation process leveraging discursive consciousness of the workshop participants. In such way mobilities, as staged from above and acted out from below (Jensen, 2013c), are reconsidered through the collective effort of latent designers (Stolk & Portugali, 2011) challenging social norms and affordances of the city. However, since no single practice element can stimulate change the iterative character of the process, as described in Figure 1, is vital to identify all agentive elements and recognize which are most effective to foster cycling as mode of urban transportation (Sahakian & Wilhite, 2014). The alternating between modes of discursive and practical consciousness and thereby scrutinizing and experimenting with new sets of social boundaries is central in this process. Once a new transportation practice seems successful and becomes widely adopted, changes in the physical structure of the city follow through the recursive pattern between human agency and urban structure. In such way this process aims to emergently create change through new ways of travelling within the city. The illustration in Figure 5, only briefly introducing the specific tools, is intended to provide a process blue print for urban design and transportation practitioners when approaching transportation issues. While the socially influencing systems are all based upon the work at MIT Media Lab and the Austrian Institute of Technology (Wunsch et al., 2015; Wunsch, Millonig, et al., 2016; Wunsch, Stibe, et al., 2016), the co-creation methodologies draw upon Chueng-Nainby et al. (2014; 2016) and Sleeswijk Visser et al. (2005).

Sensitizing Tools

In preparation of the workshop participants will be sent a **disposable camera** and a **workbook** with open-ended questions and tasks in order to take note of their transportation habits.
Sleeswijk Visser et al., 2005, p. 126

Collective Weaving

During the workshop the participants use their gathered insight from their own transportation habits and collectively “weave” it into spatial narratives. In doing so all participants can physically interact, connect and add their unique elements. Doing so opens discussion to scrutinize and deconstruct prevailing transportation practices, allowing insight into the diversity of transportation habits.
Chueng-Nainby et al., 2016, p. 3

Practice in Environment

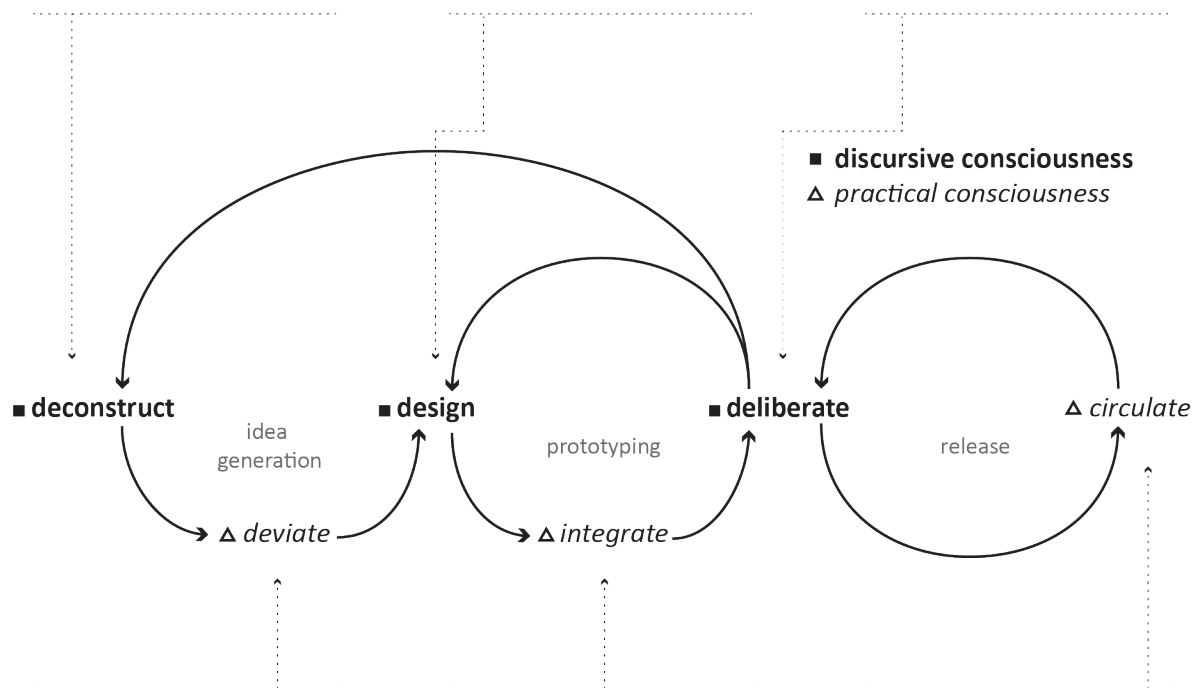
Elements of *material, meaning, competence* and *environment* are organized to understand specific cycling practices as embedded in their urban context. Following the connection between elements pivotal areas can be identified.
Barnes Hofmeister et al., 2016, p. 3853

Practice Composition

Through identifying pivotal practice elements as well as weak and strong links between these elements new practices prototypes can be designed. The visual representation of the triangular practice configuration allows for collaborative and visible emergence of the new designs.
Kuijer, 2014, p. 76

Experience mapping

The participants experiences from their individual experiments can be collected via **post-it sessions** and through **collages**. **Mapping** of these individual inputs provides an arena for discussion and for different perceptions to be aligned. Through **grouping**, areas of practice effectiveness as well as strengths and weaknesses can easily be highlighted. Based upon the visual conclusion the practice prototype can either be refined through more experimentation of circulated to be exposed to a broader audience.
Sleeswijk Visser et al., 2005, p. 141



Experience Prototyping
 Based upon the deconstruction of transport practice the participants individually experiment with cycling in the city to experience hurdles or advantages.

Frequent Biking Challenge
 As a socially influencing system combining: triggering, recognition, competition, cooperation and comparison Frequent Biking Challenge can assist the participants to experiment with the new practice prototype in a gamified environment.
Wunsch et al., 2015, p. 55

Biking Tourney
 A large scale cycling campaign facilitated by a socially influencing system, promoting the new practice underpinned by elements of cooperation, competition, social comparison, social facilitation and normative influence contributes in raising awareness. Its gamified character engages the wider community with the new practice to experience how it can fit with or replace everyday habits.
Wunsch et al., 2016, p. 497

Diary

Allows the participant to reflect through writing or drawing on a daily basis, staying engaged with the experiment. Sleeswijk Visser et al., 2005, p. 126

For detailed description of the tool refer to the indicated source.

Figure 5: Practicable practice-oriented design process leveraging socially influencing systems and co-creation methodologies to reconsider and experiment with novel practice configurations for bicycling.

7. Discussion and conclusion

Recognizing the fundamental importance of latent designers in urban issues it seems of crucial significance for designers to shift attention from mainly shaping the build environment towards shaping the practices that occur within it. Practice-oriented design as a young field seems promising in allowing a holistic approach to these complex, systemic issues. The article presents a practicable design process based on the research of Scott (2012) and Kuijer (2014) and introduces concrete tools to design urban cycling practices. The design process, as proposed by Scott (2012), alternates between modes of discursive and practical consciousness after Giddens (1984) in order to leverage collective creativity and challenge societal norms combined with individual experimentation with novel practice prototypes.

The tools facilitating this practice-oriented design process originate from the the field of participatory design and persuasive design by means of socially influencing systems. Participatory design has been recognized as influential direction within practice-oriented design (Julier, 2007; Kuijer, 2014; Kuijer & Jong, 2009; Scott et al., 2012, 2009; Shove et al., 2007). Socially influencing systems, drawing on theories of social psychology and behavioral sciences (Stibe, 2015), has a focus on the individual behavior rather than the higher level practice. While theories of social practice and theories of social psychology might seem difficult to align, treating interactive technology “analytically as just one important element in the configuration of practices” (Pierce, Strengers, Sengers, & Bødker, 2013, p. 20:3) has the potential to give access to its leverage points. As Wunsch et al. (2016, p. 1) point out “to induce long-term behavior changes, gamified biking initiatives have to be embedded into everyday life, enable social interactions and provide mutual encouragement”.

The proposed tools within the process present a first iteration based upon the experience of the previously conducted case studies. Through further research this process needs to find validation on an urban scale design issue to foster cycling. New practices can possibly be inspired through the interrelation of issues around spatial reorganization (e.g. new zoning laws), public engagement (e.g. critical mass movement, cycling festivals, neighborhood revitalization workshops), cycling education for children (e.g. during physical education), altered patterns for motorized traffic (e.g. 30 km/h zones, one way streets, limited parking facilities), health care policy (e.g. lower health care rates when proof of active travel), technology innovation (e.g. e-bikes, socially influencing systems), and so forth.

