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Habit change: The case of persuasive ICTs on personal travel

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Abstract

As mobile technology becomes ever more ubiquitous, making the choice to travel by public transport has never been easier. Still, the car is the preferred mode of transport, even within the large cities. This thesis looks at how ICT can change the habits involved when choosing modes of transport, by investigating the need for predictability within families with small children, how ICT can support those needs, and if persuasive technology can, using that knowledge, change those habits. Observations, customer journey map workshops and interviews form the empirical groundwork for the study, and literature reviews make for the main theoretical basis. The study found that predictability is important in an *ontological security* – context, and there are technological solutions yet to be implemented, like predictive technologies and better real-time information. Persuasive technology is effective on small-scale behaviour changes, but public transport as a domain demands more complete habit-models than captology currently provides.

Acknowledgments

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My supervisor Jo Herstad, for reeling me in when I have gone fishing and knowing when hinting is not effective. To Tom Erik Julsrud in TØI and Torbjørn Barslett in Ruter for their time, their pointers and their comments.

To my fellow snippeteers, particularly Robin and Bente, it's all about the crunch. Thanks to the participants, who allowed me to tell your stories. Thanks to my ever-patient family for your support.

A special thanks goes out to the ones that didn't believe: you know who you are.

Dedicated to Mari

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1 Introduction

When was the last time you stopped to think about how you get out of bed? When getting up in the morning, you sit up, then put down your left foot, or your right foot first, or you turn off the alarm-clock before or after standing up. You probably don't put much conscious thought into it. This is because it's become a habit, it's something you do *because* it's something you do, and getting out of bed is necessary to begin your day.

Habits form the core of many of our daily actions without us having to offer much conscious thought about them, and our habits extend into how we conduct our travels. But let's say that our travel habits are formed around technology that is sub-optimal for the context? How could we change them? This thesis will investigate what ICTs can do to change habits in city-proximal transport away from the car towards less space and energy-intensive alternatives.

In recent times, as our roads are becoming increasingly more congested and the pollution levels in cities rise, the call to rethink how we, as a society, are transporting goods and people, especially in urban areas, is being heard. This issue is on the agenda for legislators, producers and shippers of goods, and regular people stuck in traffic for hours every day. The need for understanding this issue involves a multidisciplinary research field consisting of scientists, legislators, economist, technologists etc., with a wide problem base and complex issues to investigate. In the 2009 U.S. National Household Travel Survey (NHTS), the data suggests that for all vehicles in the study, most are used less than 120 minutes every day (Krumm, 2012, p. 2). This survey lists all trips for personal means, including trips made by public transport, so to claim that in its lifetime, a car sits idle at least three quarters of the time does not seem to be an understatement. Combining this waste of resources involved when manufacturing a car, with the apparent issue that most travels happen within the same slots of time each day (Krumm, 2012, p. 3), makes road congestion a problem in the big cities, and with that the added pollution, frustration and loss of productivity that follows in the wake of the car stuck in traffic. This lost productivity alone is estimated to cost NOK 2,5M every minute (NAF, 2013). In the long-term strategical plan for handling public transport in the Oslo-Akershus region, M2016 (Ruter, 2015), the primary goal is to make sure that any future growth in transport is handled by public transport, i.e. bus, rail, bikes or walking. This objective is grounded in the Norwegian national

transport plan[1] 2014-2023 (Samferdselsdepartementet, 2013), which itself is a stated goal in the Norwegian white paper on Climate[2] (Klima- og miljødepartementet, 2012), making this an environmental goal first and foremost. Also, in M2016, (2015, Chapter 6), it is a stated goal to make technology an integral part of the "mobility network" to ease the daily life. On top of the environmental and health-related worries, it seemed to me to have been and still is a large focus on economics, statistics and cost/benefit-analysis when travel systems in big cities are planned. This study will investigate the users and their habits by getting to know their stories the way they relate them.

1.1 Motivation

The motivation for this study then becomes one of environmental concern. "Environment", not only on a global scale, but also on a local scale. Norway has been sentenced in the EFTA-court for violation of the EU directive 2008/50/EC on ambient air quality, and for not having a plan for air quality in the city of Oslo (*Judgment in Case E-7/15 - EFTA Surveillance Authority v The Kingdom of Norway*, 2015). In a report made by the Norwegian institute of Public Health[3], it is made apparent that poor outdoor air quality is not only a contributing cause to life degradation and early death in patients that suffer from respiratory problems, but is also linked to onset of such diseases in an otherwise healthy population (Nasjonalt folkehelseinstitutt, 2013). For a lot of people, myself included, it seems apparent that the role of the personal car in a city setting where the availability and saturation of public transport is adequate, is up for debate. The personal automobile takes up much space that could be left open for other forms of mobility such as public transport, bikes or walking, and in doing so creates an even worse public transport experience. As I don't have a car myself, I have spent many hours sitting in traffic, pondering how to better design cities to obtain the state of transport euphoria that M. Csikszentmihalyi (1997) calls "flow," and this has led to an interest in how to better enable public transport and musings on who the "real" users of a transport system is: the people or the technology. In the end, is it the end needs of everyday person "Kari" and "Ola" or the facilitation of her car-use and by extension the needs of the car manufacturers that is important? There is

[1] Nasjonal Transportplan

[2] Klimameldingen

[3] Nasjonalt Folkehelseinstitutt

already much research devoted to this topic, and within informatics and HCI this topic is as important as ever. New apps, backend data solutions, intelligent, self-driving cars; larger and larger interconnected ICT-systems are growing and evolving at a rapid pace, and being a part of this evolution is exciting!

1.2 Research Questions

The grand topic of this thesis is *habit change* and how to achieve habit change in public transport scenarios from car to public transport, or how to retain public transport users, using ICTs as support. To gain the necessary insight into how this is achievable, I have proposed three questions that look at different aspects of habit, technology and travel patterns.

This thesis is a study conducted within the field of human-computer interaction. The tradition within this field is human centred, so it's natural for me to begin the inquiry with the people that are at the core of the issue. In this context, I will focus on gaining an insight into the "why" regarding the travel patterns of families with small children living in Oslo, more specifically the ones that have daily travels that are more complex than a simple commute. The way I approach that question is by looking at how they talk about their daily travels.

- **RQ1: How do these families regard predictability as an important aspect of their daily travel patterns?**

This question is aimed at generating understanding of how they regard certain aspects of their travel experience and how this influences their choices, when it comes to everyday transport situations. This will form the empirical base for exploring questions about the use of ICTs.

Secondly, if these families were to alter or retain their mode of transportation, it's important that their needs are met. Perhaps ICTs can support this transition or retention?

- **RQ2: In what ways can mobile ICTs support the need for predictability?**

Is there a gap in the current use of ICTs, or even other technologies, that can be filled by clever use of these technologies?

And finally, the word "pattern" in travel pattern also appears in research on habit and habitual actions. If one wanted to change his/her own or someone else's travel pattern, this could be

constituted as changing a habit. I will therefore argue that travel patterns exhibit habit-like characteristics, and the act of changing travel patterns can benefit from methods based on changing habits.

- **RQ3: What are the strengths and weaknesses of using captology and more specifically the Fogg Behaviour Model to persuade these families to begin or keep using public transport?**

Changing how you live your daily life is not trivial, and looking at habit research and habit change could be useful when routine change is needed or wanted.

1.3 Outline

Thus far in this chapter, the topic, the research questions related to the topic as well as the motivation for choosing the topic has been presented. The following will provide an outline of the thesis and its sections. This thesis is written in English, but all the informants were Norwegian and all the interviews and transcripts have been done in Norwegian. Quotes and coding have thus been translated verbatim with the intent to carry the original meaning across to English as accurately as possible.

In **chapter 2**, I present the case from which the participants for the empirical study are chosen, and what the target user group is. I present some thoughts on how to approach travel patterns, and the history behind travel planning and how it has evolved into today's reality.

In **chapter 3**, a review of current theory and literature on design, habits and various technologies that support habits in a transport environment is conducted. Since habits touch on ethical issues and ethics are implicitly defined as one of the concerns in one habit model, a section on ethical theory is also presented. The main habit model discovered by MIT as well as a field of research called captology that builds on this notion are also presented. Technological terminologies such as open and big data and ITS are touched upon to leverage the discussion on these technologies and their ole in habit frameworks. The design paradigm that is service design thinking is positioned within current theory on human-centred design to understand how the process relates to other design methodologies.

In **chapter 4** I tackle the research methodology. It starts off with an introduction to qualitative research as well as some currently used methods in transport research, coupled with some critique. Then, the presentation and discussion on the applied methods in this thesis takes place. A short brief on how the informants were chosen and how the interviews were conducted and analysed follows.

In **chapter 5**, the analysed findings are presented and visualised using engaging personas and customer journey maps.

In **chapter 6,** the discussion on the research topic and research questions take place, starting with the findings relating to predictability, and then moving on to how ICT can support those

needs. The habit models are then applied with those needs in mind, then discussed and criticized to see if the model is adequate.

Chapter 7 is the conclusion, where I extrapolate the results of the discussion and use them to answer the research questions as well as the guiding question. Some limitations of this study and how to take the next step are then suggested.

2 Case presentation

This chapter presents the context in which this thesis is written, and the target user group and the reasoning for the theoretical sampling of informants. It presents the history of the travel planner to set the stage for the current discourse on the topic, and some thoughts on travel patterns.

2.1 Context

This study is an extension of the "Underveis" – project, ran by researchers from Tøi, the Institute of Transport Economics, and UiO, the University of Oslo (Julsrud, Denstadli, Herstad, Hjalmarsson, & Li, 2014). That project sought to investigate what kind of mobile applications that could make the users' journey more attractive, and presented both a set of personas sourced from quantitative survey data, and suggestions for various applications that could enhance your journey by public transport, be it a personal trip, a commute or a vacation. The conclusion was mostly focused on the travel experience itself, though, and how the mobile applications could enhance the experience of the travel, and thus had a narrow scope.

In this study, the thematic idea of mobile technology that enhances the experience is both broadened and re-scoped, and I have tried to direct the research onto a more basic level. The mobile technology is not presented in a way as to make it a product of *entertainment* or *productivity* in particular, but more on how ICTs that help you make your daily ends meet can aid or persuade you to make a choice of using public transport as opposed to personal transport (i.e. the car). Looking at mobile technology that are not mainly apps, but with requirements and wants grounded in the daily needs of the users is where this study makes it mark.

Since this is a Master's thesis conducted within the context of the *Design* – research group at the University of Oslo, the results will therefore focus mostly on people, their experiences and the human factor in general, rather than programmatic or mathematical solutions, although they will be discussed where appropriate.

2.2 History

The history of how to plan your travel is probably as old as travel itself. As soon as travel moved outside the personal sphere and became a public and coordinated matter, it became necessary to communicate the schedules of the means of transport. This was often done via oral communication or posted time tables, and these only related to the immediate vehicle or mode of transport. The first compiled time-table taking multiple sources into account is supposedly *Bradshaw's Railway Time Tables and Assistant to Railway Travelling* from 1839 (Leighton, 1906), and this is where we begin to see a structured take on travel planning. Mass transit thus began a shift from reactive, i.e. responding to the schedule of a limited and infrequent possible modes of transport, to active transport, i.e. initiated by the traveller. It was only recently, with the advent of the personal computer, and subsequently the portable computer in the form of the smartphone, that this formula has been expanded upon in a significant way. In Norway, the first compilation of routes similar to Bradshaw's work came in 1869 with *Rutebok for Norge*, and this publication was also the first foray into creating digital solutions for travel planning when it was released as a CD-ROM in 1994, as a website in 2005 and currently available as an app (L. Simonsen, 2015). In the late 2000's, Ruter, (then Trafikanten), Statens Vegvesen and Oslo municipality, implemented a data service that communicates real-time information about the location and expected arrival of the rolling stock across the subway, buses and trams in Oslo called SIS. This system was initially communicated only through the websites and WAP – solutions provided by Trafikanten, the current coordinator for route planning in Oslo and Akershus. This exclusivity sparked a debate related to the public access to information that was seen to be a part of the common good according to the principles in the Norwegian Freedom of Information Act from 2006. Then-editor of digital publication digi.no Bjørn Tennøe demanded that the data produced by Ruter and the Norwegian national railway (NSB) should be made publicly accessible to the likes of Google, to implement in their Google Maps planning service (Tennøe, 2010). The first app outside Trafikanten that took advantage of these now-open datasets was a widget for the Norwegian web browser Opera (Flyen, 2009). This initiative has paved the way for what is now the national register for Open Data Access run by the Agency for Public Management and eGovernment (Difi) since 2011.

This brings us to the current state of travel planning. Since it is now a requirement, as far as possible, that all Norwegian datasets created by government agencies are made publically avail-

able, multiple services that utilize these sets have been made, on several platforms. The *Opticities* – task group, in which Ruter participates, is an international initiative that looks at enhancing mobility in cities worldwide, and one of their core principles is based on access to open datasets: The communities and municipalities make requirements, routes and infrastructure, and private companies are invited to fulfil those demands (Opticities, 2013). This means that it's open for anyone to deliver route information and even ticketing within their apps, using the open datasets and Application Programming Interfaces (hereinafter abbreviated as API's.) Since 2015, NSB has moved from a biannual printing of time tables on paper, to a fully and exclusively digital distribution, thus burying a 150-year tradition to make way for the future of travel planning (NSB, 2015). Also, the largest ever travel electronic planner, including hard-coded and open data from virtually every Norwegian public transport source has been released (NSB, 2016). The reality then, is that we have a very good set of tools for planning a single trip, with real-time, updated and location-aware data.

2.3 The target user group

Since this study tries to look at the users' requirements and existing needs to make any assumption on technology, you have to define which selection of users you want to focus on. Since arguably every person existing is a candidate when you talk about transportation technology, making a narrow, defined selection of users that have a common perspective on travel is essential, lest the study becomes diluted and unable to make any real conclusions (see also Chapter 4: Methodology).

The chosen user group are therefore: **couples/families with at least one child attending kindergarten, that live within the confines of a big city.**

I believe that the travel patterns of this user group include more variables than the single-destination *commute*. Commuting in this context is defined as a single home-work-home travel pattern, with or without crossing a county border. These travel patterns should be more easily predictable due to their A→B nature, at least when it comes to mode of transport. Conversely, everyday travel patterns of families with children might include several vehicles, destinations and traveller configurations, and it's these variables that set them apart from commuters for the purpose of this study.

The rationale for choosing families with small children, are that they should at least have the kindergarten as one of their additional stops on the daily travel, and drawing from personal experience, small children's needs are often unpredictable and would require unexpected or unscheduled trips within the normal routines.

2.4 Travel – inherently complex?

In the above I make claims that A→B→A travel patterns constitutes a "commute" and that they are *simple* in their nature. If you look at travel planners today, like Ruter or NSB or Google Maps, you will most likely have noticed that they are very good at offering single trips from A→B, with alternatives and suggestions. This focus on single trips might lead to a conclusion that all single trips are simple, and all other journeys are complex. But even though the trip itself seems relatively straight-forward when viewed from outside, the conditions of the traveller might not be simple. So rather than making the division between perceived "simple" travel patterns and more "complex" travel patterns, I find it useful to understand travel patterns as inherently complicated, both when it comes to modes of transport, how a single traveller can behave differently across various trips, and their experience of their situation.

3 Field overview and related theory

This chapter aims to provide an overview of the field of informatics and how design and user research fits into that field. Existing research related to the topics that are discussed in the following chapters will also be presented here. The chapter starts off with an introduction to information systems design and how you perceive the role of the user in design theory, as well as some relevant theory for service design to be positioned within. Then some core concepts and ideas relevant for the discussion are introduced while reserving most of the debate for chapter 7 Conclusion. Especially theories on how we think about habit and how to incorporate habit models into informatics are presented, but also some current technologies that support travel or transport, such as ITS.

3.1 Design in informatics

The multi-faceted umbrella of informatics contains a large variant of disciplines. They all share, however, a focus on different aspects of computer systems and their use. One notable field under this umbrella is "Human-Computer Interaction", HCI for short. Generally acknowledged as being founded in 1982 at the first conference that were to become the AMC SIGCHI conference (Carroll, 2015, Chapter 2.2; Lazar, Feng, & Hochheiser, 2010, p. 2) HCI is a *research field* that occupies itself with studying individual and generic user behaviour, social and organizational computing, accessibility and so on (Carroll, 2015). Modern HCI research is thus directed at issues humans face when interacting with information systems and other computer-related artefacts, as well as discovering and understanding new phenomena related to these interactions.

One of the fields that sprung from HCI and its inclusion of *non*-technologists such as designers and architects in the 80's, is interaction design, both as the verb *to design* and as the noun *a design*. Design can be defined in general as *"to decide upon the look and functioning of (a building, garment, or other object), typically by making a detailed drawing of it"*[4] and in the context of information systems, Jonas Löwgren defines interaction design as follows: *"Interaction design is about shaping digital things for people's use"* (Löwgren, 2015). Generally

[4] http://www.oxforddictionaries.com/definition/english/design

speaking, the HCI researchers mainly concern themselves with academic pursuit, and the designers with products or services, although this is a crude generalization, since designers affect the research and vice versa. For the discourse in this study, however, that distinction will suffice. In his book "The Design of Everyday Things," Donald Norman defines three relevant areas of design that interconnect: *Industrial Design, Interaction Design* and *Experience Design* (Norman, 2013, p. 5). He defines *Interaction Design* as a discipline that focuses on how people interact with technology and how they can learn and be aware of what processes happen when they interact with a system. Thus, interaction design is an inter-disciplinary term and draws from principles from psychology, design, art and emotion. Compare with *Experience Design,* which is more aimed at products and processes and tries to make an entire experience enjoyable. All of these three design areas are clustered within something Norman refers to as *Human-Centred design,* and is *"The process that ensures that the design matches the needs and capabilities of the people for whom they are intended."* (Norman, 2013, p. 9) These definitions more than imply a real need to find ways of gaining some meaningful information from the user about the user's needs and wants.

3.1.1 Knowing the user

In several design and development disciplines within information technology, the importance of getting to know your users are presented to various degrees.

Within *human-centred design*, including interaction design, Sanders & Stappers (2008) presents a landscape in which you can position design philosophies and projects based on the relationship between the designer and the (future) users (see Fig. 1). Within this landscape, you can position your methodology according to the two axes *design-research* and *user partner – user subject*. One example of users as subject exists in User-Centred design. Here, the user is recognized as being central to the design process (Gould & Lewis (1985), in Rogers, Sharp, & Preece, 2011), and the user is being consulted on various design suggestions and solutions, and their input is taken into account when revising or releasing the product. On the other end of the scale are philosophies such as co-creation and Participatory design. Here, the user is an active stakeholder and is empowered to influence decisions to a smaller or larger degree during the process. The second dimension is *design-led* contra *research-led*, where the disciplines core to

HCI forms the basis of the research-led approaches, while principles amalgamated within interaction design and other design principles form the basis from which *design-led* approaches emanate.

