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

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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).

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 Giddens’ 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 interconnectedness 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.

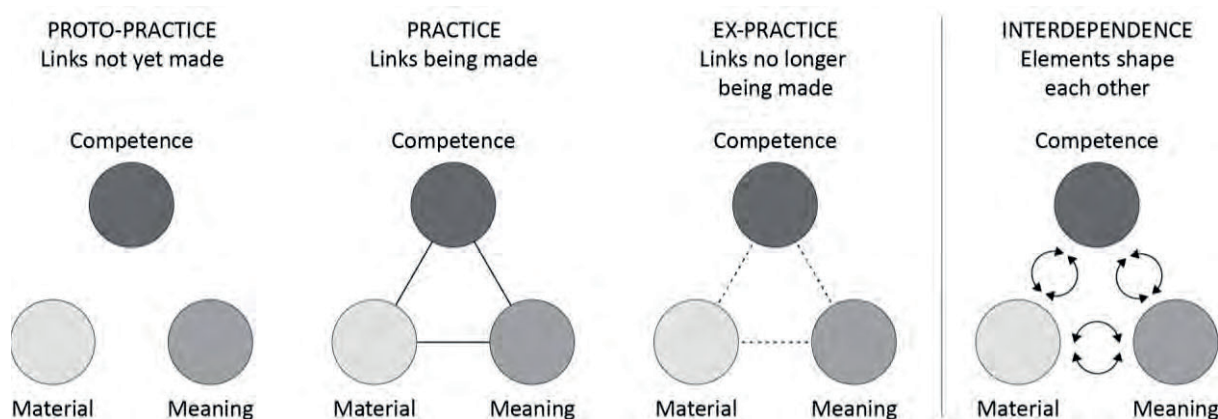


Figure 1 Emergence, maintenance and decay of a practice and the mutual interplay of various practice elements (Shove et al., 2012, p. 25).

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.

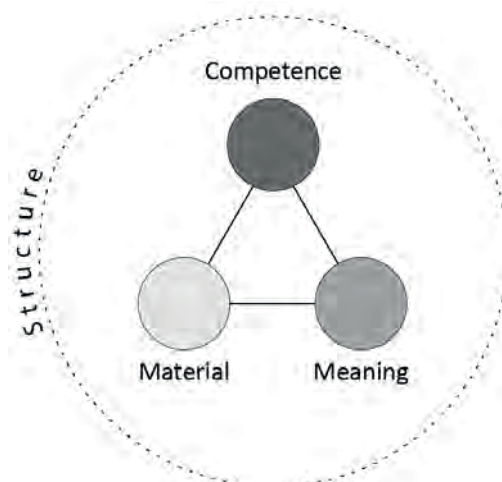


Figure 2 The interrelated elements of a practice as proposed by Shove embedded in its context, the structure, as proposed by Giddens

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 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.

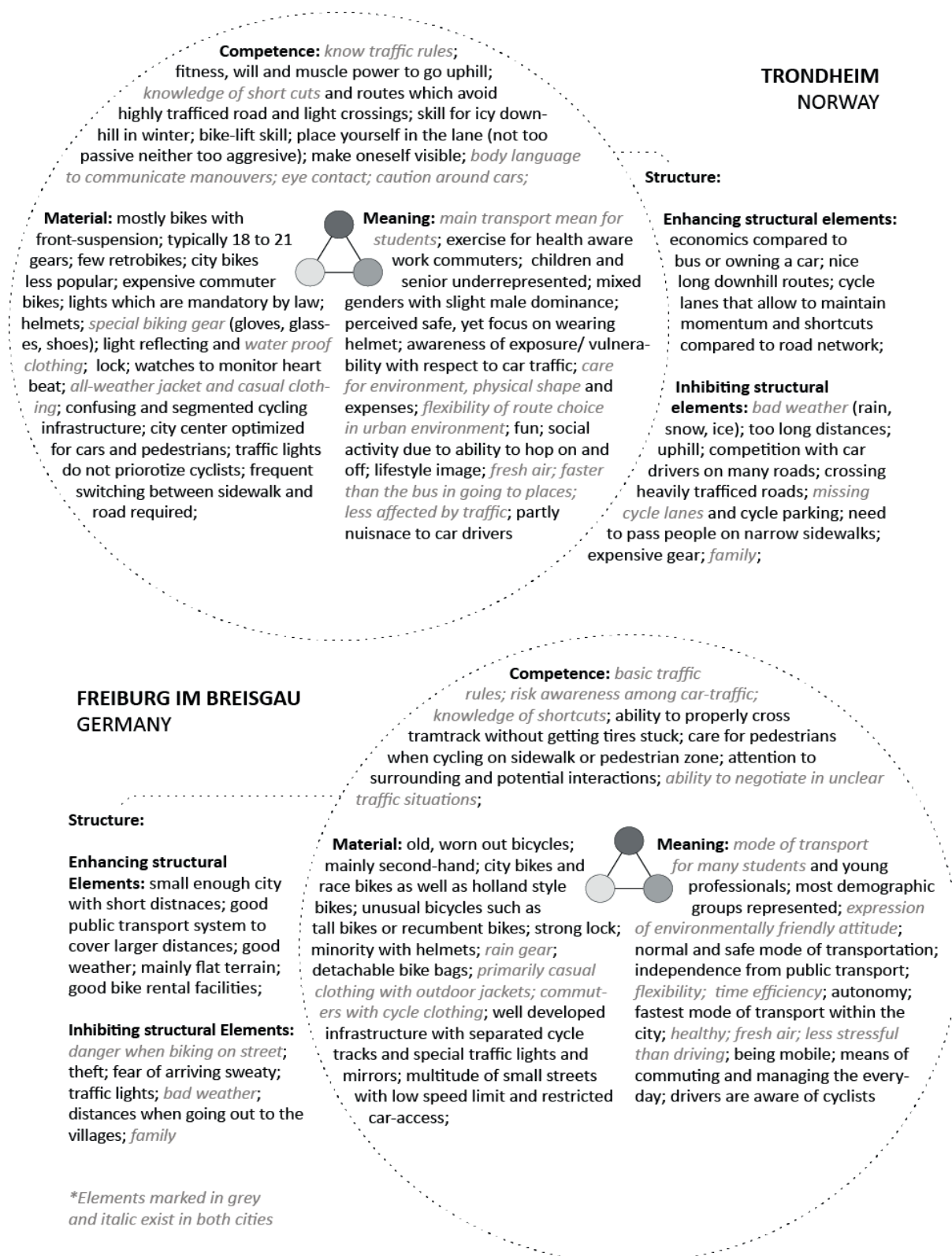


Figure 3 Visual representations of the elements and their interrelation configuring cycling practice in Trondheim and Freiburg in their characteristic manner as found through interviews. Aspects in black writing are place specific, while grey writing indicates its existence in both cities.

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.

	MATERIAL	MEANING	COMPETENCE	STRUCTURE							
FREIBURG					TRONDHEIM						
MATERIAL		16	18	13	3						
MEANING	5	4	2	6	8	9	1	7	14	15	17
COMPETENCE								10	11	12	
STRUCTURE											

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*.

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