References

- Barnes Hofmeister, T., & Keitsch, M. (2016). Framing Complexity in Design through theories of Social Practice and Structuration: A comparative case study of urban cycling. In P. Lloyd & E. Bohemia (Eds.), *Proceedings of DRS 2016 International Conference: Future-Focused Thinking* (pp. 3847–3860). London: Design Research Society.
- Burckhardt, L. (2004). *Wer plant die Planung? Architektur, Politik und Mensch*. (J. Fezer & M. Schmitz, Eds.). Berlin: Martin Schmitz Verlag.
- Chuang-Nainby, P. (2014). Collective Imagery Weave: Visualizing knowledge to co-design with a community of research practitioners. In *19th DMI: Academic Design Management Conference, Design Management in an Era of Disruption* (pp. 3104–3108). London.
- Chuang-Nainby, P., Lee, J., Zi, B., & Gardin, A. (2016). A Creative Ontological Analysis of Collective Imagery during Co-Design for Service Innovation, (Wendt 2015).
- Crane, M., Rissel, C., Standen, C., & Greaves, S. (2014). Associations between the frequency of cycling and domains of quality of life. *Health Promotion Journal of Australia : Official Journal of*

- Australian Association of Health Promotion Professionals*, 25(3), 182–5.
- Ehrenfeld, J. R. (2008). *Sustainability by design : a subversive strategy for transforming our consumer culture*. New Haven and London: Yale University Press.
- Fogg, B. J. (2002). *Persuasive Technology: Using Computers to Change What We Think and Do* (1 edition). Morgan Kaufmann.
- Giddens, A. (1984). *The Constitution of Society: Outline of the Theory of Structuration*.
- Hargreaves, T. (2011). Practice-ing behaviour change: Applying social practice theory to pro-environmental behaviour change. *Journal of Consumer Culture*, 11(1), 79–99.
- Jaeger-Erben, M., & Offenberger, U. (2014). A Practice Theory Approach to Sustainable Consumption. *GAIA - Ecological Perspectives for Science and Society*, Volume 23(Supplement 1), 166–174.
- Jensen, O. B. (2013a). Designing Mobilities – Staging Materialities of Mobilities, 1–12.
- Jensen, O. B. (2013b). Mobility Divides - ' Staging ' differential mobilities. In *Keynote Speech at 4th Pan-American Mobilities Conference "Differential Mobilities: Movement and Mediation and Networked Societies."* Concordia University, Montreal.
- Jensen, O. B. (2013c). *Staging Mobilities*. Routledge.
- Jensen, O. B. (2014). *Designing Mobilities*. Aalborg: Aalborg University Press.
- Julier, G. (2007). Design Practice within a Theory of Practice. *Design Principles and Practices: An International Journal*, 1(2, 2007), 43–50.
- Kuijjer, L. (2014). *Implications of Social Practice Theory for Sustainable Design*. Technical University Delft.
- Kuijjer, L., & Jong, A. De. (2009). A practice oriented approach to user centered sustainable design. *Ecodesign 2009 Conference, Sapporo, Japan*, 1–6.
- Pierce, J., Strengers, Y., Sengers, P., & Bødker, S. (2013). Introduction to the special issue on practice-oriented approaches to sustainable HCI. *ACM Transactions on Computer-Human Interaction*, 20(4), 1–8.
- Portugali, J. (2004). What makes cities complex? *Bk.Tudelft.Nl*, (1987), 1–6.
- Portugali, J. (2011). *Complexity, Cognition and the City*. Berlin, Heidelberg: Springer Berlin Heidelberg.
- Sahakian, M., & Wilhite, H. (2014). Making practice theory practicable: Towards more sustainable forms of consumption. *Journal of Consumer Culture*, 14(1).
- Scharmer, O. (2008). *Theory U: Leading from the future as it emerges: The social technology of presencing* (First Edit). San Francisco: Berrett-Koehler Publishers.
- Scott, K., Bakker, C., & Quist, J. (2012). Designing change by living change. *Design Studies*, 33(3), 279–297.
- Scott, K., Quist, J., & Bakker, C. (2009). Co-design, social practices and sustainability innovation: involving users in a living lab exploratory study on bathing. *Joint Actions on Climate Change*, (June), 1–15.
- Shove, E. (2006). *Towards Practice Oriented Product Design. Towards Practice Oriented Product Design at Brainjuicer*. London.
- Shove, E., Pantzar, M., & Watson, M. (2012). *The Dynamics of Social Practice: Everyday Life and How it Changes*. SAGE Publication Ltd.
- Shove, E., Wattson, M., Hand, M., & Ingram, J. (2007). *The design of everyday life*. Oxford: Berg.
- Sleeswijk Visser, F., Stappers, P. J., van der Lugt, R., & Sanders, E. B.-N. (2005). Contextmapping: experiences from practice. *CoDesign*, 1(2), 119–149.
- Spaargaren, G. (2003). Sustainable Consumption: A Theoretical and Environmental Policy Perspective. *Society & Natural Resources*, 16(8), 687–701.
- Spaargaren, G. (2011). Theories of practices: Agency, technology, and culture: Exploring the relevance of practice theories for the governance of sustainable consumption practices in the new world-order. *Global Environmental Change*, 21(3), 813–822.
- Spencer, P., Watts, R., Vivanco, L., Gaza, S., & Farley, J. (2014). *Bicycles, Transportation Sustainability, and Quality of Life*. Burlington.
- Stibe, A. (2015). Towards a Framework for Socially Influencing Systems: Meta-Analysis of Four PLS-SEM Based Studies. *Persuasive Technology*, 172–183.

- Stibe, A., & Larson, K. (2016). Persuasive Cities for Sustainable Wellbeing: Quantified Communities. In M. Younas, I. Awan, N. Kryvinska, C. Strauss, & D. van Thanh (Eds.), *Mobile Web and Intelligent Information Systems: 13th International Conference, MobiWIS 2016, Vienna, Austria, August 22-24, 2016, Proceedings* (pp. 271–282). Cham: Springer International Publishing.
- Stolk, E., & Portugali, J. (2011). A Complexity-Cognitive view on Scale in Design.
- Tukker, A., Huppes, G., Guinée, J., Heijungs, R., Koning, A. de, Oers, L. van, ... Nielsen, P. (2006). *Environmental Impact of Products (EIPRO): Analysis of the life cycle environmental impacts*.
- Wunsch, M., Millonig, A., Seer, S., Schechtner, K., Stibe, A., & Chin, R. C. C. (2016). Challenged to Bike: Assessing the Potential Impact of Gamified Cycling Initiatives. In *Transportation Research Board (TRB) 95th Annual Meeting 2016*. Washington, DC.
- Wunsch, M., Stibe, A., Millonig, A., Seer, S., Chin, R. C. C., & Schechtner, K. (2016). Gamification and Social Dynamics: Insights from a Corporate Cycling Campaign. In N. Streit & P. Markopoulos (Eds.), *Distributed, Ambient and Pervasive Interactions: 4th International Conference, DAPI 2016, Held as Part of HCI International 2016, Toronto, ON, Canada, July 17-22, 2016, Proceedings* (pp. 494–503). Cham: Springer International Publishing.
- Wunsch, M., Stibe, A., Millonig, A., Seer, S., Dai, C., Schechtner, K., & Chin, R. C. C. (2015). What Makes You Bike? Exploring Persuasive Strategies to Encourage Low-Energy Mobility. In T. MacTavish & S. Basapur (Eds.), *Persuasive Technology* (pp. 53–64). Springer International Publishing.

About the Authors:

Tobias Barnes Hofmeister is Research Assistant in the Department of Product Design, Norwegian University of Science and Technology, Trondheim. He is currently working with sustainable practices and the relationship of urban planning and transportation framed through the lens of complexity.

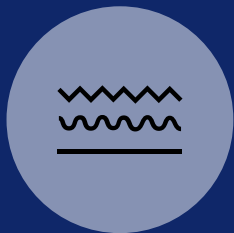
Dr. Agnis Stibe is a social engineer at MIT Media Lab, holding a PhD in Socially Influencing Systems. He believes our world can become a better place through purposefully designed urban spaces that successfully blend technological advancements with human nature.



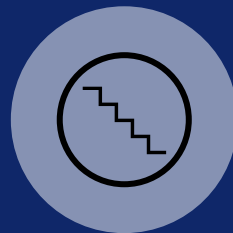
Designing mobilities requires a holistic accomodation of its social, physical and technological dimension.

4

Epilog




Designing Mobilities



Conclusion

Chapter 8 Holistically designing mobilities



“Cities are an everyday invention. They are formed and imagined by many people at a time. A city’s physical form is expressed in a vortex of temporal relations, mirrored in the activities of a collective body of individuals interacting with each other. Cities are an open stage for complementary and conflicting encounters, and allow for multiple identities to emerge and evaporate. As individuals pass through, new connections arise while others fade away. By wearing various masks and playing different role, people change the urban landscape through their encounters.”

-Petra Kempf, *You are the city*, 2009, p. 2

Designing Mobilities

This thesis highlights that urban mobility is the result of interwoven physical, societal and technological dimensions. As Jensen puts it “mobilities do not ‘just happen’ or simply ‘take place’. Mobilities are carefully and meticulously designed, planned and ‘staged’ (from above). However, they are equally importantly acted out, performed and lived as people are ‘staging themselves’ (from below)” (Jensen, 2013b, p. 4). While Jensen approaches mobilities design from the ‘mobilities turn’ within the social sciences this thesis sheds light onto mobilities design from a designerly angle. This adds to the development of mobilities design since “despite its cross-disciplinary identity, the ‘mobilities

