

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

Tobias Barnes Hofmeister<sup>a,\*</sup>, Agnis Stibe<sup>b</sup>

<sup>a</sup> Department of Product Design, Norwegian University of Science and Technology

<sup>b</sup> 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 20<sup>th</sup> 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 Kuijjer (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, Millonig, 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 Kuijter (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).

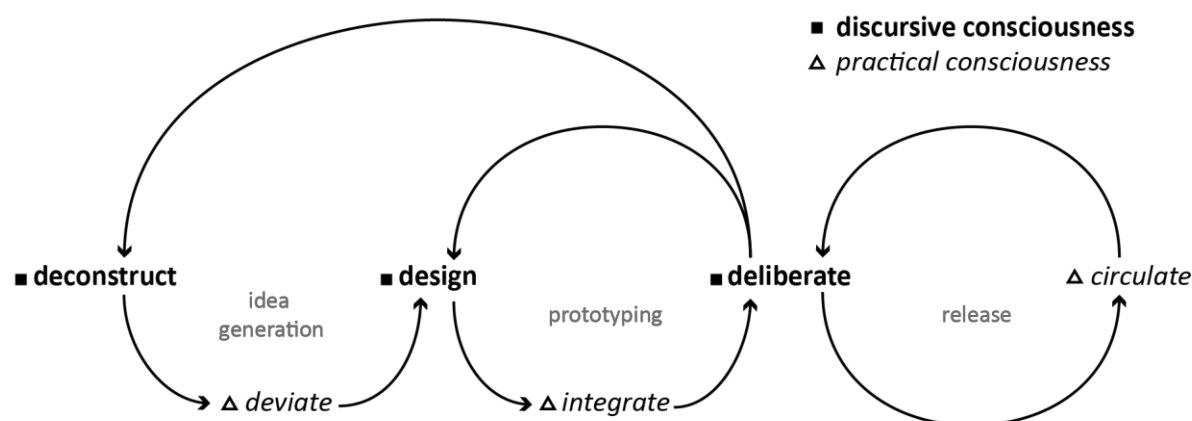


Figure 1. Iterative practice-oriented design process alternating between modes of discursive consciousness, reflecting on practice and its elements, and practical consciousness, trying out new behaviors in everyday routines. (proposed by Scott (2012, p. 286))

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).

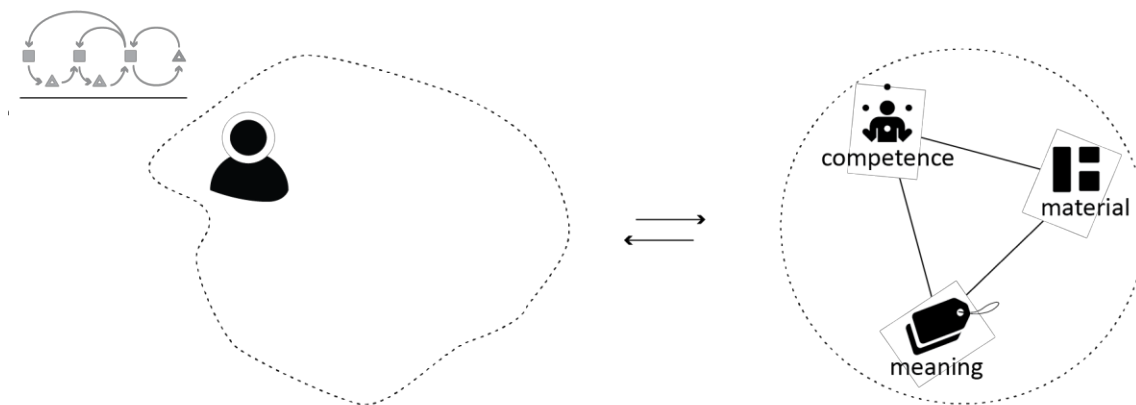


Figure 2: Initial situation in which human agency is constrained by social structure and every practice is engrained, governed by habit and tacit. The human actor is not aware of the social boundary conditions (indicated through dotted line) governing its everyday routines.