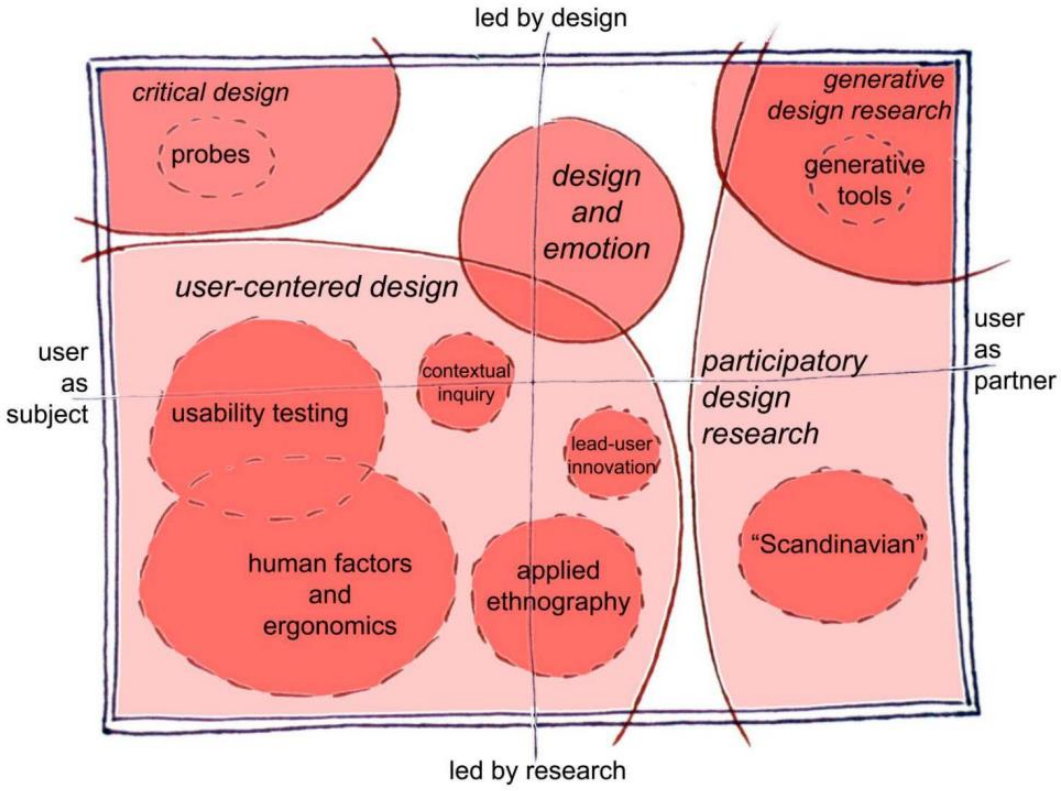

Fig. 1 "The current landscape of human-centered design research as practiced in the design and development of products and services. " (Sanders & Stappers, 2008)

3.1.2 Service Design Thinking

Interaction design was the design discipline that sprung from the area of HCI in the 1980's and onward. However, a new direction within design has emerged lately to elevate the focus from just the design of information systems, to looking at other design disciplines as well at a larger scale. This discipline is called service design and focuses its lens on all applicable design areas that relate to actors within a service.

With the invention of the World Wide Web and the internet, coupled with the notion of ubiquitous computing (Weiser, 1991), recent times has seen the increase in inter-connected and co-reliant information systems across a multitude of platforms. The ability to exchange and retrieve information at a moment's notice all over the world enabled the myriad devices and services

that constitute the modern world. Both on the field of entertainment, as evidenced by the herald of the iPod, and connectivity, as represented by the cell-/smartphone, the way we expect and consume information has led to what is colloquially known as *the information society* (see Quan-Haase, 2012, pp. 32–37). The shift from single-serve computer terminals and smaller in-business networks meant that interaction design alone no longer made the cut for a lot of services. Since interaction design focused on the interaction with the digital technology, the emerging integration with existing systems and routines and the increasingly ubiquitous digital technology demanded a new, more holistic look at how these systems could be designed. Enter service design. Taking from the various existing design disciplines, like graphical, interaction, product and social, combined with business and operations management, service design tries to look at all the actors and processes that are involved in a service from the first point where the user makes contact with the service, through the entire process, and beyond.

Principles and mind-set

Service design is not a strictly defined field. Stickdorn & Schneider (2010, p. 29) comments: *"If you ask ten people what service design is, you would end up with eleven different answers – at least,"* and that there is no common definition to what service design is. This does not, however, mean that service design is so loosely defined that is does not have any basic tenets to rely upon. Rather than trying to give a precise recipe, Stickdorn & Schneider propose that service design is a mind-set that aids in the design of services: "service design thinking." They also propose five core principles to illustrate this way of thinking, as well as some key concepts (Stickdorn & Schneider, 2010, p. 34). One of the key concepts related to service design is something called *touch-points.* This is a phrase meant to describe the various intersections between the service and the user; it's the points where the user "touches" the service. Identifying touch-points and associated feelings can make it more apparent for the designers where and how to refine or alter a service. Touch-points can be between humans (psychology etc.), between machines (standard informatics), or between human and machine (HCI) (Stickdorn & Schneider, 2010, p. 40). It's mostly the aspect of human-machine that interests HCI researchers or interaction designers.

1. **User-Centred**

   The first important principle of service design is that it needs to focus on the user, since this is the agent that the service is for. It is therefore necessary to gain the insights and the real situations of the people that interact with the service to identify rewarding and frustrating interactions. One of the points made by Stickdorn & Schneider when talking about focusing on the user, is that the user, the designer and the other actors in the service lifespan need to share a common language to better the communication and understanding of the service for all. This mirrors almost directly the points that were made by Eva Brandt (2007) when talking about the "language game" and how this enables the communication within co-creation and design.

2. **Co-Creative**

   Co-creation is a central point in many design disciplines, and service design also acknowledges this aspect. Stickdorn & Schneider defines co-creation as a process where the designers create an environment where the designers and the stakeholders generate and articulate ideas, and is mostly presented as a way to generate insight from stakeholders using various tools and techniques. Sanders & Stappers (2008) talk about *co-creation* in a more general manner, however, and they refer to the term as encompassing "any act of collaborate creativity." Co-design, on the other hand, is defined more narrowly, and resemble more the perspective of Stickdorn & Schneider, in that it's the collective creativity as applied to the entire design process. This approach expands on the idea that connecting with the user is central to the design process, and that all stakeholders should be involved in the co-creation process as early as possible.

3. **Sequencing**

   Imagining the service as a related set of touchpoints occurring one after another is a mental model designed to assess the rhythm of a service: if it's too slow and boring or too fast and frustrating, but also where the services are engaging. The sequence of a service can identify hand-offs between stakeholders but also "invisible" interactions not normally thought to be a part of a service journey. The service process is made up of three separate phases: First, you come in contact with the service and get to know it (pre-service). Then, you are partaking in the events of the service to fulfil some goal (service period) (Stickdorn & Schneider, 2010, p. 40). Finally, the post-service period is where you assess and evaluate the service experience.

4. **Evidencing**

   Stickdorn & Schneider claims that services are made up of both material and immaterial elements, or tangible and intangible materials. They describe that most services are designed to be invisible, thus removing the knowledge of the service from the user. This is not always a good thing, and can render the service hard to understand for many users (Stickdorn & Schneider, 2010, p. 42). This means that the intangible should be made tangible, both as a reminder on how the service works, but also as a signifier that the service designer is aware of how the service can be perceived and used and that some consideration has been taken into account. The example from the book is of an electric hand dryer in a hotel, with a plaque informing the users of the dryer that they are aware of the customers' preferences to use real towels, but that environmental considerations has trumped in this case. Donald Norman describes the way of calling attention to what is being/can be done as "signifiers" when they call attention to how to interact with the "affordances," (see Norman, 2013, p. 13), and evidencing in service design follows the same intent to a degree.

5. **Holistic**

   Looking at what can be described as "the big picture" is one of the core aspects of service design, although the authors acknowledge that this is not always possible (Stickdorn & Schneider, 2010, p. 44). Trying to gain as good an understanding as possible of the entirety of a service's cycle and all involved stakeholders becomes an ideal that the designer should remind her-/himself about at all time. To aid with this holistic approach, there are a few guidelines. When it comes to the individual touchpoints, the environment in which the services take place should be the focus, as the sensory and mental inputs will have an influence on how the service is perceived. When looking at the sequence, the designer should focus on discovering the rich flora of customer journeys, as all users will probably have individual preferences and expectations of a service. How the service provider is organized is also within the service design domain, as the structures imposed by the larger ecosystem will have an impact on the possible outcomes of the customer journey and thus the service itself.

Service design in the co-creative landscape

Service design is then a cross-disciplinary methodology with some core concepts. And the stated core principles of "user-centred", "co-creative" in particular can be analysed and placed within the landscape of human-centred design (see Fig. 1). As mentioned above, the definition of *co-creative* as presented by Stickdorn & Schneider (2010) differs from the one in Sanders & Stappers (2008). When taking into account that the former talks about a design discipline as an umbrella term for a composite process, and the latter mostly defines co-creation as the parent terminology to co-design, of which co-design is an instance, the reason for the difference seems apparent. When Sanders & Stappers talk about *co-design*, that's more resembling the term Stickdorn & Schneider refer to as *co-creation.* Service-design is then co-design, but it is not clear if the process defines the user as "partner" or as "subject" (refer to Fig. 1.) When talking about the focus on the users and their point of view, the process could be both very participative, where the user gets to "have a say" (see Bratteteig, Bødtker, Dittrich, Mogensen, & Simonsen, 2013, p. 129), or more asynchronous, where the users are considered informants and advisors to the designers. If we choose to regard this ambiguity as intentional or otherwise, it is the up to the designers' process to decide whether service design is participatory or not. When defining service design as being led by research or led by design, I would argue that service design is primarily emerging from a design point of view. This is because the focus is mostly on the end product or service rather than coming from a mostly academic point of view. When placing service design in the landscape of human-centered design (see Fig. 1), the question on where it fits becomes a question on how user-involvement is regarded, but mostly above the central line, see suggestion, Fig. 2.

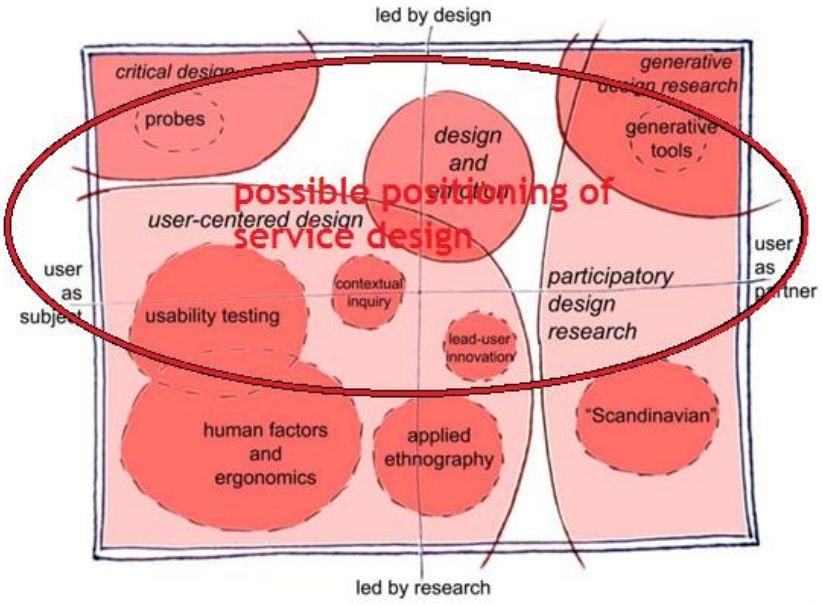

Fig. 2 Possible positioning of service design in the landscape of HCD, based on Sanders & Stappers

Another aspect of service design that places it within human-centred design, is the focus on the experience of the service and the intangible. This aspect alone sets it somewhat apart from interaction design, and fits neatly into what Norman calls "experience design" (Norman, 2013).

The notion of the "*Fuzzy Front-end"* of the design process (Sanders & Stappers, 2008, p. 6) is also shared in service design as presented by Stickdorn & Schneider, albeit with a similar, but different image. In Fig. 3 we see the image of the fuzzy front end above (Sanders & Stappers, 2008, p. 6), while the representation of The Squiggle used in explaining the service design process below (Damien Newman, Central inc, in Stickdorn & Schneider, 2010, p. 124)

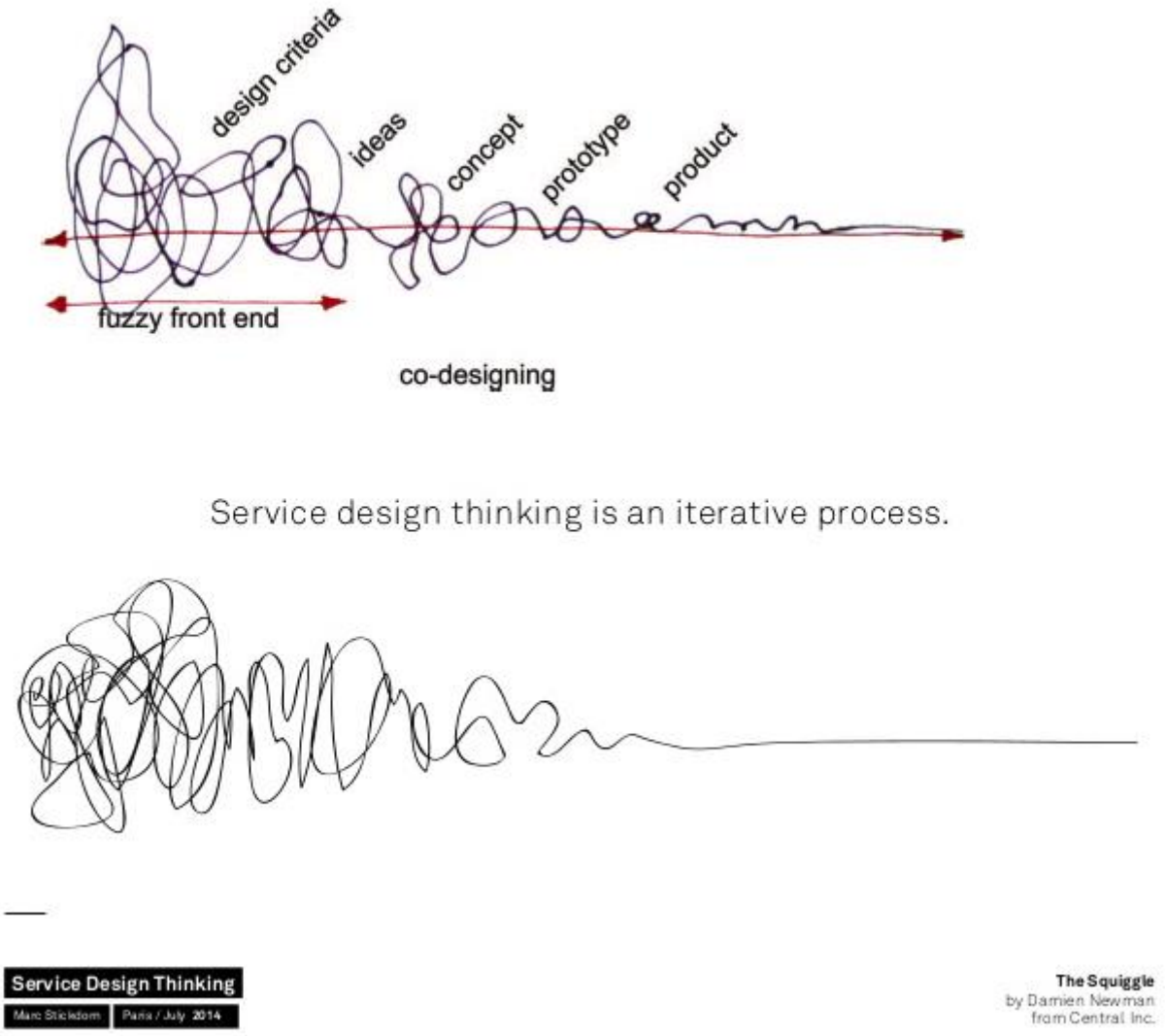

Fig. 3 Fuzzy front-end vs The Squiggle

3.2 Habits and behaviour

> *"Excellence is an art won by training and habituation. We do not act rightly because we have virtue or excellence, but we rather have those because we have acted rightly. We are what we repeatedly do. Excellence, then, is not an act but a habit."* Aristotle 384 – 322 BC

Habits and habit thinking have been subjects for discourse for several thousands of years. The above quote is attributed to the Greek philosopher Aristotle, and shows that the link between repetition, performance and the concept of habit has been linked together since the dawn of the western way of thinking. Habits play a large role in our everyday life, and without habits we would have to spend far more thought on many mundane actions. This is also the reason that habits might be tricky: because the most basic habits are executed almost automatically, they can also be hard to break or change.

There are a few terminologies associated with habits, and I will argue the following definitions in this chapter:

- Habit: A mostly social/neurological set of actions that provide a default routine in certain situations
- Routine: the actual actions that make up the realisation-part of the habit
- Behaviour: a set of habits that work together on a larger scale, but also consciously chosen routines.

3.2.1 MIT Habit loop

In a series of experiments conducted by MIT in the 1990's on rats, it was discovered that there is an ancient, basic part of the brain that is mostly responsible for storing and executing habits: The Basal Ganglia (Duhigg, 2013, p. 14). This means that there is a part of the brain dedicated to making decisions without the intervention of the higher functions of the frontal lobe; these decisions are made automatically without the conscious mind having been consulted. Habits form out of the want for the brain to conserve effort by hard-coding some repeat and automatic routines to a part of the brain connected directly to the brain stem and also to the mesolimbic

pathways contained in the brain's reward systems. For the brain, this is a good practice, since it enables us to unconsciously react to a wide set of pre-determined situations in a quick manner. In short: there are a number of things we do that we don't need to think about every time we do it; it would become cumbersome if we did not have this system. The process of the basal ganglia to know when to engage and store a habit was discovered and described as a three-phase process, named the "Habit Loop." (Fig. 4.) The first element of the habit lop is the "**cue**." This is the part of the behaviour when the brain is looking for some tell-tele signs if it should initiate a habit or not. This is a constant process. If the brain registers a known cue, it then cedes control of functions to a rehearsed pattern, named the "**routine**." This routine can be *"physical, mental or emotional"* (Duhigg, 2013, p. 19) and is the part of the habit where we actually affect a change in our surroundings or in our self. Then there is the "**reward,**" which can be tangible or intangible, as in a piece of chocolate that provides a physiological reward, or a sense of accomplishment, which provides a mental reward, or a combination of the two.

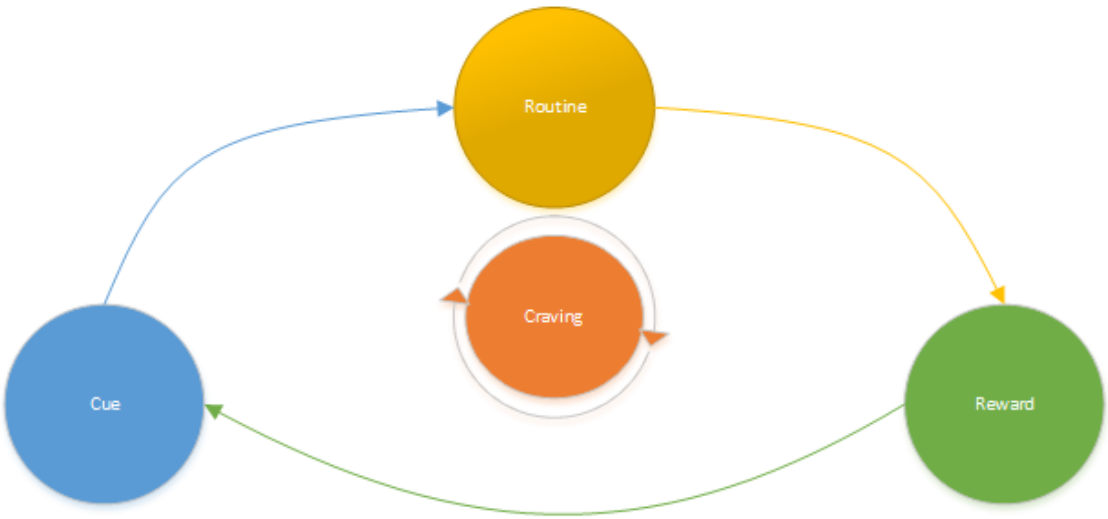

Fig. 4 The Habit Loop (Duhigg, 2013, Chapter 1).

Once this loop of cue-routine-reward has been rehearsed a number of times, either consciously or unconsciously, the routine has become a habit. The implications of this is that we might fall victims to a habit created without our knowing, because some change in our routine coincided with a cue that allowed the habit to be generated. The driving force of the habit loop, however, is something that has been called "**cravings**" (Duhigg, 2013, p. 47) that are also of neurological nature: the reward that accompanies the cue creates an anticipation within the reward centre in the brain, thus making us expect the reward at the end of the routine. The main thing, however,

that forms the premise for the way habits are presented by Duhigg, is that habits *cannot be removed once they are created.* The basal ganglia is resilient to change and once created, a habit will not easily be removed, if at all (Duhigg, 2013, Chapter 3). However, it's possible to identify the cravings that drive the habit and give them alternate outlets. In essence, you can change the routine that are associated with the habit, even though the habit itself won't disappear. The habit loop also works on an organizational level, by rehearsing situations prior to engagement and thus artificially creating habits for difficult or dangerous situations (Duhigg, 2013, Chapter 4). Firemen, police, military personnel and athletes spend lots of time training for situations that need to be executed as precise and as quickly as possible when the cue appears.