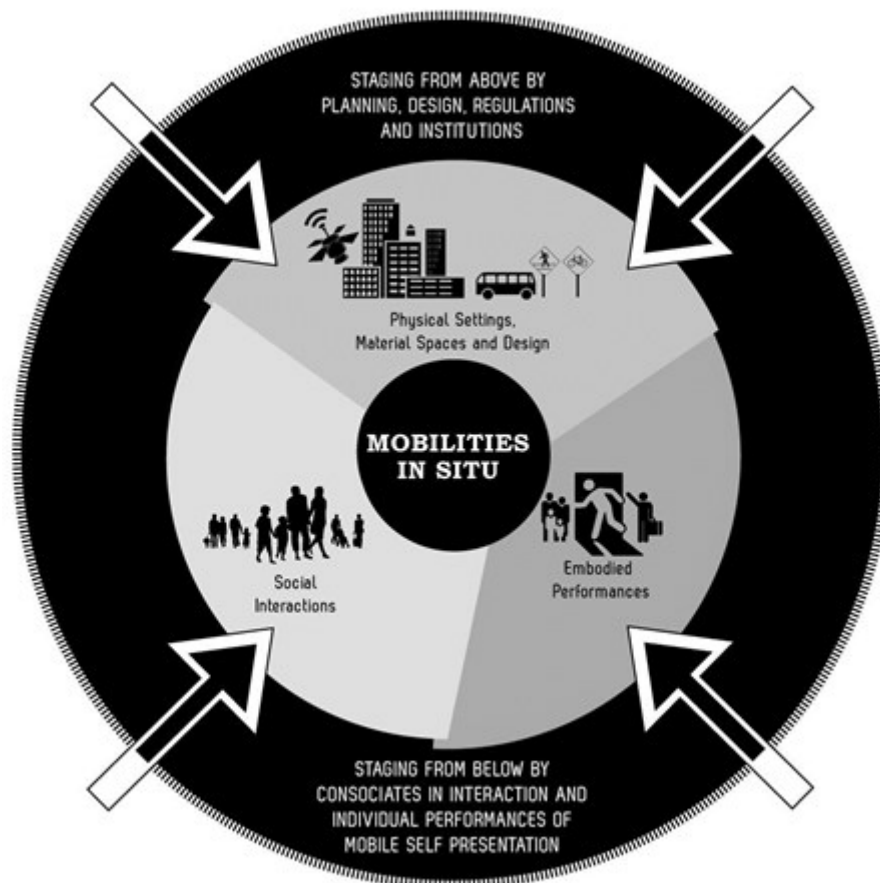


Figure 20 Staging mobilities framework in which mobilities are staged from above and equally acted out from below (Jensen, 2013)

turn' has not capitalized on the potential to explore issues of material design and physical form" (Jensen, 2014, p. 239). Figure 20 illustrates Jensen's staging mobilities framework highlighting the three influential areas: 1. Physical settings, material spaces and design; 2. social interactions and; 3. embodied performances. The interfaces between these areas are subject to policy and decision making (1. and 3.), urban space and design (1. and 2.), mode choice and space use (2. and 3.). It is thus part of the research agenda for 'mobilities design' to understand how interventions in a broadness of fields ranging from urban design, architecture, traffic planning, product design, interaction design and software design enable or inhibit specific mobility practices. Conclusively Jensen (2014, p. 240) stresses "the exploration of mobilities in general and 'mobilities design' in particular need to move beyond singular disciplines. There will be a need to engage a new and cross-disciplinary multiplicity drawing from fields from sociology, geography and anthropology to architecture, urban design and planning and then toward more technical perspectives within engineering, computer science and interaction design."

Conclusion

Recognizing the multi-disciplinary nature of ‘mobilities design’ this thesis takes a design perspective drawing on social practice theory, theories of structuration, urban studies, complexity and systems thinking, as well as human-computer interaction, participatory design and design theory. Spanning across these topics this thesis contributes to the development of ‘mobilities design’ through proposing a practice-analytical and practice-oriented-design perspective.

The two articles constituting the core of this thesis address the two initial research questions. While the first article focusses primarily on the first research question the second article builds upon these results to explore the second research question. The findings relating to each of the questions are as follows:

RQ 1. How can sustainable mobility, and cycling in particular, be understood more holistically through design and social sciences?

Building on the complexity of urban design issues transitions to sustainable forms of mobility need to be understood holistically. Thus, it is crucial to embrace the its various dimensions. The developed framework embedding cycling practice in its urban context allows to unravel these urban complexities without compartmentalizing it. By embedding the triangular social practice model as proposed by Shove et al. (2012) into a structural element after Giddens (1984) the framework is able to capture the behavioural patterns



Article 1 presented primarily theory to...
understand,
categorize,
characterize and
take holistic inventory
of a given practice.


Article 2 outlined an applicable process to...
make change,
iterate change,
co-create for change and
persuade for change
towards cycling as sustainable mobility practice
for urban transportation.

and how these are shaped and being shaped by factors of their urban environment. Particularly for issues of urban transportation such interrelation highlights entry points for design intervention. The framework being applied to study cycling practice in Freiburg, Germany, and Trondheim, Norway, provided insight into the distinct differences in cycling culture and highlights the strong correlation between environment and meaning. While cycling in Freiburg is of mundane everyday character it carries traits of an exercise activity in Trondheim. The strong correlation between environment and meaning highlights that cycling, as form of urban transport, is a response to the need of transportation, being either facilitated or hindered by structural factors of the urban landscape.

RQ 2. How can design facilitate transitions towards sustainable mobility, through practice-oriented design interventions?

Departing from recurrent relationships between urban structure and human agency, human action shapes the urban landscape, however, once emerged it impacts human agency. Thus, shaping behaviour through practice-oriented-design is one entry point to alter large-scale societal mobility practices. As proposed by Scott et al. (2012) a practice oriented-design-process needs to alter between modes of discursive and practical consciousness in order to allow the participants to reflect upon their practices, but also arrange for time to experiment with novel practice configurations. A concrete practice-oriented-design process to foster transitions towards urban cycling is presented in the second article. In order to facilitate reflection collective weaving, practice composition, experience mapping and other participatory tools are employed. To support the individuals during experimentation phases the process draws upon socially influencing systems as case studies from MIT Media Lab present greatly increased numbers of cyclists when using socially influencing system to change behavior. As such design is located in the pivotal position to facilitate the integration of a variety of tools from a broad field of disciplines in order to achieve successful interventions through inclusion of society.

In combination the research presented in both papers provides tools to analyze and intervene in existing cycling practices. While cycling has been subject of the case studies the research can be abstracted to fit the wider spectrum of sustainable modes of transport. From an academic perspective the discussion goes beyond sustainable modes of transport towards the emerging field of 'mobilities design' approached from a design angle.



“Design is the term we use to describe both the process and the result of giving tangible form to human ideas. Design doesn’t just contribute to the quality of life; design, in many ways, now constitutes the quality of life.”

- Peter Lawrence

Copenhagen wheel, transforming ordinary bicycles into hybrid e-bikes.



Appendix

Bibliography

Case Study Freiburg

Case Study Trondheim

Acknowledgement

Bibliography

- Alexander, C., Ishikawa, S. & Silverstein, M. (1977). *A Pattern Language: Towns, Buildings, Construction*, OUP USA.
- Brown, T. (2009). *Designers - think big!*, United Kingdom: TED. Available at: http://www.ted.com/talks/tim_brown_urges_designers_to_think_big.
- Barnes Hofmeister, T., & Keitsch, M. (2016). Framing Complexity in Design through theories of Social Practice and Structuration: A comparative case study of urban cycling. In P. Lloyd & E. Bohemia (Eds.), *Proceedings of DRS 2016 International Conference: Future-Focused Thinking* (pp. 3847–3860). London: Design Research Society.
- Burckhardt, L. (2004). *Wer plant die Planung? Architektur, Politik und Mensch.* (J. Fezer & M. Schmitz, Eds.). Berlin: Martin Schmitz Verlag.
- Chueng-Nainby, P. (2014). *Collective Imagery Weave: Visualizing knowledge to co-design with a community of research practitioners.* In 19th DMI: Academic Design Management Conference, *Design Management in an Era of Disruption* (pp. 3104–3108). London.
- Chueng-Nainby, P., Lee, J., Zi, B., & Gardin, A. (2016). *A Creative Ontological Analysis of Collective Imagery during Co-Design for Service Innovation*, (Wendt 2015).
- Colville-Andersen, M. (2010) *Why we shouldn't bike with a helmet.* Denmark. Retrieved from <http://tedxtalks.ted.com/video/TEDxCopenhagen-Mikael-Colville>
- Coyne, R., 2005. *Wicked problems revisited.* *Design Studies*, 26(1), pp.5–17.

- Crane, M., Rissel, C., Standen, C., & Greaves, S. (2014). Associations between the frequency of cycling and domains of quality of life. *Health Promotion Journal of Australia : Official Journal of Australian Association of Health Promotion Professionals*, 25(3), 182–5.
- Dorst, K. (2011). The core of “design thinking” and its application. *Design Studies*, 32(6), pp.521–532.
- Ehrenfeld, J. R. (2008). *Sustainability by design : a subversive strategy for transforming our consumer culture*. New Haven and London: Yale University Press.
- Fogg, B. J. (2002). *Persuasive Technology: Using Computers to Change What We Think and Do* (1 edition). Morgan Kaufmann.
- Giddens, A. (1979) *Central Problems in Social Theory: Action, Structure, and Contradiction in Social Analysis*. University of California Press.
- Giddens, A. (1984) *The Constitution of Society: Outline of the Theory of Structuration*. Cambridge: Polity Press.
- Hargreaves, T. (2011). Practice-ing behaviour change: Applying social practice theory to pro-environmental behaviour change. *Journal of Consumer Culture*, 11(1), 79–99.
- Hekkert, P., & van Dijk, M. (2011) *Vision in Design: A Guidebook for Innovators*. Amsterdam: BIS Publishers.
- Hillier, B., & Hanson, J. (1984) *The Social Logic of Space*. Cambridge: Cambridge University Press.
- Jacobs, J. (1961) *The Death and Life of Great American Cities*. Random House.
- Jaeger-Erben, M., & Offenberger, U. (2014). A Practice Theory Approach to Sustainable Consumption. *GAIA - Ecological Perspectives for Science and Society*, Volume 23(Supplement 1), 166–174.
- Jensen, O. B. (2013a). Designing Mobilities – Staging Materialities of Mobilities, 1–12.