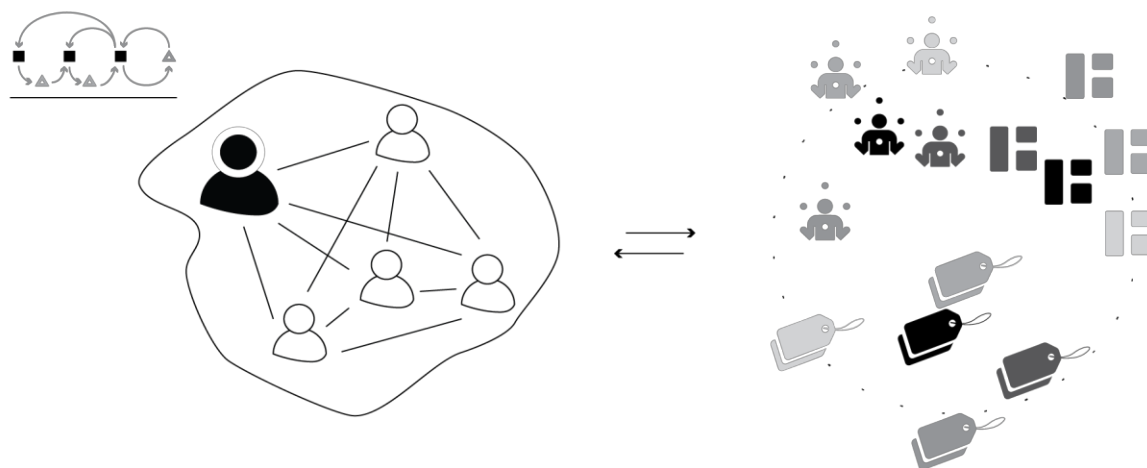


Figure 3: Through co-creation a set of stakeholders can share individual practices, discuss social boundary conditions and their legitimacy, collectively innovate and break existing social practices into its elements. By thinking of desired practices existing or new elements can be integrated into novel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

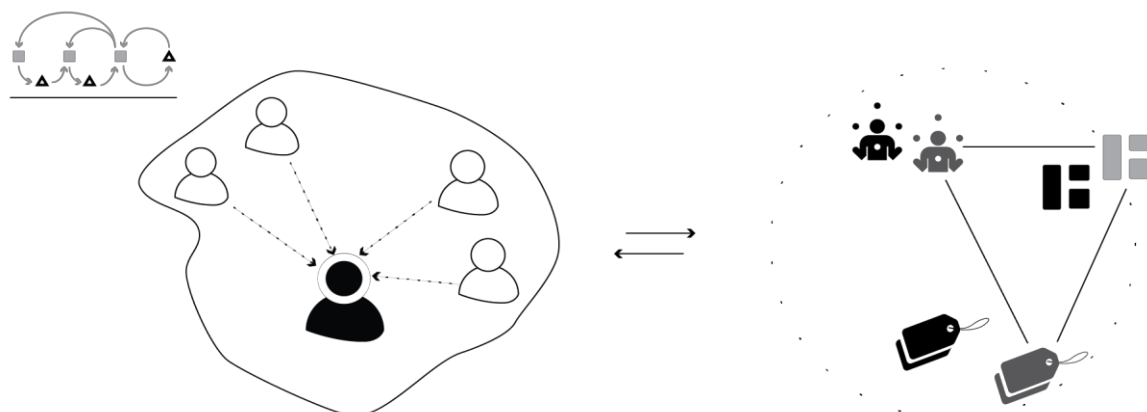


Figure 4: After designing/envisioning novel social practices links between old elements have to be broken and novel links need to be formed. To support this process of experimentation whether envisioned practice prototypes are promising, socially influencing systems can raise awareness and create visibility 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.