3.2.2 Captology and the Fogg Behaviour Model

Captology

A model that draws on the discoveries made with the habit loop and combines understanding of behaviour change and the possibilities that computer technology has for facilitating change, is captology. The term captology first appeared in a paper presented at the 1998 CHI conference. It is part anagram for "Computers As Persuasive Technology", with the added suffix "-ology," and was coined by Stanford University researcher BJ Fogg (Fogg, 1998a). In a following paper, (Fogg, 1998b) five perspectives on computers and persuasion are defined in order to better give an understanding on different approaches to research in the captology field (Fogg, 1998b, p. 225).

Fogg identifies the following perspectives:

First Perspective: Definition of Persuasive Computers

> *"Simply put, a persuasive computer is an interactive technology that changes a person's attitude or behaviors"* (Fogg, 1998b).

The paper defines ***persuasion*** as attitude- or behaviour change happening with *an intent*, and thus Fogg excludes behaviour change happening because of *accidents* or *natural phenomena* from his discussion. He goes on to talk about three kinds of inherited persuasive intent:

The first kind is called ***endogenous*** *(*coming from within*)* intent, and is defined as technology that has the intentionality to persuade built in by design. One example of an app with endogenous intent is Runkeeper, who is designed to make someone exercise more.

The second intent is called ***exogenous*** (caused by external factors), and is defined as when someone gives access to or distributes technology in order to facilitate change in others. We see examples of exogenous intent in situations like if someone should provide a state-of-the-art bicycle computer to someone else, in the hope that they will ride their bike more. Note that the bicycle computer might also be an example of technology exhibiting endogenous intent from the designer's perspective, but the action of enabling someone else to use this technology as a persuasion, is the aspect that makes it exogenous.

The last kind of intent is dubbed ***autogenous*** (self-produced), and is characterized by emerging from the person that wants to use a certain technology for him/herself, in order to change their own behaviour. Continuing the exercise-example from above, when someone decides to use Runkeeper in order to exercise more, then the application, or the scenario, exhibits autogenous intent.

Fogg notes that one single technology might fall into either or more of the above categories, depending on the situation they are used and why (Fogg, 1998b, p. 226).

Second Perspective: A Functional View of Persuasive Computers

Fogg proposes that computers function in three different ways, as ***tools***, as ***media***, and as ***social actors***, and he refers to these three areas as functions, and the set of functions as the *Functional Triad*. This is useful because different technologies can exhibit one or more of the functions, and that each function has its own way of acting as a persuasive device in how it asserts intent towards changing attitudes and behaviours.

Fogg applies the "how" – question of changing attitudes and behaviours to the functional triad and provides some *persuasive affordances* that the functions embody.

When a computer, -application or –system functions as a tool, it allows people to *"do things they could not do before, or do things more easily."* A tool can aid persuasion by reducing

effort-, time- and cost-barriers; it can increase self-efficacy, provide information for better decision-making and change mental models. One example of a computer acting as a tool is a heart monitor that sounds an alarm when it detects heartrates outside a pre-set zone.

Likewise, a persuasive computer medium can convey content of a sensory (video, simulations, virtual reality) or symbolic content (text, data, graphics). The medium-function can provide first-hand learning, insights and resolve, it can promote understanding of cause/effect-relationships and it can motivate through experience and sensation. Fogg uses the example of a computerized exhibit about HIV that lets people hypothesise about and experience how different choices alters the risk of contracting HIV.

The third function, computers as social actors, is when the computers either follow social rules (they greet you, apologise etc.), or employ animate characteristics (e.g. emotions) or play animate roles (pets, assistants.) This function is persuasive because it sets social norms, invokes social rules and dynamics, and provides social support or sanction. An example of computers as a persuasive social actor is when the computer employs anthropomorphic creatures to give advice, and praises the users when they follow its advice.

Note that the paper on captology was written well before any notion of modern "social media," so the view of computers as social actors might have overlapped with their function as media, or social media is in itself a separate tool.

Third Perspective: Levels of Analysis for Captology

The third perspective states that there are several levels of analysis to consider when thinking of computers as persuasive technology. Even though both computer use studies and notions of persuasion are held to pertain mostly to the individual user and individual use, there exists within HCI[5] and CSCW[6] other levels of analysis beyond the individual according to Fogg.

> *"… At least in principle, certain technologies are best suited for different levels of analysis"* (Fogg, 1998b).

[5] Human-Computer Interaction

[6] Computer-supported Co-operative work.

This means that any given persuasive technology can be analysed several ways and new areas of behaviour change can be discovered by doing so.

Fourth Perspective: The Design Space for Persuasive Technologies

The design space is where you connect the three already mentioned perspectives in a generative manner. This means that you actively use the framework to analyse an existing issue that can be addressed via persuasive technologies, and thereby gain some level of understanding about how to facilitate behaviour change for that issue.

Fogg suggests that, in order to do so, you should first identify the domains and issues of interest, and use the methods and perspectives in the frameworks above. This will be elaborated on later in the essay, but shortly put it is about asking the questions:

- How will this issue present itself by looking at it at different levels of analysis do?
- Where in the plane of the functional triad does this issue fit? How will the technology be employed to help in that area?
- Which possibilities for intentionality can be identified for this particular issue or domain?

  "Exploring the design space for persuasive computers is often an illuminating process" (Fogg, 1998b).

Fifth Perspective: Ethics of Computers that Persuade

Since persuasive technologies are designed to alter how we act and think about specific issues, a considerable ethical dilemma has to be taken into account whether the intentionality of the technology is endogenous, exogenous or autogenous. Fogg clarifies that most of the technologies presented in the article are perceived as ethical "good," but states that *"persuasive technologies can also serve ignoble purposes"* (Fogg, 1998b, p. 229). Examples presented are slot machines using animation and narration ("social actor", endogenous intent) to make gambling more compelling, surveillance systems that monitor employees hand-washing habits ("tool", endogenous and /or exogenous intent.) etc.

Fogg also splits the questing about ethics into two categories: The first one concerns ethics for those that distribute, design or create technology to change attitudes or behaviours. He emphasizes that the general ethical platforms in the society apply to the providers of persuasive technology. He advises these providers to *"base their design on a defensible ethical standard"* (Fogg, 1998b, p. 230) or at the very least *"[...]avoid deception, respect individual privacy and enhance personal freedom."*

The other category is concerned with the study of persuasive computers. Fogg proposes that the researchers into persuasive technology has a "watchdog role" for the HCI community in particular and technology users in general. He identifies four actions for the scientists concerned with researching within the field of captology:

1. Use the frameworks presented in the paper to identify persuasive technology, as well as what persuasive strategies that technology employs.

2. Researchers should look at the intended impact (effectiveness) and the unintended side effects of the persuasive technology.

3. You have an obligation to disclose your findings.

4. If you find a technology to be harmful or questionable, take or advocate social action.

A final note about ethics in captology is that education is the key, and it helps in two different ways. First, it can help people recognize if technology is using tactics to persuade them. Secondly, it allows people to adopt such technology into their own lives if they so choose.

Call for research: The seven directions for captology

In addition to the five perspectives that help define the field of captology, seven directions for further research is proposed (Fogg, 1998b, p. 230):

A. Captology should focus on interactive technologies that change behaviours.
The keyword here is *change behaviours* as opposed to just changing people's attitudes, because changing behaviours is a more useful metric due to the difficulty in doing so, it is more real-world applicable and behaviour change is measurable.

B. Captology should follow the well-established CHI tradition of adopting and adapting theories and frameworks from other fields.

Particularly the field of psychology is well suited for captology studies.

C. Captology should examine and inform the design of interactive technologies that are specialized, distributed, or embedded.

This is related to the notion of *Ubiquitous computers* (Weiser, 1991), and Fogg mentions that most new technologies will not be bound to the Personal Computer but exist in our natural environment in some way, shape or form. (This is truer now than it was in 1998, when the paper was written.)

D. Captology should focus on endogenously persuasive technologies.

Fogg notes, *"Understanding* ***endogenously persuasive technologies*** *seems more essential to understanding captology than the two others"* because these are created with the intent of changing or affecting behaviours and attitudes. Thus, the strategies for persuasion are written into the technology itself.

E. Captology can learn from other media but should steer clear of comparing computer persuasion with persuasion from other media.

This, Fogg notes, seems to be a dead-end because you can only directly compare the persuasive effects of the artefacts them self, not generalise the effects to the broader categories of which they are members of.

F. Captology should focus on both "what is" and "what could be."

Research into the existing reveals insight for the field, but because captology has a *"strong generative component"* (Fogg, 1998b, p. 231), the field can generate new insights and applications for computers, new methods for enacting behaviour and attitude change. The field provides a "lens" through which you can view computing technology.

G. Captology should be pursued with ethical issues and implications in mind.

Because altering people's perceptions is inherently an ethical grey zone, the researchers in the captology-field should be very aware of the ethical platforms they adhere to and implications that might arise from their technology. Fogg proposes that further research into the field of captology ethics is a needed endeavour.

Now that I have defined how the field of Captology is defined, I can begin to look at how one of the models defining behaviour within persuasive technology is defined, namely the Fogg Behaviour Model.

The Fogg Behaviour Model

In the paper "A Behavior Model for Persuasive Design" (Fogg, 2009), a model for categorizing behaviour is presented. The "Fogg Behavior Model" (Fogg, 2009) as it is called, hereinafter abbreviated to FBM.

> *"The purpose of the FBM is to help us, as researchers, think more clearly about behaviour"* (Fogg, 2009, p. 7).

This model is presented as a tool and a method of looking at behaviour change within persuasive technologies, because *"...many attempts at persuasive design fail because people don't understand what factors lead to behaviour change."*(Fogg, 2009, p. 1) It is presented as a framework for researchers and designers as a systematic way to think about what factors are involved in behaviour change.

The FBM consists of three dimensions – Motivation, Ability and Triggers, all with their own sub-sets of elements. Additionally, the article uses the phrase *Target Behaviour* to name the specific instance of behaviour change we are looking to achieve. The model also points out that you can, as a designer, also inhibit or prevent behaviours in the same way you can encourage them. This is done by looking at the same key points, but instead of adding to them, you detract and makes the behaviour more likely to fail.

Motivation

The first dimension, Motivation, is a representation of the amount of factors that influence how motivated the individual is in performing the target behaviour, and Fogg identifies three elements, or motivators.

- **Pleasure/Pain** – an axis described as "immediate" and "primitive"; people react to this motivator on a very basic level. Additionally, it is considered a very strong motivator. Therefore, use it with care (especially pain.)

- **Hope/Fear** – likewise, this motivator can either complement or overrule the Pleasure/Pain motivator (in the paper, this is exemplified by choosing pain, a flu shot, to alleviate the fear of getting sick.) Fogg considers this motivator to be the most ethical motivator.

- **Social Acceptance / Rejection** – this is related to the above, but this motivator speaks to our social instincts and not our more primal, immediately reactive "fight or flight" instincts. Fogg mentions Facebook and the advent of massive social media and social technologies as strong utilizers of this motivator to influence their users.

Ability

The second dimension, Ability, is how well the user is fit to handle the behaviour change or performing the targeted behaviour. Also dubbed simplicity, this dimension postulates that in order to achieve the target behaviour, the way the behaviour presents itself needs to be easy enough that the user can achieve it. As with the Motivation-dimension, Ability consists of several elements.

- **Time** – When a target behaviour requires more time than we have at hand, the ability to perform the behaviour is severely diminished.

- **Money** – A target behaviour that costs money is harder to attain for a person with little money than it is for an affluent person. Behaviours like "have more spare time" is attainable more easily for a rich person that can use money to pay others to do their chores etc. Fogg notes that when it comes to money and time, this varies widely from one person to another (due to age, income, gender, and other personal factors,) so knowing your targeted audience is key to understanding how these two factors can affect ability.

- **Physical Effort** – The more effort it takes to do the target behaviour, the less it is likely to succeed.

- **Brain Cycles** – When you need to think hard or concentrate for a targeted behaviour to take place, it might not be easy. This element also depends on the targeted audience.

- **Social Deviance** – or "Going against the norm", if a targeted behaviour requires the audience to break social code in some way, it might also be harder to achieve, i.e. never washing, although requiring little effort also carries a social stigma as a price.

- **Non-routine** – If you do something often, it is often easier and simpler than a behaviour that is not routine, even though other elements of simplicity would dictate the behaviour to be less simple.

When it comes to a person's ability, or the behaviour's simplicity, Fogg remarks that the person's *scarcest resource at the time a behaviour is triggered* is the key point and what the designers and researchers need to pay special attention to.

Triggers

The third dimension, Triggers, represents some method of prompt, nudge, or message stating that the time for doing the targeted behaviour is now.

> *"Computer systems often do a frustrating job of triggering behaviour."*
> (Fogg, 2009, p. 3)

There are three kinds of triggers.

The first trigger is called a "spark", and it is designed to operate together with the motivation – dimension, and is usually a communicative element that highlights or utilizes one of the three core motivators (hope/fear, pain/pleasure, social acceptance/ -rejection).

The second one is a "facilitator"; and is appropriate for when the person/ audience lacks ability, but is motivated. A facilitator can appear in the same way as a spark, but works on the Ability – elements above. For instance, a facilitator can draw attention to how easy a targeted behaviour can be attained, or that no extra resources (money, time) has to be spent in order for the targeted behaviour to initiate.

The third element is called "Signal", and is used when both the ability and the motivation falls above the Action Line (Fig. 5) and no further action is required for the behaviour to happen. A traffic light turning green or red exemplifies this: it does not try to motivate or make things easier; it just states that the appropriate behaviour now is to stop or drive.

It is important to be aware that, in according to the model, all three factors must be happening simultaneously and that Motivation and Ability must be above a certain threshold, called the *activation threshold* (Fogg, 2009, p. 3) or *the ability line* (Fogg, 2015), or else the trigger will fail. This is called *timing*, or *Kairos,* from the Greek word meaning "The right moment", in the paper. See the figure for how the FBM visualizes the relationship between the three factors and the targeted behaviour (Fig. 5).

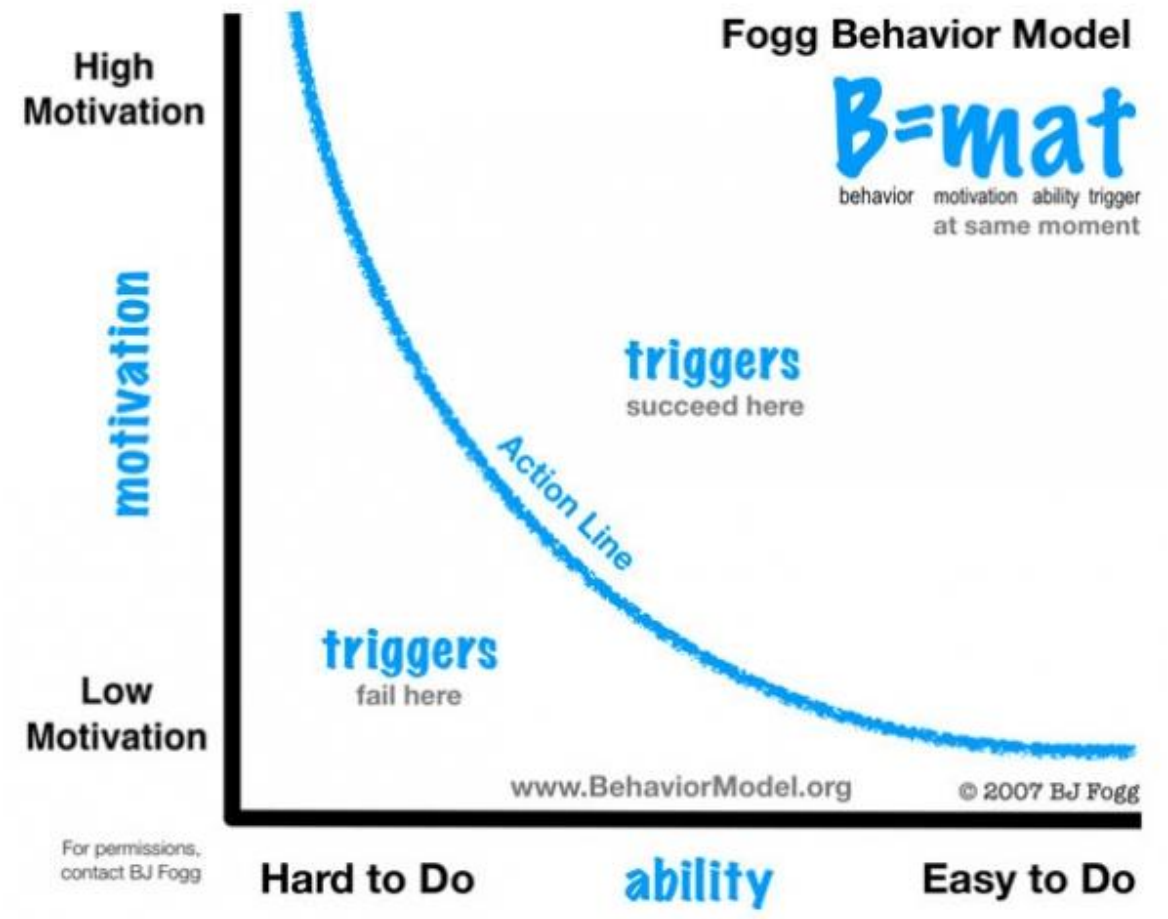

Fig. 5 The Fogg Behavior Model - (Fogg, 2015)

Fogg states that the advent of content-aware mobile phones enables opportunities for the coupling between triggers and behaviour to move from the PC world and into our daily lives, thus making the wearable device an important agent for providing triggers in an ever-widening set of target behaviour.

How to use the Behaviour Model:

As a designer or a researcher, we can use the framework to discover new ways of persuading users, in either a research or commercial setting. Secondly, we can look at existing designs systematically and see how they fail or succeed in promoting a target behaviour.

When creating new persuasive technologies, it also allows us to put our efforts into smaller areas that need the most attention by focusing on the core motivators or simplicity factors. It is also claimed to be a frame of reference within project or academic teams, to create a common vocabulary for thinking about persuasive technologies.

The combination of the above, and the way of thinking about persuasion in general, is what is called, in the paper, "looking through the FBM lens."

3.2.3 Big data as a support for the FBM

Looking at ITS mentioned above, I stated that telematics has moved from a provider-only to an open-data model. Telematics dictates a construction of information based on obtained data from the environment the sensors are embedded within, and if these data are being made openly available within open APIs, this information can be subject of big data analysis.

The concept of big data entails "data sets so large and complex that they become awkward to work with using standard statistical software" (Snijders, Matzat, & Reips, 2012). Datasets related to a journey obtained via telemetry can be combined with static data about the same journey, as is the case with the real-time system employed by Ruter in Oslo. This system is delivered on two API's – one with real time traffic information and one with deviance information. The real-time information is partially based on statistic travel times between stops, as well as current vehicle position (Ruter, 2016). This can be augmented by using telemetry data obtained from the location chips embedded in smartphones etc. Google Maps/Waze utilises such a function to generate predicted travel times on a route and also statically reported incidents (Google, 2016). These two solutions work differently: The Ruter system depends on pre-determined routes created by measuring distances and travel times, whereas the Google maps system depends on information generated by big data estimates, but also on data sourced via open data APIs for static datasets. The latter approach can generate better results since it can operate on more up-to-date data (this is sourced from telemetry), accounts for congestion via statistical models, and

it differentiates between peak and off-peak hours (Wang & Xu, 2011, pp. 202–203) (although this is also a trait that Ruter's travel plans exhibit). The main difference between the two, however, is that the Google solution is linked not only with travel telemetry, but with geolocation data of the user as well as pre-determined destinations like Home and Work, and this information allows that ITS-application to *predict* travel patterns, not only present them on demand.

Single commute or multimodal travel pattern?