- Jensen, O. B. (2013b). *Mobility Divides - ' Staging ' differential mobilities*. In Keynote Speech at 4th Pan-American Mobilities Conference “Differential Mobilities: Movement and Mediation and Networked Societies.” Concordia University, Montreal.
- Jensen, O. B. (2013c). *Staging Mobilities*. Routledge.
- Jensen, O. B. (2014). *Designing Mobilities*. Aalborg: Aalborg University Press.
- Julier, G. (2007). Design Practice within a Theory of Practice. *Design Principles and Practices: An International Journal*, 1(2, 2007), 43–50.
- Kielgast, L. (2015) The cities of the future are people-friendly cities. Retrieved July 21, 2015, from <http://denmark.dk/en/green-living/bicycle-culture/the-cities-of-the-future-are-people-friendly-cities/>
- Kuijjer, L. (2014). *Implications of Social Practice Theory for Sustainable Design*. Technical University Delft.
- Kuijjer, L., & Jong, A. De. (2009). A practice oriented approach to user centered sustainable design. *Ecodesign 2009 Conference*, Sapporo, Japan, 1–6.
- Lorenz, F. (2014) *Bicycle Urbanism*. Retrieved April 1, 2015, from <http://sustainablecitiescollective.com/florian-lorenz/223671/welcome-bicycle-urbanism>
- Lynch, K. (1960). *The Image of the City*, MIT Press.
- Marshall, S. (2009). *Cities Design and Evolution*, Routledge.
- Næss, P. (2006). *Urban Structure Matters: Residential Location, Car Dependence and Travel Behaviour*, Abingdon: Routledge.
- Ortner, S. B. (2006) *Anthropology and Social Theory: Culture, Power, and the Acting Subject* (Vol. 2006). Duke University Press.
- Pierce, J., Strengers, Y., Sengers, P., & Bødker, S. (2013). Introduction to the special issue on practice-oriented approaches to sustainable HCI. *ACM Transactions on Computer-Human Interaction*, 20(4), 1–8.
- Portugali, J. (2004). What makes cities complex? *Bk.Tudelft.Nl*, (1987), 1–6.
- Portugali, J. (2011). *Complexity, Cognition and the City*. Berlin, Heidelberg: Springer Berlin Heidelberg.

- Reckwitz, A. (2002) Toward a Theory of Social Practices: A Development in Culturalist Theorizing. *European Journal of Social Theory*, 5(2), 243–263.
- Rittel, H.W.J. & Webber, M.M., (1973). Dilemmas in a general theory of planning. *Policy Sciences*, 4(December 1969), pp.155–169.
- Sahakian, M., & Wilhite, H. (2014). Making practice theory practicable: Towards more sustainable forms of consumption. *Journal of Consumer Culture*, 14(1).
- Scharmer, O. (2008). *Theory U: Leading from the future as it emerges: The social technology of presencing* (First Edit). San Francisco: Berrett-Koehler Publishers.
- Schatzki, T. R. (2010) *The Timespace of Human Activity: On Performance, Society, and History as Indeterminate Teleological Events*. Plymouth: Lexington Books.
- Schatzki, T.R., (2002). *The Site of the Social: A Philosophical Account of the Constitution of Social Life and Change*, University Park, PA: Pennsylvania State University Press.
- Schatzki, T. R., Knorr-Cetina, K., & Savigny, E. von. (2001) *The Practice Turn in Contemporary Theory*. London: Routledge.
- Schön, D.A., (1983). *The Reflective Practitioner: How Professionals Think in Action*, Basic Books.
- Scott, K., Bakker, C., & Quist, J. (2012). Designing change by living change. *Design Studies*, 33(3), 279–297.
- Scott, K., Quist, J., & Bakker, C. (2009). Co-design, social practices and sustainability innovation: involving users in a living lab exploratory study on bathing. *Joint Actions on Climate Change*, (June), 1–15.
- Sennett, R. (1977) *The Fall of Public Man*. London and Boston, MA: Faber and Faber.
- Sevaldson, B. (2014). Holistic and dynamic concepts in design : What design brings to systems thinking,
- Sevaldson, B. (2011) Giga-mapping: Visualisation for complexity and systems thinking in design. *Nordes '11: The 4th Nordic Design Research Conference*, 137–156.

- Sevaldson, B. (2008) Rich Design Research Space. *Form Akademisk*, 1(1), 28–44.
- Shove, E., Pantzar, M., & Watson, M. (2012). *The Dynamics of Social Practice: Everyday Life and How it Changes*. SAGE Publication Ltd.
- Shove, E., Wattson, M., Hand, M., & Ingram, J. (2007). *The design of everyday life*. Oxford: Berg.
- Shove, E. (2006). *Towards Practice Oriented Product Design*. Towards Practice Oriented Product Design at Brainjuicer. London.
- Sleeswijk Visser, F., Stappers, P. J., van der Lugt, R., & Sanders, E. B.-N. (2005). Contextmapping: experiences from practice. *CoDesign*, 1(2), 119–149.
- Spaargaren, G. (2003). Sustainable Consumption: A Theoretical and Environmental Policy Perspective. *Society & Natural Resources*, 16(8), 687–701.
- Spaargaren, G. (2011). Theories of practices: Agency, technology, and culture: Exploring the relevance of practice theories for the governance of sustainable consumption practices in the new world-order. *Global Environmental Change*, 21(3), 813–822.
- Spencer, P., Watts, R., Vivanco, L., Gaza, S., & Farley, J. (2014). *Bicycles, Transportation Sustainability, and Quality of Life*. Burlington.
- Stibe, A. (2015). Towards a Framework for Socially Influencing Systems: Meta-Analysis of Four PLS-SEM Based Studies. *Persuasive Technology*, 172–183.
- Stibe, A., & Larson, K. (2016). Persuasive Cities for Sustainable Wellbeing: Quantified Communities. In M. Younas, I. Awan, N. Kryvinska, C. Strauss, & D. van Thanh (Eds.), *Mobile Web and Intelligent Information Systems: 13th International Conference, MobiWIS 2016, Vienna, Austria, August 22-24, 2016, Proceedings* (pp. 271–282). Cham: Springer International Publishing.
- Stolk, E., & Portugali, J. (2011). A Complexity-Cognitive view on Scale in Design.
- Tukker, A., Huppes, G., Guinée, J., Heijungs, R., Koning, A. de, Oers, L. van, ... Nielsen, P. (2006). *Environmental Impact of Products (EIPRO): Analysis of the life cycle environmental impacts*.

- Urry, J. (2004) The “System” of Automobility. *Theory, Culture & Society*, 21, 25–39.
- Watson, M. (2012) How theories of practice can inform transition to a de-carbonised transport system. *Journal of Transport Geography*, 24, 488–496.
- Wunsch, M., Millonig, A., Seer, S., Schechtner, K., Stibe, A., & Chin, R. C. C. (2016). Challenged to Bike: Assessing the Potential Impact of Gamified Cycling Initiatives. In Transportation Research Board (TRB) 95th Annual Meeting 2016. Washington, DC.
- Wunsch, M., Stibe, A., Millonig, A., Seer, S., Chin, R. C. C., & Schechtner, K. (2016). Gamification and Social Dynamics: Insights from a Corporate Cycling Campaign. In N. Streitz & P. Markopoulos (Eds.), *Distributed, Ambient and Pervasive Interactions: 4th International Conference, DAPI 2016, Held as Part of HCI International 2016, Toronto, ON, Canada, July 17-22, 2016, Proceedings* (pp. 494–503). Cham: Springer International Publishing.
- Wunsch, M., Stibe, A., Millonig, A., Seer, S., Dai, C., Schechtner, K., & Chin, R. C. C. (2015). What Makes You Bike? Exploring Persuasive Strategies to Encourage Low-Energy Mobility. In T. MacTavish & S. Basapur (Eds.), *Persuasive Technology* (pp. 53–64). Springer International Publishing.

Germany

Case Study Freiburg

5   1



An array of extravagant bicycles as common on Freiburg's streets

Questionnaire

The following questions were asked during the interviews conducted via email in order to understand the various dimensions of local cycling practice.

Material

1. Describe which bicycles people ride mostly.
2. Describe the condition of the infrastructure for cycling.
3. Which equipment do you use when cycling? What do others use?

Meaning

4. Whom do you see biking? Are certain groups (age, gender, etc.) over/ under represented?
5. What do people wear when cycling?
6. What do you think how cyclists are perceived?
7. Is cycling considered a safe mode of transport?
8. What is your motivation for cycling? How could you imagine why others cycle?

Skill

9. How do you interact with pedestrian, other cyclists or cars?
10. Are any specific skills required for cycling in your city?

Environment

11. What do you think are hurdles/ boosters for using a bicycle?
12. What makes cycling enjoyable/ annoying?
13. Which role does the bicycle play in your daily life?
14. Could you imagine managing your day be only having a bike? Why yes or no?
15. What you be required in order for you to be able to manage all daily activities via bicycle?
16. What is the most curious aspect about cycling culture in your city?