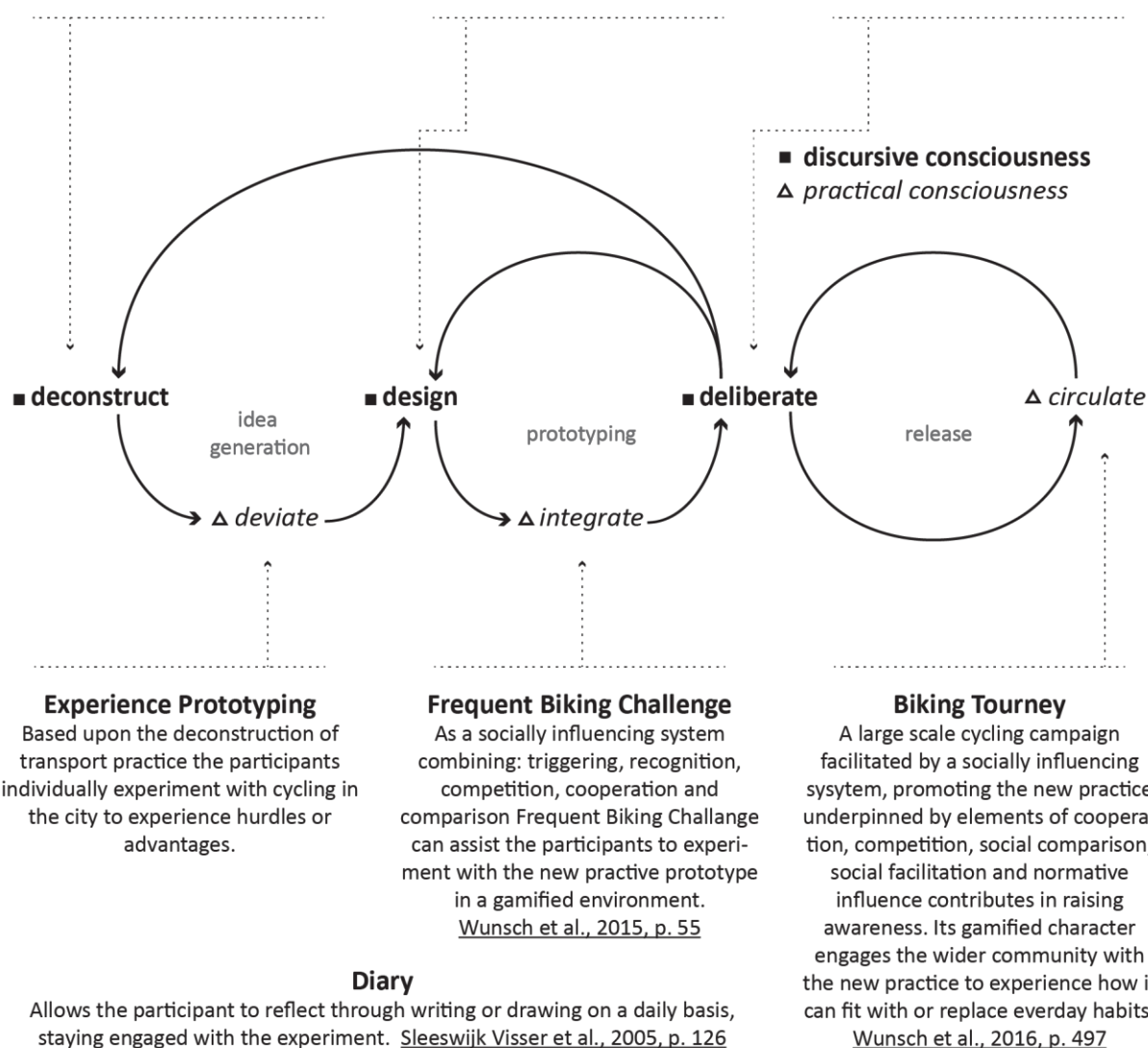
The visual representation of the triangular practice configuration allows for collaborative and visible emergence of the new designs.

Kuijter, 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 strenghts 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



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 Mobolities: 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, Sapor, 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.NI*, (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. 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.

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 thought purposefully designed urban spaces that successfully blend technological advancements with human nature.