Multimodality is defined as something that is "characterized by several different modes of activity or occurrence."[7] Within transport and travel theory, one definition of multimodal transport is carriage of goods (or persons) by at least two different modes of transport (*Convention on International Multimodal Transport of Goods*, 1980).

According to Wang & Xu, existing mapping solutions exhibit a good estimate with Origin-Destination (hereinafter abbreviated as O-D, previously mentioned as A→B) travel patterns (2011, p. 208), but as the well-known *traveling salesman problem* illustrates, adding route destinations increases the computational complexity quite drastically with each new node added (see Lawler, 1985). This implies that a travel system needs increasingly more resources the more destinations you add to your trip, and it becomes harder to have one single model to encompass all alternatives. It seems then, that predicted O-D travel patterns within an ITS system is well enough known, as is multimodal trips within an on-demand system, but predictive multimodal trips are still not, to my knowledge, existing in a working state. There seems to be some room still to evolve big data analysis for accurate predictions in multimodal transport.

3.3 Intelligent Transportation Systems

The modern travel planning systems rely on various inputs to generate and present the various suggested plans and warnings. An integral set of technologies that contribute to these inputs is Intelligent Transportation Systems (hereinafter abbreviated ITS). The term is evolved from the French term telematics (*telematiqué,* which is a portmanteau of *télécommunications* and *informatique* (Nora & Minc, 1978)), that made its appearance in the late 1970's and described

[7] http://www.oxforddictionaries.com/definition/english/multimode

technology that enabled the transport and processing of electronic information over telecommunications devices. One application of telematics is transport telematics, which is technology that enables the control and support of vehicular operation on transport routes. Finally, the particular applications that embody transport telematics are called Intelligent transport systems. Within the EU, a considerable standardization process for ITS technology has been conducted in the later years, and this has culminated in the 2010 directive on ITS deployment (European Council & European Parliament, 2010). In this directive, ITS is described as

> "… advanced applications which without embodying intelligence as such aim to provide innovative services relating to different modes of transport and traffic management, and enable various users to be better informed and make safer, more coordinated and 'smarter' use of transport networks."

They are thus not meant to be "intelligent" in the direct sense of the word, but rather to encompass large systems to better the everyday travel of all participants in the society (See Fig. 6). ITS technologies can then encompass every piece of technology from the smallest positional sensor in your car or mobile phone, to big data analysis clusters that make sense of this information in a particular context.

Fig. 6 Conceptual presentation of ITS (Evensen & Q-free, 2012).

3.3.1 Open data in ITS

ITS operate on various telemetric data obtained from sources operating within the transport system itself. This data is inherently exclusive to whatever source produced them, so making them readily available to all stakeholders is crucial for making applications that are useful across closed platforms. As mentioned in Chapter 2, electronic travel planning in Norway spurred the discussion about open data and has led to a shift in mentality and legislation when it comes to having access to registers. This notion is also mirrored in the recent EU directive on the deployment of ITS within the EU/ECC (European Council & European Parliament, 2010), where § 11 reads *"ITS should build on interoperable systems which are based on open and public standards and available on a non-discriminatory basis to all application and service suppliers and users."* This legislative move from provider-only datasets to a pre-determined focus on public availability enables a large number of new applications to come into existence. For the application area of travel planning, this means that data sets such as timetables should

be made publicly available by default from the transport providers, and any number of application creators can incorporate these data into their platform. This also resonates with the notion set forth in the Opticities – project mentioned above, where open data provides the link between the transport service provided by the legislative authorities, and the application and interface providers on the other hand. Up until recently, however, this data is *static* data based on premediated plans, and not data reflecting the real-time landscape of the service. ITS applications also include the notion of using real-time telematic data in their calculations.

3.4 How to discover ethical issues

> *"Simplifying tremendously, the theoretical variety that has unfolded over the long history ... can be represented in a table with two axes"* (Feenberg, 1999, p. 9).

Andrew Feenberg (1999) details a two-dimensional framework for classifying theoretical opinions on technology's role in society. One axis details the "role of human action in the technical sphere" and the other "the neutrality of technical means." This forms four quadrants for each of the extremes on the autonomy-vs-human controlled and the value-laden-vs-neutral axes.

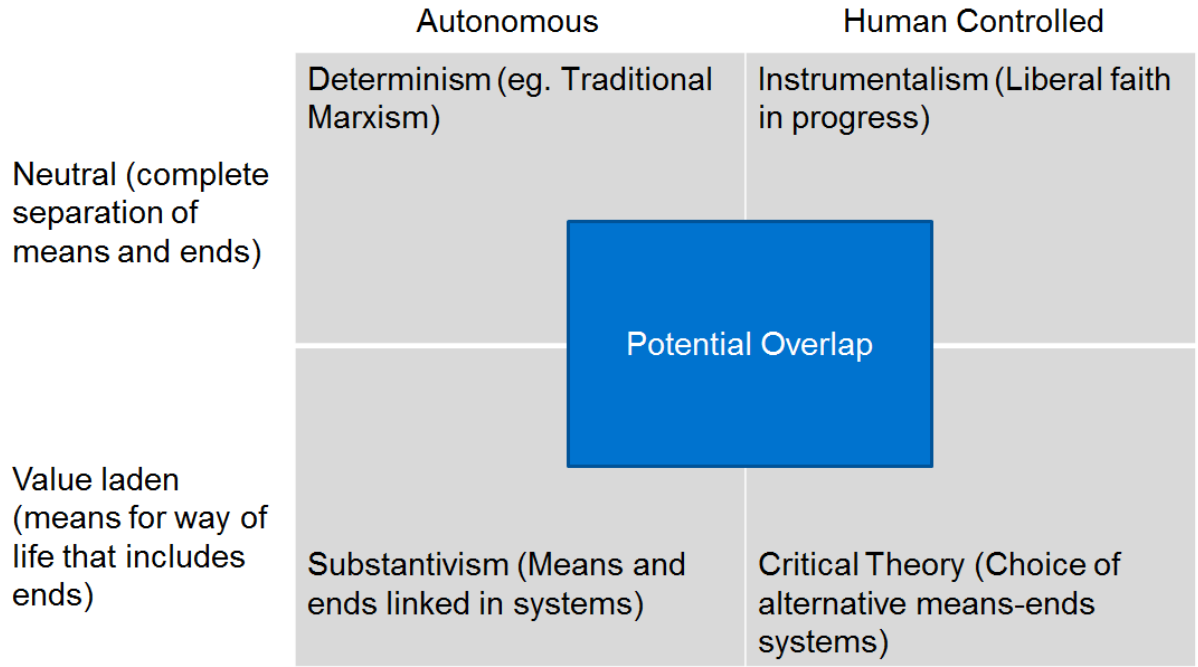

Fig. 7 Theories of Technology and Society (Feenberg, 1999)

These quadrants are then described as Determinism, Instrumentalism, Substantivism and Critical Theory, respectively. This matrix can be used to look into how technology acts on the human-world interactions, and depending on how you position issues in Big Data and Persuasive Technology can within this matrix, you might get different ethical issues.

- Determinism can be both social and technological determinism. It fits in the "neutral" and "autonomous" parts of Feenberg's framework. The common factor between the two opposing views is that they both view either society or technology as the driving factors in social change, and human agency is not included as having an effect on either systems (Quan-Haase, 2012, pp. 47–48).

- Instrumentalism, on the other hand, states that technology is still neutral, and it is only through the explicit actions of the user of the technology that any meaning can be attributed to the technology (Quan-Haase, 2012, p. 48).

- Substantivism theories argue that technology has its own embedded logic and goals, removed from human control, which it then uses to shape, create and control structures in society.

- Critical Theories argue that both technical and social factors shape technology, and it's only within the use-context that technology has meaning, but the technological artefact also shapes the context in which it is used. Context, human actors and technology is therefore entangled, but changing the context will also change the technology's mode of operation. Contrast this with determinism, which doesn't allow the technology to form the interaction or how the artefact is used.

3.4.1 Positioning technologies

Now that we have a way of thinking about theoretical approaches to the positioning of technology's role in society, I will to look into the various technologies that play a role in the project and if they present different ethical issues if we position ourselves within different quadrants. How we define technology is also useful, here I will use the definition that Anabel Quan-Haase (Quan-Haase, 2012, p. 7) for the discussions ahead, contrasting to other variants where needed:

> *"Technology is an assemblage of material objects, embodying and reflecting societal elements, such as knowledge, norms and attitudes that have been shaped and structured to serve social, political, cultural and existential purposes"*(Quan-Haase, 2012, p. 7).

Big data

Big Data is not the main point of this project, but the collection and analysis of certain user-provided data, is. This data includes all data and metadata that are collected from a user's mobile platforms and other applications related to travel, and temporal and geographical position ("Geolocation"). Big Data in itself is not really a technology according to the definition above, since it's not "an assemblage of material objects", but rather a method that allows for other kinds of use of existing data. It could be prudent to call it "technology as knowledge" (Quan-Haase, 2012, p. 3), although practice (Quan-Haase, 2012, p. 4) can also be used. I would rather call Big Data techniques a possible *augmentation* (Quan-Haase, 2012, p. 15) to human agency and function, since the main strength of Big Data is making sense of many small data points, most of which in this context are a product of human behaviour. And therein lies the core of Big Data: even though the term itself resembles a process more than a pure technology, the artefacts that feed the data into the big data algorithms will most definitely be technology, and thus they would seem to be the first thing to look into when positioning Big Data. Looking at Big Data then, as neutral, with or without human influence and agency, might seem natural. If Big Data is deterministic, it has no inherent ethics and no modes of controlling it. I would argue that there are at least human users that decide what the end product of Big Data analysis is, especially for this project, therefore I deny that notion. Is it instrumental? If we assume so, then the only ethics that apply to Big Data analysis are the ethics of the people conducting the analysis. They are otherwise free of its influence and can choose to ignore any tendencies the method has towards any particular interaction or results, because there are none. But when taking all the myriad data collecting platforms that have been designed to submit certain specific data points into the algorithms, such as time, position, speed etc., it would be hard to argue that these are also not subject to ethical bias introduced during the design phase. Since the data provided into Big Data is biased from the start, you will end up being forced into certain results and possible conclusions thereof, and therefore I argue that the technology is neither neutral nor totally autonomous. Hence, it is most valuable looking at Big Data / collection equipment through theories grounded in Critical Theory.

Persuasive technology

In the original article detailing persuasive computers, BJ Fogg (Fogg, 1998b, p. 229) devotes one of the perspectives of captology[8], and one of the seven "call-for-research"-directions to ethics.

In the perspective called "Ethics of Computers that Persuade," Fogg proposes a *front-loaded* (see van den Hoven, 2007) approach to ethical issues in captology and that they should be addressed at the very start of a development of a persuasive technology. (see also chapter 3.2.2.) In particular, four actions for scientists that study the effects of persuasive technology are relevant for the ethical discussion (Fogg, 1998b, p. 230):

1. Use the frameworks presented in the paper to identify persuasive technology, as well as what persuasive strategies that technology employs.

2. Researchers should look at the intended impact (effectiveness) and the unintended side effects of the persuasive technology.

3. You have an obligation to disclose your findings.

4. If you find a technology to be harmful or questionable, take or advocate social action

The last research direction mentioned in the paper is "G – Captology should be pursued with ethical issues and implications in mind" (Fogg, 1998b, p. 231). Because altering people's perceptions gives rise to ethical implications, the researchers and developers in the captology-field should be very aware of the ethical platforms they adhere to and implications that might arise from their technology.

> *"As with any other means of persuasion, one could compromise values and ethics intentionally or unintentionally. Therefore, those who study persuasive technologies should have a sound understanding of the ethical implications of this field"* (Fogg, 1998b, p. 231).

This idea of front-loading ethics resonates well with the "value-laden" – part of Feenberg's matrix, as well as the "human-controlled" part. Since captology is defined in such a way, it

[8] Captology is a portmanteau of the abbreviation "Computers As Persuasive Technology" with the added suffix – Ology.

makes sense to place this also under "Critical Theory," especially if compared with the arguments presented by Verbeek (2008).

3.4.2 Technological mediations

So far, I have argued that looking at these two technologies as non-neutral and human controlled seems most relevant, and although it is possible to choose another perspective, I will base my further arguments on that assumption.

In the article "Morality in Design: Design Ethics and the Morality of Technological Artifacts" Peter-Paul Verbeek (2008) expands on the notion of neutral technology, and argues that all artefacts act as mediators between humans and the world in some way. This mediation works on two levels: mediating experience by way of perception, and mediating praxis[9] by way of action (Verbeek, 2006, p. 368)

Experience	Praxis
Mediation of perception	Mediation of action
Technological intentionality	Script
Transformation of perception	Translation of action
Amplification and reduction	Invitation and inhibition
Delegation: deliberate inscription of scripts and intentionalities	
Multistability: context dependency of scripts and intentionalities	

Fig. 8 A Vocabulary for Technological Mediation (Verbeek, 2006)

The effect of this is that no technology or artefacts of technology can be seen as truly neutral. Although Verbeek states that "in ethical theory, to qualify as a moral agent at least requires the possession of *intentionality* and some degree of *freedom*" (Verbeek, 2008, p. 93), and it would seem that artefacts don't possess either, the argument is that their role as mediators alters the way humans act. And, since "ethics is about the moral question of how to act" (Verbeek, 2006,

[9] "Practice, as distinguished from theory" – from Oxford Dictionary

p. 368), mediating actions will imbue the artefact with traces of both intentionality and freedom within the relationship between user, world and technology (see Verbeek, 2008, pp. 92–98).

3.4.3 A framework for front-loading ethics

Now that I have provided an argument for why technology is not neutral and is dependent on human action, what does that entail? As a designer of technologies and technological artefacts, you have to be aware that whatever you design might have the ability to alter the possible perceptions and actions that is available to humans. You will therefore have to have some kind of knowledge about analysing and imagination for understanding any ethical issues that might result from the future use (Verbeek, 2008, p. 100). This approach is part of what is described by Hoven (2007) as the *Front-loading* of ethics; the designer needs to begin a reflexive discussion about ethical implications early in the design project.

Verbeek (2006) presents a method for this way of front-loading called *mediation analysis* as a way of "doing ethics by other means." This analysis is meant to aid the designer during the moral assessment of their project. The mediation analysis can be carried out in two ways:

The first, and simplest, method is referred to as just a prediction by means of the imagination of the designer (Verbeek, 2006, p. 372). This means that the designer tries, to the best of their ability, to anticipate and assess any mediations that the technology will enable, and if there are any ethical issues that can arise from those mediations.

Additionally, a second method of doing mediation analysis is called Augmented Constructive Technology Assessment (ACTA) (Verbeek, 2006, p. 375), but that's beyond the scope of this essay to carry out. Essentially, it is a systematic, democratic method involving a *nexus* containing the designer's anticipation of the mediations of the design, assessed by various users, regulators, pressure groups etc. until a consensus is made. It should be noted that using design methodologies such as Participatory Design (see J. Simonsen & Robertson, 2013) can also contribute to a democratisation of design mediations, particularly if techniques for eliciting users' values are utilised during the design (Halloran, Hornecker, Stringer, Harris, & Fitzpatrick, 2009). If service design thinking is applied with a participatory mind-set, this design methodology can also be utilized to discover mediations and thus ethical "touch-points."

3.4.4 Handling behaviour-steering technologies

When you front-load mediations into your design, you are essentially building technologies which are designed to steer behaviours due to the fact that some actions and perceptions are already being handled. Verbeek claims that only ACTA-approaches can deter the notion of technocratic technology (Verbeek, 2006, p. 378) and that designers are not equipped to handle such decisions alone (Verbeek, 2008, p. 102) This does not, however, invalidate the need for advance handling of such issues, and although doing a democratic design process would alleviate many concerns, an imaginative prediction is better than no mediation analysis at all.

4 Methodology

This chapter provides an overview on the epistemology of the study. I will first present a general overview on current theories and practices on how to elicit knowledge in Information System research, as well as rationale for positioning the researcher and the choice of methodology. The main focus will be on creating an argument for why the information gained through the research methods are valid, by giving a thorough account on how knowledge is created within qualitative research. When using qualitative methods to gain knowledge about a subject or a phenomenon, it is important to have a systematic methodology and analysis to build your argument upon, lest the carefully constructed data might not be believed to be real (Crang & Cook, 2007, pp. 14–15,131). The second part of the chapter is dedicated to which of the theories mentioned are applicable for this study and why, and also to give a detailed account on how these theories are applied throughout the research process, as well as what methods are currently being used to represent the user in transport research today.

4.1 Research Methodology overview

To understand how the empirical material in this thesis has been gathered, it's necessary to know the landscape of qualitative inquiries, as well as how empirical data is gathered within transport research today.

4.1.1 Epistemology, paradigms and methods

Historically, in natural sciences and the humanities, there have been two over-arching methodologies of gaining knowledge of the world: quantitative and qualitative research methods. These two directions differ mostly in how they make sense of the world: Quantitative research and its methods (randomized trials, experiments, mathematical modelling, etc.) was developed in the natural sciences to study natural phenomena. Qualitative research, on the other hand, was developed in the social sciences to research and study cultural phenomena, and consists of several methods like ethnography, case study research and action research (Myers, 1997). These differ mostly in their philosophical outlook, or their relative combination of epistemology/ontology. Crotty (1998) argues that ontology and epistemology emerges in tandem and normally does not require separate discussion, so this presentation will not include ontology as a major theme.

Both Myers (1997) and Crotty (1998) presents the following three *philosophical perspectives* or *paradigms* on research, and these embody different epistemologies. Note that Crotty includes a few more, but the three mentioned are most relevant for information systems research, according to Myers (1997), who also does not include epistemologies in his discussion and focuses directly on the research paradigms.

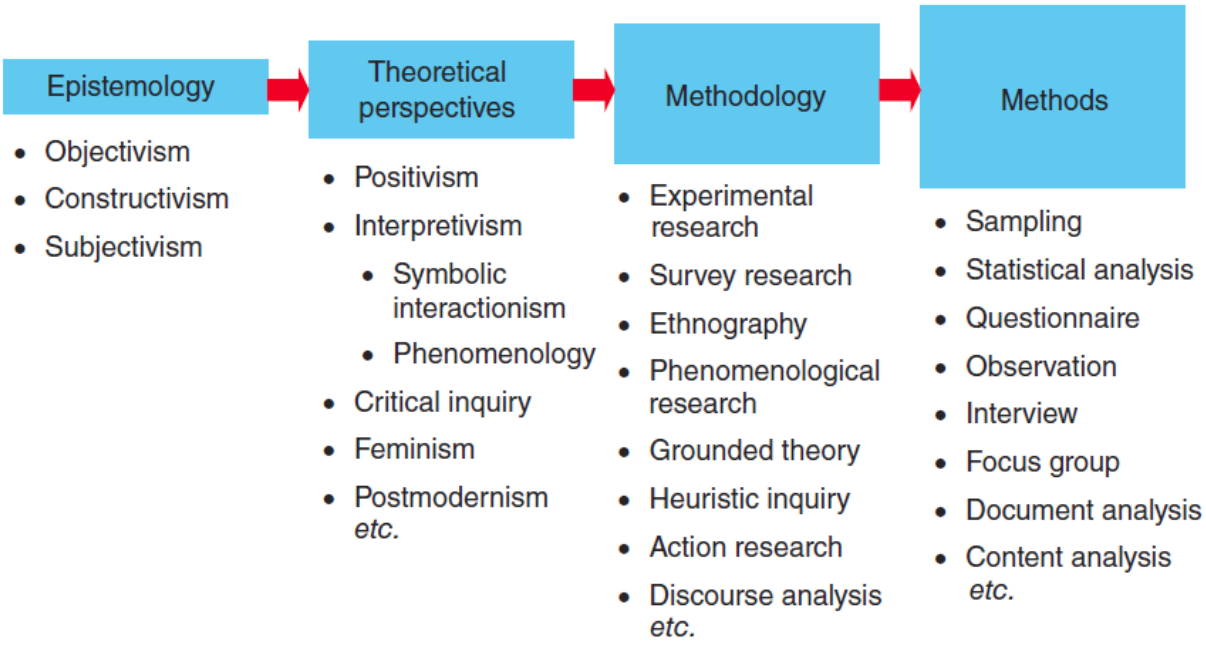

Fig. 9 Relationship between epistemology, theoretical perspectives, methodology and research methods (Crotty, adapted by Gray, 2013)

The first perspective, *Positivist research*, rely on the notion that reality is objectively given with describable properties, and that it's up to the researcher to uncover these properties through carefully controlled methods. The positivist researcher generalises knowledge to other areas based om empirical evidencing. Positivism is closely related to an objectivist epistemology (Gray, 2013, p. 20). The other two paradigms mentioned are *Interpretative* and *Critical research*. Both of these paradigms can be generalized as *non-positivist* because they share ontologies, although their epistemology differs somewhat. The Interpretative paradigm assumes that "[…] access to reality (given or socially constructed) is only through social constructions such as language, consciousness and shared meanings." (Myers, 1997) This implies that any meaningful reality is only possible to understand by first understanding the people that are connected to that reality and the phenomena they experience and the meaning they imprint on these. Myers

states that within information system research, the goal is to understand the context of the information system and how the system and context have a mutual influence on each other. This mutual relationship manifests itself in different ways within different schools of studies on how technology and society intermingle. It is described as "interpretive flexibility" in Social Construction of Technology (SCOT) (Quan-Haase, 2012, p. 52), where an artefacts meaning only emerges in a socio-cultural context. Also, within more general Science-Technology Studies (STS), this relationship is described as "mutual shaping", where *"technology and society are both seen as forces that together influence and shape each other."* (Quan-Haase, 2012, pp. 63–64) Interpretivism is constructivist in its epistemology (Gray, 2013, p. 23).