Toni

male, 25, Freiburg, 14.05.2015

1. Mostly rather old and worn out bicycles. Exceptions are mostly found as fixie- or single-speed bikes.
2. I think Freiburg in general offers a fair infrastructure for cyclists. Most streets in Freiburg are not very big and do not require specific trails for bikers. On the other hand, newer districts often comprise numerous biking trails in parallel to the streets.
3. Personally, I only use quite a strong lock and rarely small detachable lights. Most people seem to behave similar in terms of equipment. Only a minority of bikers is using helmets.
4. Freiburg has a considerable amount of students which can be seen on their bikes very often. Beyond that, older people often use bikes to commute to work. I do not remember lots of children on bikes.
5. Mostly nothing in special I think. A minority is wearing helmets. Furthermore, I see people wearing sports clothing (active trousers etc.) when biking for longer distances (e.g. to work).
6. In general I think cyclists are respected and perceived in a positive way in Freiburg. This probably originates from the general environmental consciousness found in Freiburg.
7. Depends a lot on the respective area. In newer districts it is considered as rather safe, yes.
8. My own motivation is mostly to be independent on public transportation and the search for parking spots, i.e. to be more flexible. Other people might have the same motivation, but could also consider the environmental impact and the sportive side of biking.
9. In general there is only little interaction with others. When biking with others we mostly go side by side.
10. Officially you need to pass the biking test and get the corresponding document. Other than that one needs to know the basic traffic rules.
11. The biggest hurdle I believe is the danger that comes with biking on streets with lots of cars. Furthermore, Freiburg is known for its thieves,

which also is a problem for bikers. Boosters, on the other hand, are trends set by friends and colleagues, and good bike rental facilities.

12. For me its very dependent on the weather. Furthermore, the quality of the bike is very influential on the enjoyability.
13. Right now, it plays only a side role, since my bike got stolen recently. But otherwise I am biking to work every day. It also enhances my motivation to go to work and improves my mood.
14. I am not quite sure if I understood the question correctly. But yes, in terms of moving I could be almost 100% rely on my bike and not use any other means of transportation. Only when I travel outside of the town I am dependent on other means.
15. I mostly do that already. Moving outside of the city is quite impossible, though.
16. The trading culture. There are lots of auctions and other sorts of occasions for buying and selling bikes taking place. So, people started businesses with buying and reselling bikes...

Jonathan

male, 28, Freiburg, 21.05.2015

1. Very different: some have more than one, because many go mountain-biking in the hills, many have old racing bikes, and only few holland bike types.
2. The condition is quite good compared to other cities, but there is still lots to do in terms of security and the surface, which often destroyed by the roots of trees
3. Some have clickable luggage bags. Some where helmets but this is the minority. In rain, of course rain cloth. an at night lights. most people use battery powered lights that are removable.
4. All groups, old people less.
5. See 3
6. As often rude

7. Mostly yes and especially fast
8. Because it is the fastest and cheapest way. you can put your bike anywhere, can take routes cars can not go (one-way streets)
9. Pedestrians have to be cared for. with cars I have to comply to the traffic rules.
10. No, you just need good breaks especially when it is wet
11. Traffic lights, they make the bike not faster as the car. Sometimes bikes can avoid these, but not often enough.
12. Flexibility no time tables of public transport, fast, and not parking spot
13. Do it every day, use it to go anywhere in the city
14. Sure. that's what I do
15. Only a bike
16. There is not much curious stuff, there is a critical mass group in Freiburg

Andi

male, 34, Freiburg, 26.05.2015

1. Wenn ich die Frage richtig verstehe, geht es um den Typ des Fahrrads?
2. In Freiburg: Sehr unterschiedlich, vor allem viele alte Stadträder und Rennräder.
3. In Freiburg sehr gut (viele Radwege). Allerdings meiner Ansicht nach große Gefahren, da die Radwege teilweise unübersichtlich und für Autofahrer schwer erkennbar sind. Zudem ist das (sicherheits-) Verhalten vieler Radfahrer alles andere als angemessen - große Unfallgefahr.
4. Radhelm (immer), normale Hose oder Outdoorbekleidung (je nachdem ob ich sportlich unterwegs bin oder einfach so). Bei anderen: Helme teils, teils (würde sagen 50:50), ansonsten in der Stadt hauptsächlich normale Klamotten

Alle Gruppen vertreten, ich sehe keine Gruppe besonders repräsentiert.
5. S.o. Helme teilweise, sonst hauptsächlich normale Klamotten.

6. Großes Problem in Freiburg - Verkehrslage ist zu unübersichtlich. Autofahrer sind häufig überfordert. Radfahrer missachten häufig Verkehrsregeln und sind sich ihrer Verletzlichkeit nicht bewusst.
7. Bei den meisten ist kein Bewusstsein über eine Gefährdung erkennbar. Ich persönlich denke, Radfahren ist in Freiburg durchaus nicht ungefährlich.
8. Sportliche Betätigung, Frische Luft, Schneller und unkomplizierte Fortbewegung ohne auf öffentliche Verkehrsmittel achten zu müssen. In der Stadt ist man zudem am schnellsten mit dem Rad.
9. Ich fahre sehr defensiv und verzichte bei Autos in der Regel häufig auf meine "Verkehrsrechte", z.B. Vorfahrt.
10. Gesunder Menschenverstand und Risikobewusstsein - bei der Mehrzahl der Radfahrer meiner Meinung nach zu wenig ausgeprägt.
11. Hürden: Bequemlichkeit, mangelnde Motivation zur Bewegung, Angst davor "verschwitzt anzukommen"
Boosters: Gute Radfahr-Infrastruktur (Radwege etc.)
12. Enjoyable: Freies Fahren, am liebsten außerhalb der Stadt
Annoying: Autofahrer, Fußgänger, Ampeln, unübersichtliche Verkehrsführungen, Gestank etc.
13. Seit wir in Waldkirch wohnen eine geringere, ich fahre fast nur noch sportlich
14. Ja, war jahrelang so. In der Stadt und ohne Kind kein Problem. Mit Kind und außerhalb der Stadt wohnend kann ich es mir nicht mehr vorstellen.
15. Wohnung in der Stadt und ohne Familie, sonst wird es zu beschwerlich.
16. Die völlige Abwesenheit jeden Gefahrenbewusstseins bei vielen - erstaunt mich immer wieder. Ich sehe so viele Radfahrer, die wirklich "Harakiri" in Freiburg fahren und bei denen ich mich frage wie sie bisher überlebt haben (da wir oft mit dem Auto in Freiburg unterwegs sind, kenne ich beide Perspektiven).

Brian

male, 28, Freiburg, 01.06.2015

1. City bikes
2. Cycling infrastructure is developed, but inadequate in the city centre.
3. I don't use any equipment. Others use often helmets, lights.
4. I would say that teenagers and older people 65+ are underrepresented, students over represented.
5. Normal clothes when daily cycling, often cycling clothes for the more sportiv tours.
6. I think cycling is absolutely normalised in Freiburg, they are perceived as normal people doing a normal activity.
7. Yes
8. It's fun, extremely time efficient in a city this size, and healthy to use the body.
9. Harmoniously. With cars sometimes less so.
10. Cycling, and knowing the 'way' people cycle here. It's often different in different cities.
11. Hurdles: could be perceived as expensive. the weather is not always ideal. can be dangerous for the inexperienced.
Boosters: really fun, healthy, easy to learn, efficient to get around.
12. Cycling fast makes it more enjoyable, harmonious interactions with other people make it enjoyable, as does sun shine, being fit. Cycling into the wind makes it annoying, and cobblestones.
13. I cycle every single day, to work, to go shopping, it carries me about the city.
14. Yes. I do, Freiburg is small enough that it works, and Germany has good enough public transport for longer distances.
15. The only thing missing now that I could use is more carrying space - either as a trailer or with a cargo bicycle.
16. That more people don't do it

David

male, 25, Freiburg, 27.05.2015

1. Mostly used 2nd hand bicycles. But also there is a big group of Mountain Bikers and well situated with ebikes or good tracking bicycles. Also there is a small but still recognisable group of people with crazy bikes like "liegefahrrad" or very high bikes
2. Infrastructure is very good. A lot of cycle paths, special mirrors or special traffic light constructions for bicycles.
3. Bin mir nicht sicher was du mit equipment meinst.. I use a second hand bicycle mostly without any special equipment, helmet or clothes. Sometimes I use a rain-resist clothes.
4. In Freiburg there are mostly all kinds of people riding a bicycle but (young) students probably represent the biggest group.
5. Mostly standard clothes. Distances in Freiburg mostly are short so there is no need for special clothes. Sometimes weather-related clothes are worn such as scarfs or rain jackets.
6. For the reason that Freiburg is a bicycle city cyclists are very welcome as long as they are staying on cycle paths and do not interact unnecessarily with car or pedestrian "traffic".
7. Yes. Car drivers know about the cyclists and also the good infrastructure helps for a safer cycling.
8. Autonomy, Money saving, Time, Fun. Same reasons for other persons.
9. If possible there is very few interaction needed. If there is an interaction I try to be as attentive as possible. I always try to avoid pavements if there are pedestrians.
10. No not really, but there are some trappy railways.
11. Hurdles: laziness and weather / Boosters: Weather, Autonomy, Money saving, Time saving, Fun.
12. The feeling that one moves faster the just walking/ weather (rain/wind), hills
13. I use my bicycle for nearly all of my traffic between different locations.