Compare and contrast this with the third paradigm, Critical Research. This paradigm upholds that the reality in which social interactions occur is only accessible through social constructs imposed and enforced through historical inequality and power relations. The term critical is thus meant to lead "critique" and tries to uncover sources of conflict and contradictions in society in order to have an emancipatory effect on the people participating in these structures.

This study and its author tries to take an interpretative route, because I believe that within a socio-technological setting, evidence-based paradigms such as positivism and the objectivist epistemology does not fully address the intricacies of human-computer interaction. I cannot claim to be fully constructivist in my epistemology, however, and in the discussion about habits and their basic neurological origin, I claim a positivist approach. Mainly, however, I will apply a constructivist epistemology when it comes to describing the experiences and needs of the users. If we assume that the epistemological origins are baked into the philosophical perspectives, Myers (1997) explains the three-tiered approach as one of detail: At the top, you have the paradigms described in the earlier section, and these function as a way of positioning the researcher and what the researcher believes constitutes "valid research." This is crucial in determining both how the researcher handles his or her biases and assumptions, but also in how the research is communicated and received throughout the science community. Implicitly (via chosen methods or terminologies) or explicitly stated philosophical perspectives relay to the reader how to interpret and make sense of the data presented in the study. Below this basis of paradigms lies a selection of methods. However, I will refer to these as "methodologies" throughout to avoid confusion, because the word "method" is also commonly used within design terminology, and has varying meanings (see Löwgren & Stolterman, 2004, Chapter 4; J. Simonsen & Robertson, 2013, Chapter 6). Additionally, the four-tiered approach that puts epistemology as

a foundation presented by Crotty (in Gray, 2013, p. 19) consists of *Epistemology – Theoretical Perspectives – Methodology and Methods,* and I will choose this set of terminology to avoid confusion. A methodology in this context is *"...a strategy of inquiry which moves from the underlying philosophical assumptions to research design and data collection"* and *"[...] influences the way in which the researcher collects data."* (Myers, 1997) The methodologies as presented by Myers are Action Research (AR), Case Study research, Ethnography and Grounded Theory (GT).

Action research *"... aims to contribute both to the practical concerns of people in an immediate problematic situation and to the goals of social science by joint collaboration within a mutually acceptable ethical framework"* (Rapoport, 1970, p. 499, in Myers, 1997). This means that action research tries to both contribute to the furthering of theories and knowledge within the social sciences, as well as to the immediate concerns of a group of people. This approach shares a lot in common with Participatory Design, although the latter is a design paradigm, whereas the former is a research methodology. Action Research is arguably best suited in the Critical paradigm due to its focus on issues and power relations.

Case Study research is defined as an inquiry that *"investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident"* (Yin (2002), in Myers, 1997). The methodology is a choice of what the researcher should study, and Stake (2005) notes that a case is a *"specific, bound system."* Case studies collect data and information about what is important from within its own boundaries. Case studies can be intrinsic, where the point is to look at the case itself, isolated from other cases, or it can be Instrumental, where you examine a case because you want to understand another issue (Stake, 2005). Case studies are thus mostly useful when you have one or more well defined problem(s) or research area(s), or a phenomenon that can be explained through these cases.

Ethnography is a discipline that originates in the field of anthropology, and the point is to immerse the researcher into the life and context of the people he or she studies. One of the main principles of ethnography is thus to investigate the phenomena *in* situ, or in the natural setting of the informers (Crang & Cook, 2007, p. 7; Myers, 1997). Ethnography is reliant on co-construction in its epistemology and is a good example of an interpretative methodology. Ethnography in information systems can help in uncovering "invisible work" (Star, 1999) that is

otherwise not available to the researcher. Ethnography seeks to include as many informants as possible (Gray, 2013, p. 25).

Grounded Theory is an analytical methodology that aims to generate a theory about the studied phenomena, that is grounded in the systematically gathered data (Myers, 1997) Grounded theory allows for a broad investigation into people's attitudes and experiences (White & Weatherall, 2000, p. 374). Kathy Charmaz (2005, p. 508) notes that the methodology allows the researcher to gain close access to the problem or research areas without distancing themselves later on in the process. The data collection and analysis occurs simultaneously so that they can inform and focus each other throughout the research process. This means that analysis should occur early to influence and guide further data gathering sessions. In the book "Qualitative Analysis for Social Scientists, Anselm L. Strauss presents ten main elements for conducting grounded theory (Strauss, 1987, p. 23):

1. The Concept-Indicator model which directs the coding
2. Data Collection
3. Coding
4. Core Categories
5. Theoretical Sampling
6. Comparisons
7. Theoretical Saturation
8. Integration of the Theory
9. Theoretical Memos
10. Theoretical Sorting

The concept-indicator model is a model that directs the *conceptual* coding of a set of *empirical indicators*, (Strauss, 1987, p. 25), and this means that when coding the data, the researcher

examine the indicators (who are behavioural actions or events) comparatively, so that similarities, differences and meaning can be confronted. This relies heavily on data gathering, from all matter of sources and as mentioned above, is an iterative process as described in Fig. 10.

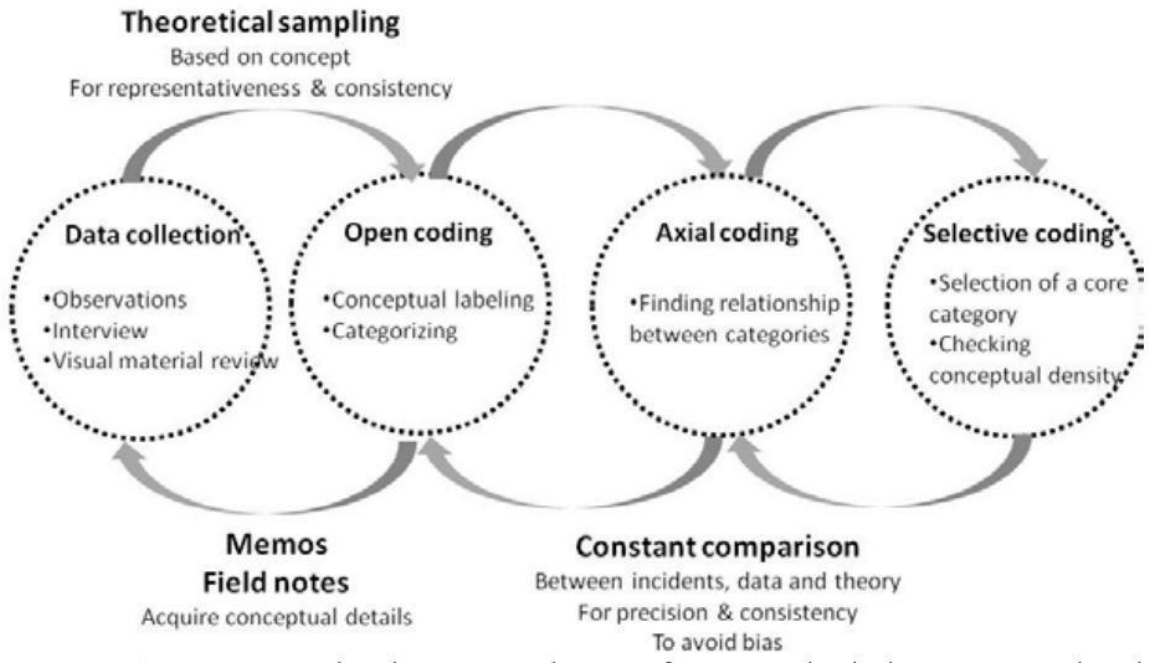

Fig. 10 Data analysis procedures within GT (Cho & Lee, 2014)

Grounded theory relies on coding to interpret its data. Strauss calls this the general term for conceptualizing data (Strauss, 1987, p. 20) and is defined by four paradigms that helps the researcher code the data that is most important in a qualitative setting: conditions, interaction among the actors, strategies and tactics, and consequences (Strauss, 1987, pp. 27–28). The first wave of coding happens when the researcher goes through the data initially and assigns tentative codes to the different terms and themes that appear. Once the open coding is beginning to solidify, you can move on to axial coding: generate relationships between the open codes so that patterns can emerge (Strauss, 1987, p. 21). When these relationships emerge, a theoretical memo should be produced to capture the essence of the relationship. From this point, you can go out and gather more data and begin the process anew to further refine the patterns and relationships. Grounded theory as presented by Strauss and later Strauss & Corbin (Strauss, 1987; Strauss & Corbin, 1990) is thought to be constructivist (Mills, Bonner, & Francis, 2008, p. 27), and in the context of this study it would then also be categorized as interpretive. In addition to these four that Myers mentions, Gray mentions another methodology: phenomenological re-

search (Gray, 2013, pp. 19, 24–25). It resides under phenomenology as a theoretical perspective, which is itself a form of interpretivism, and are not to be confused with one another because one is a methodology and the other a paradigm (See Fig. 9). Phenomenological research *"…holds that any attempt to understand social reality has to be grounded in people's experiences of that social reality"* (Gray, 2013, p. 24). This methodology tries to obtain the subjective experience of the informant, and care has to be made to diminish the researcher's prejudices in order to not bias the data. Phenomenological research differs from ethnography in that it focuses more on individuals and interpretations thereof, rather than the focus on "sites" and groups in a phenomenological context. Ethnography is also mostly based upon participant observation, while phenomenological research derives most of its data from interviews (Tesch (1994), in Gray, 2013, pp. 24–25).

Ethnography	Phenomenological research
Study of culture	Study of the 'lifeworld' human experience
Discovering the relationship between culture and behaviour	Exploring the personal construction of the individual's world
Studying 'sites'	Studying individuals
As many informants as possible	Between 5 and 15 'participants'
Use of observation, and some interviewing	Use of in-depth, unstructured interviews
Unit of analysis: event	Unit of analysis: meaning unit
Reliability: triangulation	Reliability: confirmation by participants

Fig. 11 Distinctions between phenomenological research and ethnography (Gray, 2013, p. 25)

The Thick description

In his essay "Thick Description: Toward an Interpretive Theory of Culture" (1973) Clifford Geertz proposes that there is no single theory that can explain everything, and least of all everything human (Geertz, 1973, p. 1), and he goes on to argue that within ethnography in particular, it is not the collection of methods and techniques that define what ethnography is. He "borrows" the phrase "thick description" from the philosopher Gilbert Ryle (Geertz, 1973, p. 2) and uses it to point out that any analysis of a phenomenon is only made possible through recording as much information about it and its circumstances as possible – even if it seems irrelevant at the time. This means that data that seems clear to the researcher might have causes that, due to the researchers own experiences and biases, are recorded and interpreted incorrectly.

This also means that having in-depth knowledge gained from single subjects can be valuable on its own; a notion that will resonate with the ideas set forth when discussing phenomenology.

Methods in qualitative research

In qualitative research, there are a lot of methods or techniques that can be applied to the various methodologies. Some methods lend themselves better to some methodologies, but more often than not, you are free to choose your methods freely. The goal of any given technique is to gain some "empirical materials" or data. Myers (1997) lists a few techniques: interviews, observation (participant or passive), and Gray (2013) lists a few more: Document analysis, questionnaires, focus groups, diaries etc. The researcher's choice of methodology can be viewed as a recipe, and the methods as ingredients. This means that when you choose a methodology, within a theoretical perspective, you also give some direction to how the methods are applied and interpreted.

Validity in qualitative research?

In positivistic research, the aim is to describe a real world that is separate from the researcher and its tools, and this in turn relies on carefully designed experiments that seeks to generalize knowledge about the subject. In qualitative research within the interpretative paradigm[10], however, the researcher seeks to produce *inter-subjective truths* (Crang & Cook, 2007, p. 14), and these neither are, nor should be, generalizable to a larger population but rather be gauged on their own terms. To be able to make this claim, it is important to try to adhere to three concepts (Crang & Cook, 2007, pp. 14–15):

- **Theoretical sampling**[11]: Engage with subjects that are involved in living through the research problem, to let them enlighten the researcher from various perspectives. This rather than random sampling from a population.

[10] Note that this is mentioned as a part of a discourse within ethnography in particular

[11] See Fig. 10 for an example of Theoretical sampling in Grounded Theory

- **Theoretical saturation:** At a point, you will begin to hear the same stories and tales being repeated. Within a group, there is a limited set of discourses that will be available to explain certain events, and once these are exhausted, theoretical saturation is reached.

- **Theoretical adequacy:** If possible, try to get other researchers' views on similar topics in order to understand not only your own interpretations, but also what has been done within the same context.

The researcher's reflexivity on his or her personal biases are important in any qualitative research, as noted in Dowling (2008): *"researchers are required to ask questions of their methodological decision making and are encouraged to think about epistemological decisions regarding the research and its findings,"* and *"It requires consideration and examination of decisions made at each stage of the research process, and the extent to which such examination is adopted depends on the methodology adopted."* In the data-collection and analysis phase, the researcher will influence the data, starting with how the research questions are stated, and then through how the interview is conducted, then how the focus is when transcribing, and lastly, how it is coded and categorized. The data is never "raw", as stated in Crang & Crook (2007, pp. 132–133) and the analysis and ordering happens in many stages in the research process.

4.1.2 Commonly used methods in transport research

In current transport research, there are already a few methods that are being used. The largest publication in Norway on travel routines and habits is the quadrennial "Nasjonal Reisevaneundersøkelse" (Hjorthol et al., 2014). The methods employed in this survey are a travel diary, as well as a manually conducted structured interview/ questionnaire based on the diary. This is designed to reveal both statistical and descriptive data, and thus is by design both quantitative and qualitative at the same time. Stangeby (2000) however, raises questions as to how effective the choice of methods really is, and that the chosen methods only addresses and uncovers attitudes and justifications to a limited degree (Stangeby, 2000, p. 16). Additionally, she points out that the interactions between respondent and researcher is limited, (Stangeby, 2000, p. 19) and when you combine this critique with the discussion above on theoretical perspectives, I will argue that much empirical material is wasted due to the lack of opportunities for creating the "thick description" mentioned previously.

Another common method in transport research, is cluster analysis of quantitative data obtained via questionnaires or similar (see Julsrud, 2012 et al.) This data can then even be made to generate *Personas,* a statistical representation of a group or individual that is used to represent the "real" users (Pruitt & Grudin, 2003; Weinstein, 1998).

The goal of this and other methods for gathering quantitative data is to say something about *what is right now* in terms of demographic and other statistical data, this in turn to influence or advice legislators and other stakeholders on how to allocate resources. However, as mentioned above, these methods might not be adequate for getting to know *how this came to be* or even *why*.

Within the *Underveis* – project, *focus groups* were also conducted, mostly as a way of responding to application designs and ideas, but also to elicit information about the users' preferences regarding public transport (Julsrud, Denstadli, Herstad, et al., 2014, p. 17).

This is not to say that the realm of transport research is devoid of good accounts on why people behave the way they do, but it is my emergent understanding that it could be improved.

4.2 Applied methods

The last section presented an analysis on the landscape of qualitative research, why it's needed and a few of the theories regarding how to conduct qualitative research, and how to position the researcher. This section is dedicated to stating how these theories are put into practice within the context of this study. I employ the service design mind-set as a guiding principle, use interview as the main data-gathering method, and analyse the data using coding paradigms from grounded theory.

4.2.1 Implementing Service Design Thinking

Service design focuses extensively on collaborating with the users of any service that is being designed. Because of this mind-set, interacting with the user is required, and this in turn relies on qualitative research to succeed. Service design feels like a natural choice in this setting, because of the similarities between service design methodology and the realm of personal transport: Both use "journey" as a metaphor, and consist of a multitude of actors with differing responsibilities and goals that interact to provide a service to a user. This means that the design

process takes place of the normal qualitative methodology in how the researcher interacts and gathers data from the informants. However, having chosen to employ the paradigm from phenomenology that enables the researcher to investigate few but "thickly described" informants, this hybrid approach is not true service design. For a project to be true service design, it also needs to include the inputs from all the stakeholders, this is beyond the scope of this study. Neither is this study a true design task, but rather a research study that aims to gain understanding about users' preferences and how technology can support these. In this hybridization, the only real applied aspects of service design are the way the user is made important, and the common language of the "customer journey." This is, in a way, service design "thinking" on a different area, because the study acknowledges the advantages with the service design methodology, but acknowledges that the study only represents a part of a true service design process. In the interview sessions, I incorporated a "customer journey mapping game" to create a visualisation of the travel pattern, to aid in both my and the informants understanding of the touchpoints involved in the journey. This might be a good way to engage the co-creation of ideas via design games (Brandt, 2006) and can help to evolve the common language game, (Brandt, 2007, pp. 184–185) in addition to being a preferred way of doing service design (Stickdorn & Schneider, 2010, pp. 128–131,158–159).

4.2.2 Conducting literature review

To gain insights and directions into this field, I have been in contact with one senior researcher at Transportøkonomisk Institutt, Tom Erik Julsrud, who is the main author of the "Underveis" project. In addition, I have been in contact with Torbjørn Barslett, System manager in Norwegian public transport provider, Ruter. These two have provided directions, comments and suggested readings to help build the theoretical framework for this thesis. More theory has been obtained by following the trail of cited literature using the university library online catalogue and open access systems.

One challenge I encountered by using one contact rooted in the research community and one contact from the scientific community, was that their approach to my inquiries differed because of their different priorities. During the process, I have focused most on the information provided from TØI, and the focus and scoping of the thesis has been influenced by the material that has been acquired in those sessions.

4.2.3 The Informants

My initial hunch was that you could most easily find and investigate travel patterns within families that have one or more small children, preferably in kindergarten. I myself am in that very same situation, so extrapolating my own experiences seemed to be a good starting point. I began by contacting the administration in a nearby kindergarten, because connecting with a group requires some kind of access through what is called a gatekeeper (Crang & Cook, 2007, p. 21). Being in a position of power, not only as a person in whom the parents in the kindergarten would hopefully trust, but also the person that has final say over how the collected contact information to the parents could be used, presenting my topic of interest to the administrative leader was the first step. I asked if they could forward my call for participants within a single department in the kindergarten, and to forward any contact information to the ones that had consented to participate to me. I then sent everyone an introductory letter, a consent form and the link to the preliminary survey[12]. The results from the survey became the basis for who was invited to the second round consisting of a face-to-face interview. The reasoning to not include the entire group in the interview phase was mainly because of capacity constraints. However, Flyvbjerg (2006) reasons, in the chapter about sample and selection in case studies, that you can select cases based on expected outcome, (Flyvbjerg, 2006, p. 230) and the possibilities of defining one or several "extreme" cases would still shed light on real needs and requirements. On top of that, when conducting the interviews, I hoped to find a case that could work as a critical case to inform me on how the habit models applied to their case. Finally, sampling from the target users is in accordance with theoretical sampling, mentioned above.

From the fifteen people contacted in the second round, however, only two respondents were able and willing to participate in the round of interviews, of which only one met to the appointed interview session. One additional participant was sourced through the co-workers of an acquaintance, for a total of two participants, both two degrees removed from the researcher. Keeping with the nature of phenomenological research, however, where the experiences of the individual are given importance, I argue that even with only two informants, the interviews still yielded valuable information about the topic of interest.

[12] See Appendix 2

4.2.4 Interviews

Interviews are one of the primary methods through which a researcher can gain a rich understanding of an informer's context. It allows the informant and the researcher to "construct intersubjective understandings" (Crang & Cook, 2007, p. 60). The purpose of the interview is to gain understanding about the needs and wants that lies behind the choices the informants have made regarding how they choose transportation modes on a day-to-day basis. The interview guide was designed to be semi-structured, because there were some questions that were grounded in the research questions, but also allowed room to branch off into more descriptive stories and also other topics altogether[13].

The interviews took place in an informal setting where the informants could feel comfortable and that would encourage free flow of speaking. Since the goal of this data collection was *not* to observe or to gain *in situ*- knowledge about the informants, a comfortable setting for both the interviewer and the interviewee was preferred over a natural setting. This setting was different for each participant. A recording device was used to gather the conversation, for a number of reasons (Crang & Cook, 2007, p. 81):

- Scribbling down notes during the conversation would possible be very disrupting the flow of the conversation.
- The researcher's memory of the nuances would quickly fade before the transcribing session was done.
- To avoid mental exhaustion during the interview.

The interviews lasted for about 35 minutes each. When done, the interviews were then transcribed mostly verbatim, with some clean-up done regarding pauses and stutters, but with transcription notes detailing emotions and body language where applicable.

4.2.5 Coding

Since the aim of the interviews were to gain some understanding of practices, feelings and needs that enabled the informants' travel patterns, it made sense to try and categorize that information

[13] See Appendix 1

via a set of codes. This method is borrowed from grounded theory and is used as suggested by Crang & Cook (2007, p. 134), as well as the iterative way of going through the data (Fig. 10). The transcribed interviews were first coded openly using constructed codes based on the subjective interpretation of the meanings, then coded axially within a single interview to categorize topics. The same codes were used throughout the interviews, and when a new topic or theme emerged in one, the other interview were revisited using the newly emerged codes. When strong topics or recurring themes were appearing, I wrote code memos to sort the topics for use in findings. Theoretical saturation was only used within the interviews themselves and only partially across the group of informants to highlight themes or issues that only emerged in one informant's description or that were common to all. However, this reflects the application of coding as a method, and not as a part of the Grounded Theory methodology: I disregarded the more particular levels of analysis like diagrams and conditional/consequences matrices (Mills et al., 2008, p. 30), didn't have the ambition to create a theory from the data, and focused more on the narrative in the data.

5 Findings

In this chapter, I will present the results from the interviews/workshop sessions and discuss how they were analysed. Since Research Question 1 revolves around needs and requirements, these will be the main theme in this chapter. To make sense of the data I have employed a coding paradigm borrowed from Grounded Theory to discover themes. These themes will be paired with a generated persona made from an archetype based on the individual informants, in order to gain as thick a description as possible of the context and the real life experienced by the informants. Some themes were common across the informants, but having a markedly different life situation, some themes were quite individual. Naturally, the parts of the interview that relates directly to RQ1 were the ones most closely focused on during the analysis, but other topics emerged that were directly related to other research questions and themes explored therein, such as the informants' views on privacy, and how this relates to the ethical analysis. (See chapter 3.4 on mediation analysis.)

5.1 Analysing field materials

It bears reiterating that according to Crang & Cook (2007, pp. 132–133), the analysis and ordering of data begins even as early as when the research questions are focused and refocused. Going into a data-gathering session, the researcher has already made some assumptions on what kind of information he is likely to discover, and this even serves as a basis for the theoretical sampling mentioned in chapter 4. The way questions are phrased and even how you transcribe your recordings will influence what data bleeds through to the later stages of analysis, and a skeleton of themes might emerge so early as to set you off on a chase for confirmation of those themes. As Myers puts it: "*from a hermeneutic perspective it is assumed that the researcher's presuppositions affect the gathering of the data - the questions posed to informants largely determine what you are going to find out*" (Myers, 1997). The audio from the interviews was transcribed in a way so that the meaning of the discussion got across, while some of the inflections, pauses and hesitations were discarded to create a better flowing text. The transcribed material was then coded iteratively, going between the two sources and re-doing the open coding when new themes emerged in one of the sources. As seen below, the open codes were then axially coded into groups of thematically similar codes.

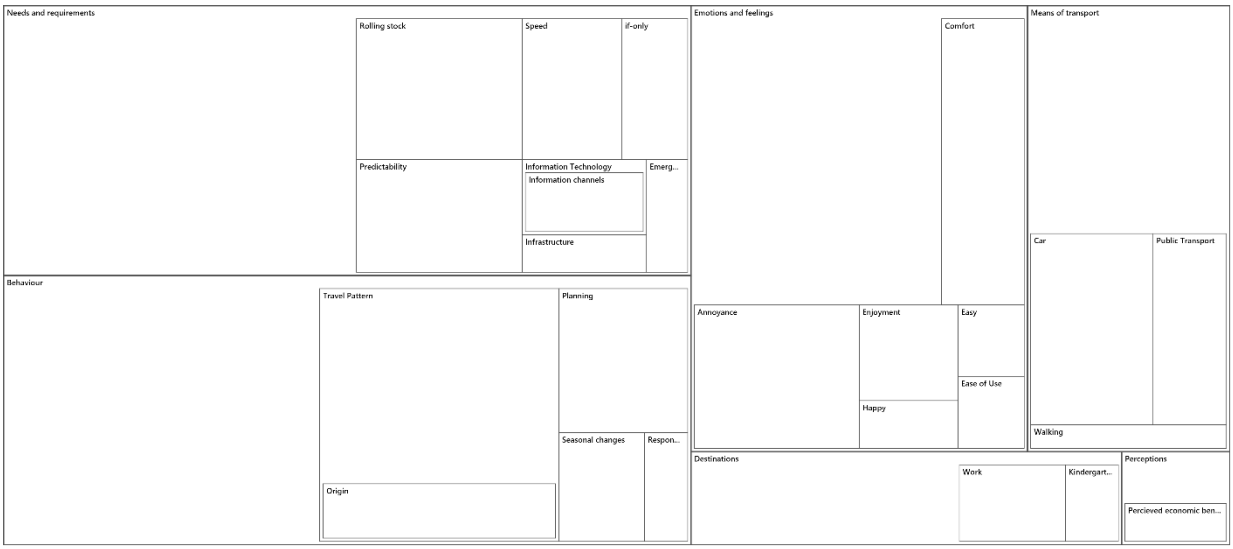

Fig. 12 Hierarchal Tree Map of Coding references, by frequency, Informant A “Kari”

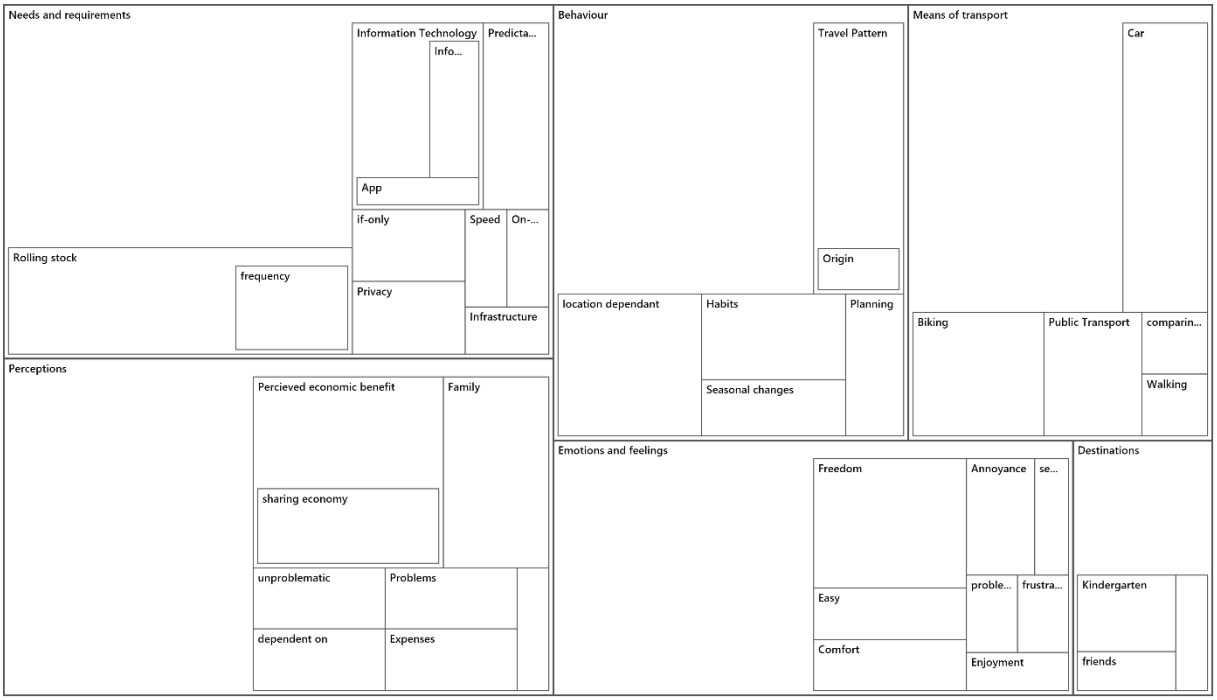

Fig. 13 Hierarchal Tree Map of Coding references, by frequency, Informant B “Ola”

	A : Subject A	B : Subject B
1 : Behaviour	17	16
2 : Habits	0	3
3 : location dependant	0	5
4 : Planning	4	2
5 : Responsibility	1	0
6 : Seasonal changes	2	2
7 : Travel Pattern	10	5
8 : Origin	3	1
9 : Destinations	4	4
10 : friends	0	1
11 : Kindergarten	1	2
12 : Other locations	0	1
13 : Work	2	0
14 : Emotions and feelings	12	12
15 : Annoyance	5	2
16 : Comfort	5	2
17 : Ease of Use	1	0
18 : Easy	1	2
19 : Enjoyment	2	1
20 : Freedom	0	5
21 : frustration	0	1
22 : Happy	1	0
23 : problem-free	0	1
24 : serenity	0	1
25 : Means of transport	9	15
26 : Biking	0	4
27 : Car	5	6
28 : comparing to	0	1
29 : Public Transport	3	3
30 : Walking	1	1
31 : Needs and requirements	11	13
32 : Emergencies	1	0
33 : if-only	2	2
34 : Information Technology	0	3
35 : App	0	1
36 : Information channels	2	2
37 : Infrastructure	1	1
38 : On-time	0	1
39 : Predictability	4	3
40 : Privacy	0	2
41 : Rolling stock	5	6
42 : frequency	0	3
43 : Speed	3	1
44 : Perceptions	1	17
45 : cost-benefit	0	1
46 : dependent on	0	2
47 : Expenses	0	2
48 : Family	0	5
49 : Percieved economic benefit	1	4
50 : sharing economy	0	4
51 : Problems	0	2
52 : unproblematic	0	2

Fig. 14 Table of codes, coded per informant

The most important part of this coding process, however, was the notes that emerged from the coding process. Combining the coding as a process with the interview data together with the recollection of the conversation provided more insight into the routines, needs and thoughts of the informants than the coding alone seemed to do. The overview of codes used, seen in Fig. 12 and Fig. 13, shows that out of the two interviews, codes belonging to needs and requirements make up the largest group, then emotions and feelings, followed by behaviour. The two first are concerned mostly with subjective perspectives regarding one's own situation and experience, while the third is part matter-of-factly, and part reflections on own actions from the informant. Although these three make up most of the codes used, they do not tell the entire story on their own, and the themes the codes suggest are not necessarily identical across informants.

5.1.1 From codes to needs

The goal of the qualitative inquiry was to elicit and discover complex travel patterns, the modes of transportation involved in these and the underlying causes for both the patterns and the preferred choice of transport. Of all the themes related to needs and origins, a few stood out:

- The perceived need for **predictability**: During the interviews, one of the informants expressed that their daily life depended on their mode of transportation to be predictable, both as a function of making ends meet, but also in the event of an emergency. The lack of predictability in a transport situation was linked to feelings of frustration and anger.

- Closely related to predictability was **speed**: Due to the closing and opening times of the kindergarten, and the fact that at least one of the parents in the family had early, non-flexible working hours, the speed of getting around was vital for at least one of the informants.

- **Contextual information:** Both informants noted that their chosen mode of public transport could benefit from even more granular and real-time information about capacity, estimated travel times and facilities, even as early as before leaving their point of origin. This information consisted of, amongst others, free seating and room for prams on the bus, true availability of bikes on a city bike-grid, and delays and exceptions regarding corresponding transport.

- **Clearly communicated privacy**: When talking about data collection in an always-connected scenario, one of the informants expressed the desire to have open and honest statements about how any collected data would be used and, as importantly, not used.

- **External demands.** Especially one of the informants were concerned about constraints and services that originated outside the scope of the information system and her own planning capabilities, and these concerned city-wide standards on opening hours in the kindergarten (too late for her liking) and also several concerns regarding the physical rolling stock and the route infrastructure and scheduling of connections.

5.2 Customer Journey Map

To visualize the complex travel patterns, I employed a technique central to service design called Customer Journey Maps (Stickdorn & Schneider, 2010, p. 158). This method is usable throughout the four stages of the service design workflow: explore, create/reflect and implement. Mapping a customer journey in the exploration phase helps the informant to realize where the "touch-points" of their journey are, and what ICT, if any, that mediates their interaction with the service. This technique details the myriad channels and agents the user of a service is interacting with or getting information from when using the service. Journey maps are most useful when paired with personas, so that the customer becomes more than just a name on the paper (Stickdorn & Schneider, 2010, p. 158). This particular version of the customer journey map was originally created for a French transportation study and its role was to discover shared customers across public transport operators and how they migrated from one to another during the service journey (Kahn & Tallec, 2011). The journey-metaphor in Customer Journey Mapping is directly transferable to personal transport, since this domain really contains journeys in the right sense of the word. It was used during the interviews when travel patterns were discussed, to gain common understanding of the terms used and to illustrate and detail the patterns that the informant and myself were talking about then and there. In one of the interviews, the game even helped the informant to come up with travel patterns and ICT use that might otherwise have been forgotten, due to the multitude of pieces offered in the game. However, this also showed up to be tiresome and logistically challenging because of the paper-based nature of the

pieces, so it was abandoned after a few patterns to better focus on the conversation instead. The maps are integrated in the presentation of the personas to highlight certain topics.

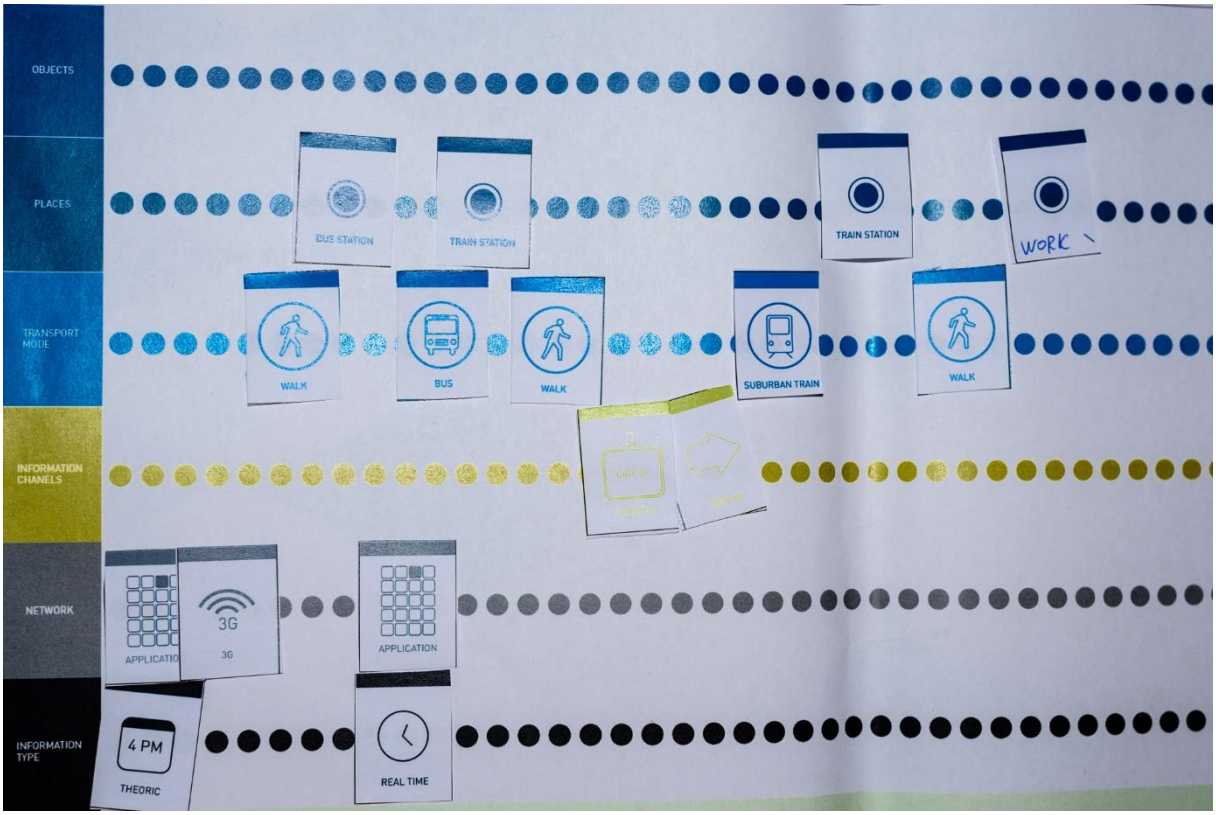

Fig. 15 Customer Journey Mapping of a relatively simple travel pattern, “Kari”.

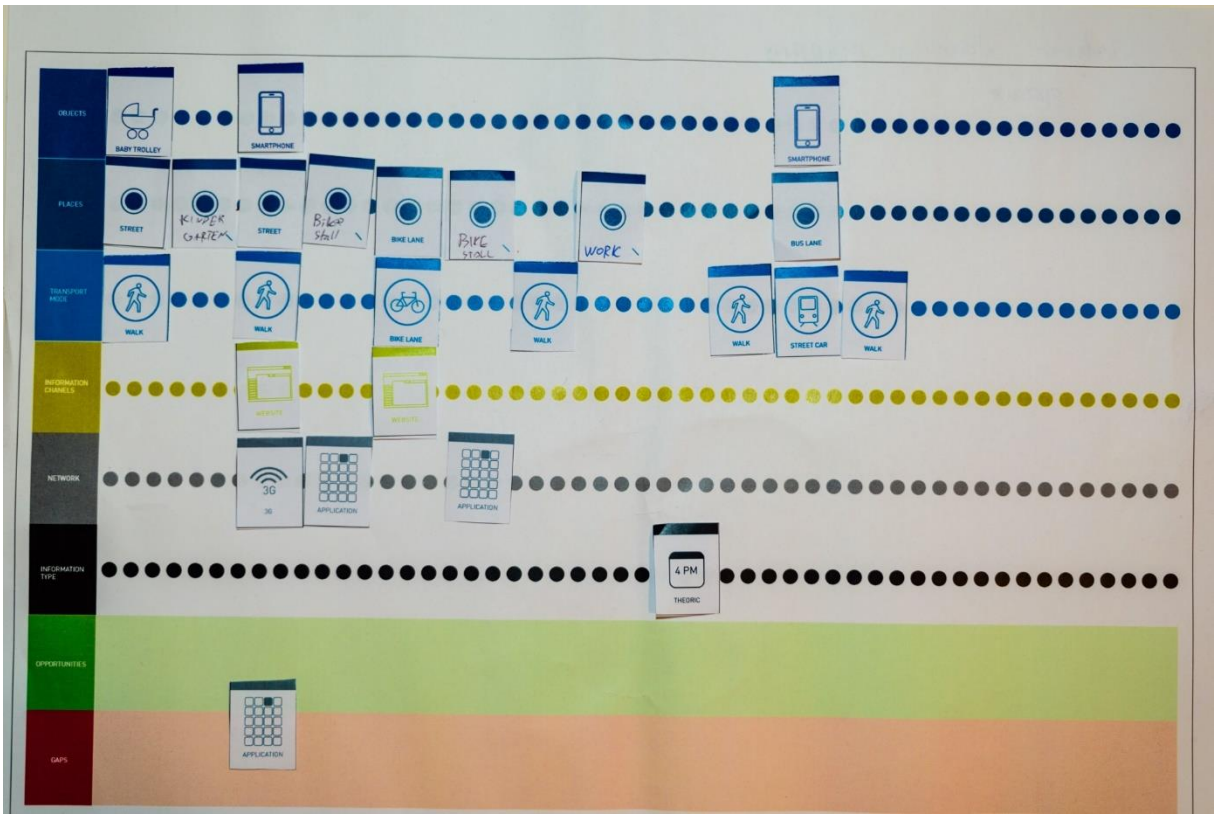

Fig. 16 Common daily complex travel pattern without car, “Ola”. Note the suggestion for improvement.