14. Now, yes (with one exception: holidays). Freiburg is a small city. It's no problem.
15. I think having children, living in a really big city or in a small town will make things more difficult. So: short distances to e.g. work, shopping etc. are required. Also feeling safe while cycling is necessary (good infrastructure etc.)
16. I don't really have an answer for this but regarding to other cities in Germany I have the feeling the main station of Freiburg is surrounded by thousands of bikes in all directions.

Ina

female, 28, Freiburg, 26.05.2015

1. City bikes, mountain bikes, racing bikes...
2. Separate cycling lanes mostly, partly separated from the pavement, partly on the main road
3. Bike, lights, helmet
4. Students, I guess elderly people are a bit underrepresented
5. Normal cloths, in Freiburg mostly outdoor clothing (jackets) and sneakers
6. Highly respected
7. Yes, also because car drivers are more aware of cyclists as in other cities
8. Faster, less stressful as driving, healthy, lifestyle —others, I guess, similar reasons
9. Showing respect, sometimes greeting
10. Not really. Probably knowing the short-cuts
11. Weather, sometimes the distance when going to the villages
12. Enjoyable: fresh air, no traffic jams
Annoying: red lights
13. Being mobile

14. Yes, I do
15. Better rain trousers, more patience
16. Why are people swapping to electrobikes?

Norway

Case Study Trondheim

9♂ 2♀

Bicycle lift “trampe” in Bakklandet, Trondheim, to facilitate the climb from downtown to the residential areas



Ivan

male, 25, Trondheim, 17.06.2015

1. Road bicycles and mountain bikes (both used and new)
2. Good bicycle roads in the center of Trondheim, but there are no bicycle roads in the outskirts of town. Cyclists there use the shoulders of normal roads.
3. Helmet, blinking lights and reflector-vest/jacket
4. I see people of all age (10-65 years). Most cyclists are young adults (18-30 years) and grown people (30-55 years). The elderly and children (below 10 years) are less likely to use bicycles.
5. Generally cyclists use the same gear I do. However, the majority of youngsters (teenager-24 years) does not use any gear.
6. Training freaks are rude to car-drivers, but most people do not really care about cyclists.
7. Yes.
8. I cycle, because it is a training activity, good for the environment, I get fresh air and I do not have to wait for the public bus.
9. I watch out for other road users. I do this by making myself visible and try to communicate with them.
10. No.
11. Hurdles: bad infrastructure, expensive gear, expensive bike reparation.
12. The thought of doing good, both to myself and the environment
13. My bike is my legs.

14. No, because bikes are not always the appropriate tool in terms of weather (winter) and distance.
15. Good infrastructure and it should be free to have bikes on public transport systems (busses and trains). This would make it easier to use bikes even for long distances.
16. The popularity of cycling during the summer.

Ole

male, 26, Trondheim, 22.05.2015

1. People ride most kind of bicycles, but the one i mostly see is with front suspension. Old cycles usually have steel frames and new has aluminium
2. The conditions in trondheim are really good. There are even designated lanes for bikes.
3. I dont use anything. Light because it is mandatory. If im using a racer I wear a helmet.
4. Mostly students and people in their 50's. Both genders
5. Jacket and helmet
6. I don't think many people think about that.
7. It depends. In cities it is a little risky if you are in a hurry, but if you are patient it is as safe as walking in my opinion.
8. Cheap and fast
9. I usually use the designated lanes. And if there are anyone walking in them i use the bell on the bike. I try to avoid cars, as they will smash me if im not careful. But eyecontact is key.
10. Favourable to know the traffic rules.
11. Hurdle: Uphill, rain, too long distances; Boosters: Cheap, Fast
12. see Question 11
13. Small trips to friends and for shopping. (I have an old womens cycle from the 80's)

14. No. School is at Tyholt. Too much uphill to cycle.
15. Add a motor to it, Too much uphill in Trondheim
16. That they have an “elevator” for cycles.

Cristina

female, 29, Trondheim, 21.05.2015

1. The most common bike I have seen used here in Trondheim is the non-suspension city bike with 18 to 21 gears.
2. You can find bike lanes on most of Trondheim streets and they are in good shape.
3. I just use helmet. Other people use special clothing and shoes.
4. I have seen all types of people cycling, but as a group I feel students are the ones are most represented.
5. At least a helmet, but cycling glasses, cycling shoes or cycling clothing are also common.
6. Like people who care about their environment, their physical shape and their expenses.
7. Yes. Unless you try to do it while you are drunk. :)
8. Fun. But most of the students that I know do it to save money.
9. Both pedestrians and drivers are considerate towards cyclists (most of the times). You just need to make sure you let them know when you are approaching from behind or you want to change direction.
10. Will and muscle to go uphill.
11. For newcomers to Trondheim, weather can be an issue. If you want to cycle all year, cost of all the extra equipment (snow tires, tools, good clothing etc.) can be a hurdle.
12. Cycling is fun because it's an workout while you go from A to B.
13. Workout and transportation.
14. No, because of 2 kids.

15. I will need a spacious trailer and an electric bike that will help me climb the hills.
16. That even company managers go by bike to work.

Ruben

male, 25, Trondheim, 21.05.2015

1. I think students usually ride some kind of 18-24 gear mountain bike, often quite old. For non-students living in Trondheim they usually ride more expensive city bikes.
2. It's very confusing because at some parts of the town it is really good but at other ones very poor. You can have very nice bike roads just ending up in nowhere or in gravel roads. Also the traffic lights are not constructed to prioritize bikers/pedestrians. Many of the bike roads close to car roads have such a poor condition that you can only ride the bike road if you have a very low speed. Otherwise you have to use the car road.
3. I wear my normal clothes and a bike helmet. Many in Trondheim wear specific light-reflecting and water-proof covers on their bags and helmet, which I don't. Bike commuters often wear tight pants and specific jackets.
4. I think it's mixed in terms of gender, but many other groups have differences. Children and seniors are clearly very underrepresented. The same goes for people with African and Middle Eastern culture origin. Richer people bike less, students bike more.
5. See question 3...
6. Here in Norway cars have a large respect for bikers, at least out on the country roads where they give you lots of space when overtaking you. I think bikers in Trondheim are seen as quite well-trained, fit people since there are many hills in this town.
7. I haven't experienced the safety to be an obstacle to me biking too much. But I am very careful with always wearing bike helmet so surely I'm aware that there is some risk, mostly because car drivers are not seeing you.

8. I bike mainly to have fresh air on the way to school/work and to reduce emissions. It feels healthy and closer to nature to bike than to chose other modes of transport such as bus or car.
9. I try to avoid pedestrian streets and rather choose the car roads. Often I choose the car roads instead of bike roads since the bike roads are of such poor quality, which means I have to look carefully for any cars and then go over to the car road. Car drivers tend to be respectful towards me.
10. Not so much special skills but you do need to be quite fit :)
11. Boosters: It's cheap, bikes are easy to maintain, it's fast, some bike infrastructure is in place to help you. Hurdles: you have to fight with the cars on many roads, it may be dangerous, it may take more time than other modes of transport if long distances, the weather (such as snow) may be hard to deal with
12. Enjoyable: You get fresh air, you minimize the environmental impact, you get good exercise

Annoying: When you are tired and/or lazy you need some will power to go out there and bike...
13. I bike almost every day so it's very important to me. I also often go out on bike trips, longer and shorter. I also host other long distance bikers.
14. Yes, I have a car for some purposes (such as transport of goods, going to the mountains) but I want to get rid of this car and instead share a car with others for when a car is needed.
15. The bus connections to the mountains would need to be better and the cost for having a carpool would need to be lower. Would need to have some way of transporting goods, for example using a carpool.
16. You have a very high difference between students that ride cheap, old bikes (they simply bike because they can't afford having a car) and other citizens for whom biking shows some kind of status (they bike because it's a part of their identity being healthy) and you therefore need a very nice, expensive bike. Since the weather in Trondheim is quite harsh many people are "sorted out" and choose not to bike at all, so those that actually bike are really into biking.

Heikki

male, 28, Trondheim, 29.05.2015

1. More mountain bike type bikes.. I have also seen some retrolooking bikes
2. Seems to be pretty nice, everyone is biking. I lived one year in UK in a test ground city for biking, it is not the same amount of bike lines and stuff, but people seem to get by.
3. I don't have a bike and don't really bike, but seems there is always lights, many helmets, and fancy biking shorts/shirts.
4. A lot of students of course on the way to Gløshaugen. but also surprisingly many middle aged men(30-40). Then there is many times during the week funny mixed gender groups of 3-8 people who seem to have faster bikes and looking like going to tour de France.
5. Depending on the bike, Fancy gear when having racing bikes, more "normal" clothes the more "normal" bike
6. Taking care of themselves and maybe they save money and try to save environment on their part as well.
7. I would say so, here they don't go too much in the traffic so there is not too many danger zones in the City. Also I would imagine most of people start early and are good bikers, so it makes it safer as well.
8. I would bike, because it is fast and easy in a city that is this size. For others: Health, speed, competitiveness, image, environmentally friendliness.
9. Use body language.
10. I wouldn't know, I can guess not falling down at the long downhills
11. Bike stuff can be expensive/Nice long roads to use
12. Rain is making it nasty. And having to change clothes after the trip to work or so.
13. Not much really, I don't have one in Norway.
14. Yes, I manage now with only walking, so I would imagine my travel time would decrease. No, because I don't want to hassle so much with locks

15. and worrying it to be stolen.

Something to carry my daily groceries, other than that enough gears to

16. go up to Gløshaugen by bike.

Where do they have their bike during winter?