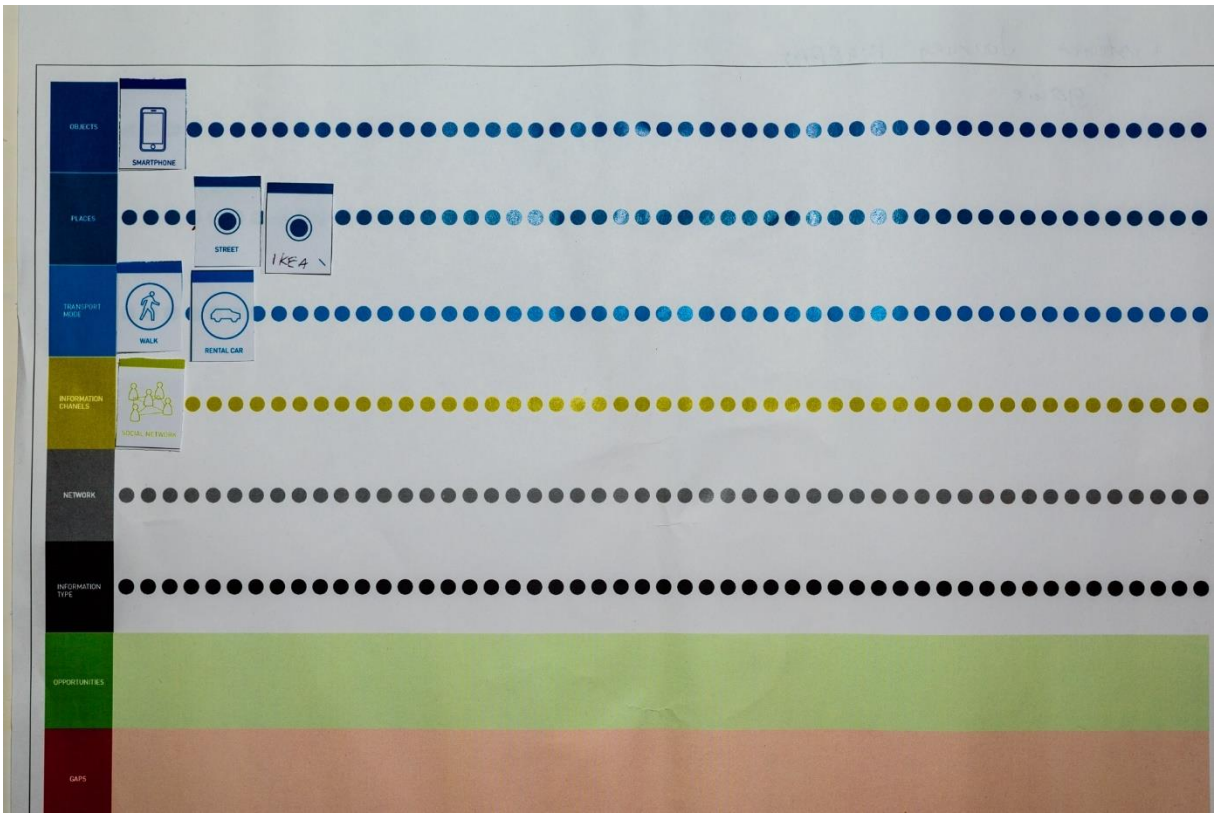

Fig. 17 Solving the car dilemma for certain situations. Reversible. “Ola.”

5.3 Personas

> *A persona is not the same as an archetype or a person. The special aspect of a persona description is that you do not look at the entire person, but use the area of focus or domain you are working within as a lens to highlight the relevant attitudes and the specific context associated with the area of work* (Nielsen, 2015, p. 2040).

Within service design, personas are often used as a tool to explore and engage with a fictional character based on collated and grouped research data (Stickdorn & Schneider, 2010, p. 178). The data is often gathered from other tools and techniques such as interviews and stakeholder maps, but, as mentioned in chapter 4.1.2, more quantitative ways of generating personas based on larger sets of questionnaire data are also possible.

There has been some critique towards using personas as a technique, and one of the arguments is that it's often impossible to define how many, if any, data points actually make up a persona and how this data is sourced (Chapman & Milham, 2006, p. 634). The approach chosen in this study, however, creates personas directly from interpretations of the real-world informants. These interpretations are sourced from the interviews, the interview notes, the coding, and the observations made during the interview process not visible in the coding. When interviewing another person, you don't just record words. You will invariably also observe other ways the informant reacts and communicates. According to Crang & Crook (2007, p. 60), "separate" methods in social research can end up blurring into one another, and "*all social research involves learning through conversation*."

The personas are therefore more fleshed out than you would find in a regular personas template (cf Cooper, 1999; Goodwin, 2009), and the main purpose of this exercise is that this way of presenting the empirical data contributes to the "thick description" of the informant and his/her context (Geertz, 1973) .This enables the creation of a narrative that embodies most, if not all, of the real situations and needs of the informants to better explain the experienced phenomena. This way of discussing personas has much in common with what Lene Nielsen describes as "The engaging perspective" [of personas] (Nielsen, 2015, pp. 2046–2047): I aim to create a "[…]vivid and realistic description[…]" to help avoid looking at the subjects as stereotypes through biased glasses in the way you might do with other fictional persona. Finally, the reason why I still call these representations personas although they are obviously based on single data

points, is because I only look at aspects of the real person, as interpreted by me, not the entire person.

This, however begs an ethical question: if the personas are directly based on a single person, care has to be taken to avoid this person being identified by anyone that does not already know their identity. To avoid the cocktail-effect of multiple identification points[14], the personal information is stripped down or replaced with similar information to a degree where any identification should be impossible.

[14] Also prohibited in the legislation (*popplyl,* 2001 §1)

5.3.1 Informant A, “Kari”

Age: 29
Occupation: Social service worker
Household size: 3, Number of children: 1
Related Customer Journey Maps: Fig. 15

Kari is in her late 20s and she lives together with her husband and her son, a one-and-a-half-year-old, in an apartment in the suburbs. Kari and her husband work on different locations in Oslo, and today it’s her turn to take the bus to work. She works in an office in another district in Oslo, while he has various assignments on various locations in his job as a craftsman. They started using a car just before their son was born, because they inherited her mother’s old car to be driven until it gave in, and they have grown reliant on the car as a means of transport. So when it finally broke down, they had to acquire another one. Normally, the one that gets to use the car is the one also making the drop-off in the kindergarten, since it does not open until 07:30, and there is no public transport connection that will allow either one of them to get to work on time and still manage to drop their son off. Her journey already began last night, when she used the travel planner app to suggest several possible trips, and use her device’s screenshot functionality to store them locally on her phone. She uses these pre-selected trips to give herself alternatives in the ever-changing morning routine of a family with toddlers. Today’s trip involves one bus, then a connecting train, then a 10-minute walk. She is concerned that the bus is late and will miss the connection, so she chooses an earlier bus in her list of pre-planned schedules, then checks the real-time system for any exceptions. Before boarding the bus, she spends a few seconds purchasing a fare for today’s trip. Between stops, she checks the mobile phone as well as the boards with traffic information to locate her train. On the bus, she allows herself some comfort-time to relax with social media and sometimes music. She values the free time she gets, sitting on the bus and the train, and besides, it’s early in the morning and the extra rest is welcome before a long day of work. The last leg of the journey could also have involved a bus, but the train often misses that connection and it’s just a small walk anyway, and it doesn’t take any more time than the bus, so Kari ticks of today’s exercise goal and feels content. She hopes there won’t be any emergencies in the kindergarten today. She has the most flexible work situation and will get contacted if their son becomes ill, and not having the car, she knows that it takes at least one hour before she will be able to come and fetch him via public transport. The alternative would be to grab a taxi, but the cost is high and she feels annoyed thinking about

having to spend even more on transportation, as they already pay enough on the car, and she feels that in a city the size of Oslo, it really should not be necessary to have to rely on the car.

After work, Kari hops on the bus for a total of two to get home. It's late in the day and Kari is hungry and tired, and even though she gets on the bus at one of the first possible stops, the bus is already so full that she cannot get a seat. On top of that, it's inexplicably delayed, again. The trip is not a pleasurable one at all.

In the afternoon, they take the car to visit some friends. It's just more comfortable to use the car: no need to drag the pram in and out of buses, or having to wait on a cold bus stop with a small child, especially in the winter. She looks forward to the summer; it's much easier to use the bus service then, when it's warmer. In the car, they play and sing along to the music on the stereo and Kari and her husband gets some time to talk about private things. Having taken the car, they know they don't need to worry about planning the trip home again, the car is just there waiting when they are ready to leave.

The issue they are discussing in the car this particular evening is the worry that Karis husband might get a new assignment well outside the city. His normal working hours is from 07:00, and with the job he has now, in the city centre, that's not a problem, but now they are facing the possibility of either having to get up for work at 04:00 and combining that with family life, or getting another car to make ends meet.

5.3.2 Informant B, “Ola”

[15] Age: 36

Occupation: Consultant in the Civil service.

Household size: 4, Number of children: 2

Related Customer Journey Maps: Fig. 16, Fig. 17

Ola is in his mid-30’s. He lives with his wife, their two-year-old daughter and his older son from an earlier relationship, in the centre of Oslo. Living in the city centre is care-free: he only has a short commute to work and most of the amenities and offers of the city is within a short walk of their apartment. Today, he walks their daughter to the kindergarten before hopping on the tram to work. If it had been the correct operating season, he would probably have chosen a city bike[16] from a nearby bike stand and ridden that to work. He uses the city bikes as much as possible when they are available, because he likes to be in shape, and besides, the trip is short enough that he believes any other mode of transportation would probably be just as fast. Also, every little bit helps in the environmental budget. One of the things he enjoys the most about the city bikes, however, is the freedom of knowing that he doesn’t have to take it home if he doesn’t want to: once he deposits the bike, he doesn’t need to worry if he has to ride it home if it rains later; he’ll just hop on the bus leaving the bike behind, physically and mentally. He used to own a car not long ago though. This was when his eldest son lived with his mom a bit outside the city. It was just more convenient, handling all the transportation to and from a place without frequent public transportation with a small child in tow. His son is older now and has moved in permanently with him, and his mother has even moved closer to the city, so he got rid of the car at the earliest convenience. He doesn’t even miss it. Thinking on how much he saves on insurance, petrol and the constant trouble of finding parking in the city centre: Either he would have had to rent one for a substantial amount, or he’d have to pray and hope to get a spot in one of the free ones that are scattered around his neighbourhood, and that’s an unpredictability or cost he doesn’t need. The topic comes up now and then, however, and with a growing toddler, it’s always a debate. But so far, the three or four times a year he needs to use a car for anything: shopping or travel related, he has used a car sharing service, of which he is a member. Only

[15] Illustration photos. Both images licensed under “unlimited free license” from https://blog.placeit.net/unlimited-license-agreement/

[16] Bysykkel

needing to pay a fixed yearly members fee and an extra rate per kilometre driven is so comfortable, and this allows him to have very good control on the expenses and helps him to realize how little he really depends on the car. The cost really outweighs the benefits for his use. He doesn't particularly like having to use the bus if he's out walking the pram, however. During rush hours, he often finds that the bus is full, and more often than not, the other passengers won't bat an eyelid to make room for the pram. When their daughter was small, this was more of an issue when visiting friends and having to take the bus in the congestion, but as she grew older, the size of the pram grew smaller, and besides, they mostly use it on the way to the kindergarten, and that is just a short walk anyway. He laughs silently as he realizes that their only real issue with transport is having to find a place to store the rather large car-seat they use whenever they do rent a car for a family trip. Living in an apartment, it has to stay in the attic due to storage space.

Looking forward to the start of the city bike operating season, he only wishes that they'd make a real app or a better mobile-enabled website, because he finds that the level of detail in the current solution makes him have to plan more than he'd like. If only the app could show the real number of available spots rather than a general indication, coupled with some kind of suggestions if his chosen bike stand became occupied during the trip, or the last bike disappeared before he got there. This would probably require that the app knew a bit more about his chosen route than it does today, but he doesn't do anything wrong, so he feels no difficulty with letting the app know what he wants to do or where he goes if that makes his day even easier. He is aware, though, that there might be privacy complications, but he believes that if the creators of the app just behave in a transparent, open and honest way, he would probably trust them with his data.

5.4 Case definitions

There are two distinct general modes of traveling that can be gathered from the findings. The first is the car-first household of Kari, where the car forms the backbone of the family's daily travel patterns. The second is the non-car household of Ola, where rental cars and bikes, combined with walking and public transport, makes up for the main means of transport, both in the day-to-day life and the weekends/vacations.

Not having a car at your disposal will naturally render the option to use a car more difficult, or on a specific-needs only-basis, as is the case of Ola and the car collective. On the other hand, with a car available, it might be the go-to mode of transport.

The patterns of Ola and Kari are centred around what means of transport they have at their disposal, either owned or otherwise available.

Kari inherited her mother's car when she and her husband were expecting a baby. When that car broke down, they had grown dependant on that mode of transport and decided to get a new one.
Ola used to have a car for the better part of his son's early life, when his mother lived far away and he had to travel a lot to make the schedule fit. However, when that was no longer an issue, he got rid of the car for practical, environmental and economic reasons. Both of these major changes in how they conduct their travel seems to have happened or emerged around life-changing situations: having a first child or gaining permanent custody of another.

Ola and Kari are very different in how they approach and conduct their daily travels. Finding this was not something that was planned for, but rather a lucky happenstance. It is often not possible to do a strategic selection of cases beforehand, since you don't know the true role of your selected case (Flyvbjerg, 2006, p. 231). Thus, my personas play the role of "maximum variation cases" (Flyvbjerg, 2006, fig. 1) in the respect that they differ on important dimensions, such as preferred means of transport and location. They might even be considered critical cases when discussing if the FBM is possible to apply to their situation.

6 Discussion

The following chapter looks at the findings, the technology and the habit models as per the research questions, to discern and discover relationships that will help in answering the guiding question: how to achieve habit change in public transport patterns.

6.1 The importance of predictability

This chapter looks at how the informants think about predictability in their travel situations and how this fits into their narrative. Although I focus on predictability foremost, some of the findings are relatable to other projects that have focused on other matters. The "underveis"- project focused on the travel experience and how applications could enhance the experience. As a part of the evaluation, two focus groups were conducted to elicit feedback from their target user group on the app suggestions (Julsrud, Denstadli, Herstad, et al., 2014, p. 17). One interesting feedback from these groups was the idea that many of the participants were using public transport as a "charging station" for their thoughts (Julsrud, Denstadli, Herstad, et al., 2014, p. 26). Some of these "charging needs" were identified as an in-between place where you could get away, and a place where you could catch up on new information (news, mail etc.) This fits with Kari's story about the morning commute and how she uses that space for the same purposes. Kari also shares similarities with the cluster and activity profile "busy driver," whereas Ola fits mostly within the "public transport and bike-user"- cluster, although with a much shorter commute (Julsrud, 2012, paras 3.3.2, 3.3.4) .

This section will clarify the results from the findings, present them in a way relevant for the following discussion, and relate the findings to other relevant research to satisfy the idea of *theoretical adequacy* presented by Crang & Cook (2007, p. 15).

The first research question is:

- **RQ1: How does these families regard predictability as an important aspect of their daily travel patterns?**

The qualitative research presented under findings is what forms the basis of this inquiry. To understand what level of importance predictability holds for the informants, I have to look at the topics from the findings and see if any one topic emerges as important.

From the findings, I discerned a few preliminary topics and themes of interest (see section 5.1.1): **predictability, speed, contextual information, privacy** and **external constraints.** These topics can be looked at separately, but I will show that these topics are better understood when they are discussed under a common theoretical umbrella.

On a normal weekday, Kari's primary transport needs are centred around getting to and from work. In its basic form, this is a relatively simple home-work-home scenario. However, this pattern is influenced by a number of different factors. Having a child in the kindergarten imposes some constraints on the perceptions on how this pattern can be realized.

> *"...predictability is a very good word for it, I know I can trust my car when going back, and if it's lots of traffic, I can choose another route."* – Informant A, "Kari"

> *"And, for some reason, the bus doesn't departs on schedule, it almost never does,and it's very full, so you have to stand. That's crap."* – Informant A, "Kari"

Taking from the topics, the need for **predictability** is based on perceived **security**. Kari needs to be able to react to situations involving her child at a moment's notice, and she doesn't feel that she can count on public transport to provide that security. This also relates to the need for **speed**. This is a derived need, however, since it relates directly to the possible modes of transport, and the opening hours of the kindergarten. If the kindergarten opening hours were extended, the imposed time-limitation of getting to work in time and still being able to deliver and pick up her child would not be so critical. Any technology that would support Kari and her daily routine would have to bear in mind her need to be there for her family. The other theme that Kari mentions is that of **comfort.** But this theme takes on varying aspects depending on what the purpose of the trip is. For the job commute, it's often early morning and then the comfort is related to escapism and relaxation before a workday, and then apps such as social media and music are central to that experience. These are not related directly to the travel planning, and are of a more entertainment nature, but the fact that she is able to use these technologies for comfort seems to be a trait of the mode of transport, where she is not required to do the driving herself.

> *"-In the commute to work, it's really more comfortable to sit on the train, just to relax, because you're tired. But in the evening, in social settings, then it's nice to not have to plan and check the bus routes and get to the bus stops. Even when the destination lacks parking spaces, you take the car, and that's kind of silly."* – Informant A, "Kari"

One last major influence on Kari's available choices of transport modes come from **external factors** like opening hours in kindergartens, flexibility in work hours or capacity in rolling stock in the case of public transport. Not knowing the current configuration of the transport vehicle creates insecurity on the comfort of the trip, especially when traveling with children and their need for space.

Ola, on the other hand, lives close to all amenities and has grown to rely on available public transport, or walking, for most of his daily travel. For him, the security-aspect does not seem as important, and he presents a generally more positive attitude towards his transport situation than what Kari does. His needs are communicated as being of a practical nature: He also needs to get to work, and deliver the kids, and doing shopping, but his proximity to all his destinations makes these needs easy to fulfil. He wants to stay healthy and chooses modes of transport that can support that goal. The only frustration he has is that some of the apps that he uses to plan his bicycle-travel are lacking in contextual information. Ola is aware that privacy-issues can emerge if an application relies on his personal data to increase the predictability for his mode of travel. He is not too distraught about this, since he believes that he has nothing to hide. Still, he needs to be assured that the data is kept and processed only for those specific purposes, and that the actor that is using the data is open and honest about their practices. For Ola's needs, **predictability** becomes a pragmatic practical concern when he tries to maximise his efficiency in his bike-transport scenario.