Henrik

male, 23, Trondheim, 05.06.2015

1. People mostly use «terrain»-bikes or hybrids. City bikes similar to ones in the rest of Europe are not so popular, it seems.
2. Pretty half assed. There are a few bike lanes, but they are usually short, and stop at random places. In the city centre it is mostly optimized for either pedestrians or cars.
3. I use a terrain bike, with a helmet and biking gloves. Helmets are the most common equipment, but maybe half of the bikers use it. When it gets dark the law states that you should have lights on your bike, but I think under half actually use/have lights.
4. I mostly see either students or people in their young thirties bike. Especially on some roads there are a lot of people using bikes for riding to work, for example the bridge by Lerkendal.
5. This differs a lot from person to person. I would roughly divide it into two groups, the casual biker and the sports biker. The casual biker is the largest group, and uses the bike as a way of transportation, but the only change in «clothing» they make is to put on a helmet. The sports biker is mostly people that work, and really dress up when they are using their bike, with biking shorts, special glasses etc.
6. There was a big thing in the news some time ago that showed that at least in Oslo bikers were being harassed by drivers. I'm not sure what the situation in Trondheim is for most, but I feel that there is not really a place for bicyclists a lot of places (see 2.). This makes me feel that I am in the way of someone, when either being on the road or the sidewalk.
7. I guess it is, but we learn from a really early age that we should wear helmets. This is the only safety measure most people use. You also learn

from an early age that you are a «soft road user» (makes more sense in Norwegian, «myk trafikant»), so you have to take measures to not get injured.

8. My motivation is that it saves money by not having to own a car, or buy bus tickets. It also saves time for a lot of the places I want to go to in Trondheim, by not having to wait for the bus. I would think there are others with the same motivation as me, and also some people that use it as a way of exercising.
9. I use a bell to signal to pedestrians that I want to pass them, and also use my hands as «turn signals» to signal to cars/cyclists that I am going to make a turn.
10. If you use a standard bicycle some training in biking up hills is preferred. There are a lot of hills in Trondheim, and it will take some time if you have to walk beside your bike in every hill.
11. I guess the greatest hurdle is when there is rain outside. You expose more of yourself to the rain when biking compared to walking, so you either have to put on a lot of rain gear, or prepare to get wet. The hills are also a hurdle, since even if you can manage to ride up them the chance of getting sweaty is high.

The biggest booster for me is that it is a way to get around quickly and efficiently.

12. I think I answered most of this in the previous question-
13. Right now it is my preferred way of transport for when I have to go maybe 1 to 3 km away. If it is a shorter distance than that I will usually walk, and if it is longer I will usually take the bus. To places that are a long way from a bus stop, like some places in Byåsen, I might also take the bike since I can get to the place faster than by using a bus.
14. I think I could have managed, since most of Trondheim is pretty compact. I would have had to find a way to get up the hills more efficiently, though.
15. I think I would either want a lighter bike with thinner wheels, or an electric bike. This way I could get up the hills without using as much energy as I am using at the moment.

16. I would think it is that even though they want to be the foremost cycling city, I don't feel that they up to this point have been doing a great job. So even though they might be better than other cities in Norway, when comparing to other cities in Europe it is not saying that much.

Marius

male, 31, Trondheim, 12.06.2015

1. I think the bicycles people ride are too diverse to categorize. a lot of elder (people in the 30s/40s/50s) have expensive looking cycles, while younger (typical students might tend to favour old bikes (either original singelspeed "town bikes", old racers or modified in to fixed gear or in other ways personalized etc
2. Measured in meters of road I think it's an okay amount, the problem is that it's rather broken up, so you can't typically ride anyway far without losing momentum due to crossings, car lanes etc. this I think is getting better every year but rather slowly so
3. Hmm the only equipment I try to always have is my helmet, everything else tends to be related to season and where I'm going/what I'm doing. the same goes for most people i guess. a lot of people wear helmets, some wear specialized clothing, shoes etc others don't. too diverse to say anything general
4. I guess students are over represented, most don't have cars, and the bicycle is probably the cheapest mean of transportation. Also I got a feeling middle aged men in typical finance/oil businesses often ride bikes, partially to get from a to b, but more importantly to get mileage for "Birken" etc. Gender wise I don't have the impression the differences are significant. middle-aged men might not even be over represented, just easier to see in the yellow jackets
5. Either what seems to be nothing special in particular or full on yellow windstopper jackets, watches to monitor heart beat and elastic trousers with reflexes on them i.e. clothes designed for biking. The differences might be between the ones cycling for transport alone and those who consider it a workout

6. Most people I think are used to cyclists, some car drivers seem to still think they own the road but I think they are fewer and further between than just 10 years ago. As the city is full of students whom I have a feeling rides more bikes than the rest of the population people here might be more used to bikes than in cities or communities with less students/young adults
7. I wouldn't say it's an un-safe mode of transportation but I guess it all depends. Compared to in a two ton car one could argue you are rather un-safe on a bicycle, but I believe the closeness to everything around you and lack of protective technology/steel cage etc makes you take less chances riding a bike compared to in a car
8. My main motivation is time, cycling saves me time in the morning, bringing my son to kindergarden, getting to work etc. I don't own a car, so the only other option would be busses (which use in the coldest winter months)
9. I try to stay cautious around cars seeing how I would "lose" any accidents involving these, around other cyclists I like to think I'm rather okay, neither too aggressive nor too passive, pedestrians on sidewalks I try to show a lot of respect, and pedestrians in the road I might be less tolerant around but all in all I consider myself a nice guy in traffic
10. Not compared to other cities I think, it's always good to know the smart roads and short cuts that might save you having to cross heavily trafficked roads, waiting for light crossings etc.
11. Designated cycling lanes on major roads where the cyclist doesn't get too much starting and stopping. Also having cycling paths with shortcuts compared to roads (time saving) could boost cycling.
12. The flexibility you get in an urban environment (getting from A to B, in as short a time as possible) is for me the most enjoyable part of cycling, the cost friendliness of cycles compared to cars, busses, trains and so on. And for me the third and least important aspect (at least for another couple of years) the health aspect, getting the pulse up. Also I find riding a bike funny, or enjoyable on its own i.e. I like riding my bike
13. Its first and foremost a means of transportation, getting from one place to the next in as little a time as possible.

14. If I could imagine managing a day with only using a bike as transportation, why yes, while you can't do everything with a bike, you can do a lot. If the question goes the other way around, could I manage my day without the bicycle I would also say yes, I would need more time for logistics and lose the freedom but it wouldn't be the end
15. Daily activities I manage today, for me to manage/ want to manage on bicycle year round I guess I would need to live closer to equator.
16. I don't know if cycling culture in Trondheim is curious at all, there might not even be a singular or uniform culture around cycling at all, and if it is I'm rather sure you could find the same traits in other cities around the world

Henrikke

female, 24, Trondheim, 10.06.2015)

1. In Trondheim people ride mostly mountain bikes, or hybrid bikes (not the expensive ones). There are also a few who ride classical bikes, but it is not the domineering trend I think.
2. The infrastructure in Trondheim is much better than for instance Bergen, where I come from. There are close to no cycling lanes there, especially few in the city center(I actually think there are none). In Trondheim it really good, although mostly the bike lanes are in the car road, and therefore some areas are a bit sketchy to cycle in when there is heavy traffic.
3. I don't really use anything, except for rain gear when it rains. Not even a helmet, even though I have one...
4. Students are overrepresented, and middle aged women. I don't really see that many grown/ elderly men, only a few work commuters in spandex.
5. «Allværsjakke» is a big hit in Trondheim. People seem to just wear regular clothes, except for the spandex men I mentioned, but they are really few.
6. In Trondheim they are not that big of a part of the car traffic, so I think they are positively/ neutrally perceived. Places where you have to cycle

in the car road, I think they are more negatively perceived and more of a nuisance.

7. Yes, as long as you wear a helmet.
8. Quicker than walking, cheaper than the bus.
9. I stop for pedestrians crossing the street, and keep a safe distance. I signal clearly to cars. I am used to cyclists being a nuisance in Bergen, so I strive not to be one.
10. Not really.
11. Hurdles: the weather here, when having to cross a lot traffic, and passing people on narrow side walks. Boosters: time saving
12. Enjoyable: when you roll downhill feeling the wind, «sightseeing»/annoying: splash from dams when I have no (don't know the word) ... windshield? uuh, the thing over the tire.
13. Very important, I would not be on time at all without it.
14. Yes, because I live so close to school and shops.
15. If I had to pick something up, I would need a trolley or something to attach, to rent/lend one.
16. I think it is the mountain bike thing, who really needs one here? You need a lot of gears for the hills, but not THAT many, and you don't need THAT solid dampers.

Simen

male, 23, Trondheim, 02.06.2015

1. Cruisers. Cheap metal, such as steel. Also budget city bikes from sports stores. Probably most steel as well I think.
2. Mostly pathways or roads, But there is one bicycle path from Moholt to city centre through Gløshaugen I believe. However I often switch back and forth between pathways and roads and find the edges a bit frustrating.
3. Nothing but a lock for my bike.

4. More men than women. I'm guessing peaks at 10, 22 and 40 years of age. Men at the age of around thirty are underrepresented (I think, but do not know why..).
5. Some wear helmets, and some wears light reflecting jackets. Raincovers for backpacks are also popular.
6. How they are perceived? I think primarily through sight, but also the ring from bells occasionally used. Not sure I got the question right...
7. No, I don't believe so. I think the risk is high, but the consequence mostly low.
8. Speed, and also the feel of a bike, the speed of this and in particular turns is what I like the most. I think it's good fun, and walking bores me sometimes. I imagine people for the most part ride bicycles to save time and to be less affected by traffic. And also the free exercise!
9. I don't interact to much to be honest. I mostly just try to get past as easy and smoothly as possible. If communication is necessary I use my hand to signalize.
10. The bicycle lift skill. And the skill of adjusting speed for icy downhill action!
11. First one must own a bike, that comes with a prize quite literally. And a place to store it. Both at home and wherever you are planning to ride it to. You will have to choose to be a helmet wearer or not, and many find it silly-looking to be wearing one and stupid not to. You obviously also need to know how to ride it, but I don't know of anyone who doesn't. Some people might find it risky and a bit scary.
12. The speed makes it enjoyable for me, for others it may be annoying. It is colder on the hands and face in comparison to walking.
13. I love to ride my bicycle. I feel good riding my bicycle and it is flexible as to giving me the right response for my need. That is my need to cruise and enjoy the weather or my need to get where I'm going as soon as possible. I would feel a lot less comfortable running late somewhere by feet, than I do with a bicycle. It does appear less dramatic to be cycling fast than running.
14. Yes, for the most part. But I would need a car for trips to solitude places, as I being a Norwegian tend to go for these particular trips quite often...

I don't need a car as long as there a few good friends around me who does. Hehe. Bicycles are great for commuting, but there are other times they do not suffice.

15. I would need the distances to be shorter.
16. The lift. We also ignore traffic lights. When riding a bicycle you can choose to act as a pedestrian or a car. In for example Denmark you are to act as a car.

Emil

male, 23, Trondheim, 16.06.2015

1. Most young people seem to be riding terrain bikes, while office workers seem to ride tempo bikes. I suspect money is the deciding factor.
2. Well, in Trondheim the cycling infrastructure is quite excellent, there are bike roads where needed, and bikers can always just ride wherever pedestrians walk as long as it's in a okay speed, which means they get around everywhere. In most cases biking is faster than driving, and it's certainly faster than taking the bus.
3. Myself I rarely ever bike, and when I do I might use a helmet, otherwise I would just wear my normal clothes. Young people seem to just wear whatever when they are biking, while office workers (the ones with the tempo bikes) often have a full body suit with a matching helmet.
4. Generally most people bike, but I believe overweight people and elder people and under represented, and maybe office workers are over represented.
5. Mostly everyday clothes, however some use those tight cycling clothes.
6. My brother started hating cyclists after he got his car, but he also started hating pedestrians and other drivers so I'm not sure if he is representative. Personally my relationship with cyclists is quite neutral, but for the greater good cyclists are really important. It's a much cheaper way of transport than cars for society, as it keeps the population in shape, puts less strain on roads, is faster during the rush hours, and it is enviromently friendly.

7. I did a bike project on elder people, and they had some safety issues with it because they feared both traffic and tipping over. For the non-elderly population. I don't think they see traffic as an issue, but I think they would be hessitant to bike if it was icy outside or something. I think some might consider the risk of getting there bike stolen as an issue aswell, even though it's not directly related to safety.
8. Staying in shape and it's fast, should cover most of the motivation for anybody.
9. Mostly I only interact with cars when crossing the road, in the sense that I stop for them if it's not a crossing, and they stop for me if it is.
10. Not that I am aware of.
11. Boosters I believe is: Getting a useful workout, it's fast, it's cheap, it's enviromentally friendly, and quite simple really.
Hurdles I believe is: The fear of the bike getting stolen, the weather, and for some it might be too exhausting aswell. You are also stuck with the bike, in case somebody wants to give you a ride or something.
12. I believe this mostly depends on the weather, and how accustomed one is to physical workout.
13. I take the bus, so not much sorry.
14. Yes, I could, I'm actually not sure why I don't have a bike. The only case where I would much rather take the bus than bike is if the weather is horrible or if it's winter.
15. All daily transport you mean? Well, I would just have to buy a bike really.
16. The huge ammount of bikes that changes hands at the end/start of each semester, when students start/quit their studies they usually just sell their bike real cheap.

And there are alot of bikes changing hands for ~200NOK at the end of each term. Check the studentmarket trondheim facebook group.

Anders

male, 25, Trondheim, 21.06.2015

1.
I believe the bike that is most common is the “all round” kind of bike, the ones that you typically can buy rather cheap either at a sports shop or biltema, that is equipped (or are they??) with shock absorbers and rather broad wheels.
2.
The condition of the infrastructure is highly varying, mostly in relation to how close you are to the epicentre of the city centre, but also in midt-byen you have large differences. The bike lanes seem to be introduced partly where you have broad enough streets, partly where Miljøpakken sees it as most urgent/important. This way of prioritizing the bicycle is a relatively new thing to Trondheim, as bicycle infrastructure up until a few years ago was non-existing.
3.
Do you mean in terms of safety? Like helmet or signal colored clothing? I don't use neither. Same with most people, I think. However, it's my impression that most of the guys riding in the car lane, the exercisers that are off to work, often use both high visibility clothing and helmets. I ride a 30-40 years old vintage DBS, if that's what you're asking.
4.
I guess people of all ages are biking. Both school children, students people working in the city, and older people as well. The elders might be under represented, though.
5.
People usually wear their everyday outfits, the clothing they've picked out for the occasion, not taking into consideration the use bicycle as means of transportation. (Dependent on the weather, of course). The exception is men (aged 30-60) using bikes to their workplace.
6.
I think the general perception of biking and cyclists are good, that it's healthy and eco friendly. Previous exception is also valid here: Men in tight suits are cause of irritation, both when cycling fast in the pedestrian lane, and especially when cycling slow in the car lane. Also, there is possibly a stage of youth (14~17) where cycling is considered uncool, as well.
7.
I guess every cyclist is aware of how exposed/vulnerable you are in case of a collision with a car. This is repeated to a child growing up both through the educational system and the parental upbringing, and most

8. people know or have heard of some unlucky cyclist getting their body broken in this way. However people are not leaving their bikes at home because of this, in contrary they are in most cases cycling without helmets, not taking much precaution towards the car traffic.
9. My motivation for taking the bike is both that I get the exercise and the fresh air, and that I actually save some time. Taking the bus is a 30 min journey, whilst using the bike is 15 to, and 30 from. I guess other people have a quite similar motivation. Plus, owning a car is expensive.
10. I think the most important way of communicating in traffic is the act of moving in itself. Passive/aggressive, placing yourself in the lane, etc. Next most important thing I think, is through the eyes, establishing eye contact to ensuring that others know you're there, rolling with your eyes, etc. For other uses I might signal a turn by reaching out a hand in the current direction. Pretty non-verbal.
11. No skill is required when cycling in Trondheim, besides common knowledge about traffic. The exception is 1. When using the high speed cycle lanes (f.x. along Vangslunds-/Udbyes gate). Here you better not go the wrong way, stop in the lane, or do anything that can piss off the crazy bike-to-work boys. 2. When cycling in Midtbyen. No more rules here, just a bit more tense. Maybe the exception, where you need to be more attentive, is mostly related to the bike lanes?
12. Public hurdles/boosters might be bicycle lanes and parking spaces for bicycles, or the lack of these. You could also have self-service bike repair sheds/stops on key spots, where you could pump up tires with air pressure gun, hang up your bike (to make maintenance easier), etc. Making the use of car more expensive!!
13. What makes bicycling enjoyable is that you can jump on/jump off to walk/ride along with others and be social. You get the fresh air and the weather, and you get the exercise.
14. I might be using the bicycle for appr. 80% of my outdoor errands (now in the summer at least), 10% bus, and 10% walking. Rough estimates, of course....Maybe more 80 - 5 - 15 (in summer), 70 - 15 - 15 (in spring/autumn), 0 - 85 - 15 (in winter). I also go through most days feeling guilt for not taking better care of my bike, but that's a different story...

Yes, easily in the summer half of the year. I would still walk to the store/
walk with Ingeborg to midtbyen/Voll gård, and for some rare (couple
of times during a year) occasions you might need bus or car, but for all
15. others I can think of I would be fine.

I guess I'm doing it now. But I always have the T-kort for the bus in
addition, so when I'm going far, or just wan't to get somewhere without
getting wet/sweaty I use the bus. Also when my father in law comes
for a visit, we sometimes use it, but that's mostly for the sake of Idunn
16. getting practise

I don't know what to say here. I don't think there are many curiosities.
Some would answer the Trampe bike elevator, but I don't know what
that says about anything. I've never seen it in use. Trondheim is city with
some steep terrain, and there is'nt much bike infrastructure either. Yet,
people still use their bicycles.

Acknowledgements

I wish to thank Prof. Martina Keitsch for her enduring guidance throughout the long process of formulating and refining the topic of this thesis. Her presence and valuable comments in meetings have immensely contributed to developing a cohesive research agenda. I am particularly appreciative of her guidance throughout the process of my first publication. In this regard, I also want to express my gratitude towards the Department of Product Design for covering my expenses to present my research at DRS2016.

Further, I am grateful to Prof. Ida Nilstad Pettersen for reviewing various abstract and paper drafts for the second article providing significantly helpful comments for the development of its final version. Her insight into practice-oriented-design as well as interested in urban issues was a valuable resource.

Master Thesis

Tobias Barnes Hofmeister
Norwegian University of Science and Technology
Department of Product Design
January 2017