> *"[It's problematic] both to find and deliver bikes at times. Either the station has no bikes left, or it's filled when you want to deliver it back. You need a certain overview of where the stations are."* – Informant B, "Ola"

Then again, the lack of predictability when using a car when living in the city centre is also an aspect:

> *"I chose to not have a car mainly because it's hard to find and expensive to rent a parking space in the city centrum, I live in a central street and the free parking spaces are few and far apart."* – Informant B, "Ola"

These two personas are not directly comparable, but they share some similarities. Even though both feels that predictability is one of their major needs for a transport system, Kari uses this predictability to ensure the peace-of-mind that she can react to emergencies with her family. Ola uses this predictability to conserve time and effort. But the need for comfort manifests itself in different ways for both: sometimes, the comfort is in not having a car, as you are able to relax and do your own thing, like listen to music, or the ability to forget your means of transport once it has been delivered, as in the city bike-example. Then again, sometimes the comfort is in having the car: Knowing that you are not bound to the transport providers schedule, and that you can fulfil your other needs on a moment's notice and have a wider utility at your immediate disposal relieves uncertainty, and is thus a key component of predictability too. Predictability links to control and is thus found to alleviate stress in transport scenarios, as noted by Legrain et al. (Evans & Wener, (2002); Wener et al., (2005); in Legrain, Eluru, & El-Geneidy, 2015, sec. 2.2)

To summarize: their needs can be categorized under two general headings: practical needs and emotional needs. And it seems that the practical needs come about as a result of the emotional needs. For Kari, security and availability for family life are the emotional needs that dictate the practical needs. The emotional stability that comes with this feeling of security is known as *ontological security* (Giddens (1991), in Hiscock, Macintyre, Kearns, & Ellaway, 2002), which is a term relating mostly to housing stability, but is shown to be applicable in other areas as well. In a Scottish study regarding travel and ontological security, Hiscock et al. looks at the ontological security in transport situations and linked the term to three aspects: *Protection, autonomy and prestige* (2002, p. 123). They found that reliability and predictability were linked to the aspect of autonomy and were contributing factors to achieving a feeling of stability.

This correlates with my own findings with "Kari", where *predictability* primarily, and *speed* secondly were felt as essential in case of unpredictable scenarios, and these form the basis for the overall goal of ontological security. Still, this is a circular relationship, and the practical

needs such as getting to work on time also impacts the preferred choice of transport mode, and also feeds back into more or less feeling of security. In Ola's case, however, I argue that his needs for predictability are linked with *autonomy,* and the need to be in shape and environmentally aware are linked with *prestige* as an aspect of ontological security. Additionally, some needs are addressed by ITS/ICTs already, like basic functionality such as electronic tickets. Some needs can be handled differently though, like the need for up-to-date information has some room for improvement. To summarize, these are the major themes that are derived from the findings, and they are linked with the corresponding domain from the FBM:

Kari

- Needs to know that she can get home fast in case of an emergency. **Ontological security -> predictability -> peace-of-mind -> Comfort**. FBM Domain: **Personal relationships.**
- Wants to be able to get to work on time and still have quality time with her child. **Speed, predictability.** FBM Domain: **Personal Relationships.**
- Appreciates the alone-time on the train where she can relax with or without apps. **Comfort.** FBM Domain: **Personal improvement.**

Ola

- Needs to get up-to-date and relevant information for his daily bike-rental. **Predictability, productivity.**
- Wants to use his transport mode to keep in shape. **Personal improvement, fitness.**
- Doesn't need to worry himself with finding or paying for a parking space. **Comfort, personal finance.**
- Wants to be sure that his data is treated with respect and honesty. **Privacy**, **security**

Regarding the findings, I found that the informants expressed several different needs and views when they talked about their travel and family situations. When it comes to predictability, this was but one of these topics, but an important one, since it seemed to connect and be common to several others such as security, speed and prestige. The personae, Ola and Kari, are very

different in how they conduct their daily life and their social context, and thus have very varying outlook on the role of the car in their daily life, and thus predictability becomes something different for each of them. This correlates again to findings done by Hiscock et al. where the value people place on car versus public transport depends *"...In part upon the psychological characteristics of the users..."*(Hiscock et al., 2002, p. 133) *and their social and familiar situation.*

6.2 Designing for predictability

In this section I will present why it's useful to look at the service-aspect of personal travel, and how service design can help elicit technology that can aid the service experience. The role of touch-points is vital to the perception of where the user interacts with the service and this is also where introducing technology is most likely to have an effect (Stickdorn & Schneider, 2010, p. 80). Service design thinking has been used as a *perspective* (Bratteteig et al., 2013, p. 118) during the interaction with the informants, so drawing on this method further is only natural to answer research question 2:

- **RQ2: In what ways can mobile ICTs support the need for predictability?**

Arguably, travel planning today already designs for predictability. With the prevalence of functional real-time information systems that are present at several bus, tram and train stops, as well as ubiquitously available on our mobile devices, this concern has been duly noted and addressed somewhat already. This implies that it is deemed important enough to warrant investments from the service providers. The question then is if these technologies can be improved even more, based on the concerns of the users, in the form of the informants.

The findings suggested that there are a few major touch-points where the personas use ICT already when they conduct their travel, namely when planning their trip, and for interaction with the mode of transport itself. To specify, this means that they use technology to either buy tickets or maintain their subscription, and unlock e.g. a bike, respectively.

> *"-It should be nice to have a system that told me how to fastest get from point A to B that also knew about how I change my travel mode with each season. [..] on their web-*

site [City Bikes] they have a colour coded availability chart, but it only shows red, yellow, green, and it updates very slowly. It would be nice to have it more precise." – Informant B, "Ola"

Secondarily, at least one of the personas use ICT for entertainment when they relax using public transport. Combining touch-points, where the user interacts with the service, and eliciting their emotional responses to these interactions, is one of the aims of service design and is meant to lead to better services (Stickdorn & Schneider, 2010). One of the ways that this can be accomplished is to understand what these emotional responses are caused by, and remove or subvert these causes to make the emotional response more positive. ITS technology can be used in this way to aid some of the negative reactions and/or needs that were uncovered in the findings, such as frustrations or insecurity.

To know how to present information to the user, it's useful to know what ICTs the users employ. The travel maps from the findings uncover that the informants used mobile technologies in their travels, and this is supported by data provided by the "underveis" – project. The pre-study found that 80% or more of the travellers brought with them some form of mobile device with internet capability on their public transport or car-related journeys (Julsrud, Denstadli, & Herstad, 2014, fig. 3.1). I assume that data can be presented through such mobile devices.

6.2.1 Possible implementation of ICTs

The problematic aspects that were marked with frustration and/or annoyance, are the ones that are most in need of attention. Being aware of the touch-points where the users experience negative emotions is important in order to better the experience of the service (Stickdorn & Schneider, 2010). For Kari, these areas relate to her planning her trip the evening before, the lack of space and poor predictability on the bus on the way home from work, and for Ola, the low granularity of information provided from the booking app for rental bikes. The system that allows Ola to see available bikes and/or bike return spots uses a three-tiered colour-codes system[17]: Green for more than 5 available, yellow for 1-5 available, and red for unavailable. Note that this represents free bikes, not free delivery spots, which is the reverse metric to free bikes. Ola could want a system that would report available bikes OR available return spots depending

[17] http://www.oslobysykkel.no – information accurate per 2015-12-31

on the context: if he already had a rental bike or if he was going to get one. The system could also present better resolution data, as a real-time number of availability instead of a time-delayed approximation. A third option, to prevent wasted journeys to a station that changed availability mid-trip, would be to update information on availability based on some form of knowledge of which station Ola was considering using.

For Kari, her annoyances with uncertainty and lack of predictability regarding free space on the bus for her pram could be reduced by real-time telemetric data informing of the current capacity and layout of the bus she was planning to take, such as availability of seating or pram places using system similar to the ones that detect free parking spaces in parking garages. The second annoyance she experiences is the need to create alternative pre-planned routes the day before the trip will take place in order to have alternatives. This demand could be met to some extent by allowing the app itself to store pre-set routes, but I believe that using some form of predictive systems related to her routine and destination would be even better. This way her routes could be pushed in real-time to her device as she was progressing through her day, discarding outdated routes and suggesting new ones.

This set of problematic feelings related to public transport, namely the ones that relate to security, speed, flexibility and the predictability for the family life that are the main reasons that the car is the preferred mode of transport for one of the informants. Most of the issues regarding speed and predictability are directly related to the routes and the over-arching plan of the transport lines, and personal ICTs cannot directly influence this kind of technology. One method that these technologies can be used to influence the route planning and scheduling is to use telemetry obtained from mobile devices as tracking, but this way of using data raises privacy concerns and has been commented on by the Norwegian data protection authorities (‘Kontroll hos Ruter - Datatilsynet’, 2009).

So, in general, ITS applications that utilize telemetric data should be able to reduce some if not all the negative emotions that are present within some of the implementations of transport solutions that the personas utilize. They could do this by recording and communicating information about aspects of the physical means of transport like availability of certain features, delays and alternate routes. But how would the systems know what route to present?

6.2.2 Customisation or personalisation

This brings us to another topic. To be able to give you a correct timetable for an upcoming route, the travel planner application would need to know where you are going. There are two ways this can happen: You can tell the system, or the system can tell you. As a user of a travel planner, you can provide the destinations and durations necessary to the application, and the application can then provide a suggested route. Or, the application can be aware of how you normally travel, and prepare a route for you based on your routines. These two distinctive ways of generating data specifically for you are called *customization* and *personalisation,* respectively. Personalisation in this context is generally regarded as a terminology originating within commerce, and the Personalization Consortium defines it like this:

> *"Personalization is the use of technology and customer information to tailor electronic commerce interactions between a business and each individual customer. Using information either previously obtained or provided in real-time about the customer, the exchange between the parties is altered to fit that customer's stated needs as well as needs perceived by the business based on the available customer information" ((2005), in Vesanen, 2007, p. 410).*

Thus technology (telemetry, applications etc.) is coupled with customer information (your username or contact profile in a travel planner) to tailor, or personalise, interactions (the calculated route and the gathered data) between the customer and the business. There are various other definitions of the term (Vesanen, 2007, p. 412), and they all share the notion that information is generated to match a single user based on some form of gathered data. Customisation, on the other hand, relies on data provided by the customer or user instead (Vesanen, 2007, p. 412), and means that instead of the system preparing the information on its own, only the specific information provided by the user is to be considered. So a travel planner operating on the principle of personalisation would be designed to use telemetry and other logable information (accessed Wi-Fi-hotspots, geolocation tagging, check-ins on social media, grocery receipts etc.) to calculate a suggested travel pattern and present alternatives for traversing said pattern. A system that is based on customisation, on the other hand, would rely solely on explicit user input to generate the route and not take other data points into account.

The personalisation – route requires access to a wide array of data points and would require big data analysis because of the "large and complex" nature of the datasets involved. Existing apps,

such as Waze, already creates contextual and relevant information based on this method combined with statistics from other drivers, using big data analysis (Google, 2016). *This approach poses questions about ethics and privacy however, and will be further discussed in section 6.4. Informant B expressed minor concerns about the privacy involved in such approaches, but his stance on the matter is that he has nothing to hide and is thus not concerned.*

> *"Personally, I don't really mind. I don't try and deliberately hide where I've been and what I do and those sorts of things, I tend to think that it's just those that have something to hide, like those that do shady business and the like."* – Informant B, "Ola"

6.3 Changing travel habits, is the FBM adequate?

> *"But it's a matter of habit, right. You get used to how things are, and, as far as we are concerned, it's about having everything in the immediate vicinity, and that relives much frustration."* – Informant B, "Ola"

For this analysis I will refer to the MIT habit loop and contrast that way of looking at habits as hard-coded behaviour with other existing theories on habit and transport. I will look at how the routines involved in personal travel can be linked with habits, and how ICTs or ITS applications can aid habit-change, both directly and indirectly. The discussion is guided by the research questions:

- **RQ3: What are the strengths and weaknesses of using captology and more specifically the Fogg Behaviour Model to persuade these families to begin or keep using public transport?**

The FBM is a habit-altering model that operates on the principle that habits consist of routines and triggers, and thus works according to the habit loop presented earlier. Hence, the discussion about the strengths and weaknesses becomes a discussion about whether the underlying model for habits is adequate for the transport domain.

To properly discuss the FBM, it is necessary to propose a way that the model implements ICTs that fits the aspects and the domain that the ICT would be used within. This section thus describes some possible solutions based on the already discussed ITS applications and available ICT presented in section 6.2.

6.3.1 Transport and the habit loop

In chapter 3.2.1, I defined one model that explains how habits work, at the neurologic level: the habit loop. This model can be related to personal transport in the sense that you have a goal, you have a routine that consist of one or more distinct travels, and you have some form of trigger. In the term *travel patterns*, the pattern itself corresponds with the routine – part in the habit loop, and the cue is often time-based. This cue will be tied to the travel time, if using a car, or the travel time combined with the departure of the first mode in a modal travel pattern, i.e. the bus. According to the model, the proper cue would initiate the routine that leads to the reward. The reward can be linked to the destination, although you would need to know the intention behind the travel to know the real goal, and thus the real reward. In the findings, the goal of the travel patterns that were discussed were often centred around work or friends, but the reward involved in the habit is either "getting to work on time," "socializing with friends," or similar. The craving – part of the habit loop would then be related to the positive sensation you get when you get back to your family, or the happy feelings coming from the company of good friends, or similar. Even though there are set goals for the travel, there are still multiple factors that all affect the goal and thus the reward, in some way. These are feelings, needs and practical concerns, and identifying the craving that forms the underlying need for reward can be hard. The habit loop dictates that as long as you have alternative routines to swap with the ones that make up the habit, this will result in an alternate habit. So it would seem that it should be possible to imagine transport patterns as interchangeable according to the habit loop. Routines linked to habits are also fragile (Duhigg, 2013, p. 27), and changes in the routine, such as external disruptions in traffic patterns, can redirect the habit. This is especially true when the routine is fresh or the habit is developing, and can make or break a transition to another mode of transport (Duhigg, 2013, Chapter 3).

6.3.2 Analysis through the FBM lens and perspective

So, the habit loop-model of how habits are created and transformed rely on routine and cues. The question is then how technology can aid in altering these patterns and thus the habit.

In chapter 3.2.2, I defined an area of research called Captology, with some suggested research areas and methods. I also presented a model that looks at key elements and relations in persuasion, and how these relate. Persuasion in this context is closely linked to behaviours, and behaviour is to be understood analogous with routine for this exercise.

This section will utilize the abovementioned frameworks for looking at how research in the field of personal transportation/mass transit fits into captology. On top of that, I will look at target behaviours within personal transport, and try to look at them "through the FBM lens."

Positioning Transport Research within Captology

Looking at the design space for persuasive computers stated in (Fogg, 1998b), I have a way of positioning design and research into personal and mass transit into that framework. There have been identified a few domains for captology already (Fig. 18).

Domains for Persuasive Technologies	Example
Commerce—Buying and Branding	To buy a certain product
Education, Learning, and Training	To engage in activities that promote learning
Safety	To drive more safely
Environmental Conservation	To reuse shopping bags
Occupational Productivity	To set and achieve goals at work
Preventative Health Care	To quit smoking
Fitness	To exercise with optimal intensity/frequency
Disease Management	To manage diabetes better
Personal Finance	To create and adhere to a personal budget
Community Involvement/Activism	To volunteer time at a community center
Personal Relationships	To keep in touch with their aging parents
Personal Management and Improvement	To avoid procrastination

Fig. 18 Domains for Persuasive Technologies (Fogg, Cuellar, & Danielson, 2008, p. 135)

I suggest the following domains and issues related to personal and public transport. This list is not exhaustive, but for this discussion, I suggest that these key points are most valid:

Domain	Issues
Environmental conservation	Reduce pollution from private cars by moving travellers onto less energy-intensive modes of travel
Personal finance	What does the car really cost? Is the bus more expensive? Gain better understanding of costs involved in transportation.
Personal management and improvement	Gain knowledge that can incorporate daily commuting habits into a more fluid way of living. Exercise more with the aid of your commute.
Personal relationships	The findings suggest that family life is an important factor when travel patterns are generated or altered.

The design space for captology is more concerned with areas captology can be applied to and not how a particular research area fits into various domains. This means that since there seems to be several aspects of transport and thus several domains that field can fit into, getting a total overview can seem a bit daunting. The main domains identified from the findings were “Personal management and improvement,” and “Personal relationships,” with the other two playing a minor role. I will therefore focus on these domains, and use the example issues “exercise more” and “getting home to the family on time,” but also “reduce car pollution.”

Level of analysis

Since transport is a complex issue that requires thought all the way from personal to communal and even national level, there are several concerns that can apply to this field.

On both *community, organizational and personal* level, the obvious way of handling the issue would be to look into how individuals can use the private car less, or how they should use public transport more (or a combination of the two.) For instance, tackling this issue at a communal or societal level would be to use legislation to either reward bus users or penalize car drivers On a personal level, looking closer at other methods for direct persuasion could be feasible. More about that in the next section.

Functional Triad Perspective

Looking at how a persuasive technology could act as a *tool* in the above domains differ somewhat for the different issues, but the main intent of this perspective is to aid persuasion by making the threshold for performing a certain behaviour lower and aid in decision – making. The persuasive technology would then be built into the travel planner that relies on ITS and telematics, a detailed view of your intended travel pattern (customised *or* personalised) to lower the perceived effort in public transport compared to the car, or by reinforcing or dissolving mental models connected to transport use. In this case reinforcing the mental model that biking is good for you and the environment, and cheaper than the car in many situations, and by providing solutions to personal public transport planning that require less effort, to align the mental model with the apparent and possibly real ease-of-use of the car.

When the computer acts as a *medium,* you could get visualisations that reflected your choice of transportation. One real-life example is the Nissan Leaf electric car that has a graphic of a growing tree that grows when you are driving economically (conserving energy) and withers when you are driving aggressive (spending more energy per distance unit) (Schmitt, 2012). Currently, the NSB ticketing app displays information about how much energy in CO2 – equivalents your trip is saving compared to the same trip by car.

With the advent of Social Media, it seems artificial to think about the persuasive technology as a medium and as a social actor separately, so a persuasive technology that acts as a *social media actor* could allow the user to brag about being ecological conscious or their last workout by city bike on a social media platform.

Intentionality perspective

There are two ways of looking at this perspective. If you are a user that wants to change your habitual driving on a personal level, you can employ technology that works autogenously, like travel planning apps that makes public transport easier, or some form of reminder about the total cost of car use etc. But in accordance with Fogg's suggestions (direction D in "call for directions, (Fogg, 1998b, p. 231),) I propose that persuasive technology employed on both the personal and community level should be endogenous. This is because I believe that in most large systems, no individual is sufficiently skilled to handle decisions with widespread impacts all by him/herself. Therefore, persuasive technology in the transport sector should be inherently designed to alter behaviours. However, designers must communicate this clearly and openly, and this demand for openness and honesty echoes the findings from the discussion on big data with "Ola."

Stating target behaviours

I have tried to position aspects of public transport within the confines of captology, and I shall continue to look at two separate target behaviours through the framework of the FBM, and look at what kind of motivation, level of ability and triggers that could be useful when trying to achieve or block various behaviours. I shall look at two different behaviours. I will try to block the behaviour "drive the car" and attain the behaviour "take public transportation."

By defining some values within the ability- and motivation- dimension, I can see what kind of triggers will help me to attain the target goals.

Both target behaviours have a similar goal and share the same setting: getting to and from daily activities such as work, grocery shopping and hobbies.

Drive a car to work

For this discussion, I assume that you already own a car. If that is not the case, I speculate that the economical and time/effort- aspects of simplicity will make most triggers fail in the day-to-day life.

Motivators

Of all the normal motivators discouraging car use, I believe that social acceptance or rejection, and to some degree fear and pleasure, are the main motivators. Some people find driving a car liberating, thus they will derive some amount for pleasure from driving the car. They might also be demotivated by fear of pollution levels and the sustainability of the fossil fuel consumption, or not getting enough exercise. The social acceptance/rejection – part though, is harder to quantify. In large cities especially there seems to be a social agenda to decrease the saturation of cars and the use of them. This might be motivated in turn by fear/hope or other motivating factors, or be an aspect of simplicity. On the other hand, driving a car is generally considered normal behaviour and it will take some effort in reducing this perspective. From the findings, I argue that the perceived social stigma that "Kari" experiences when she picks up late from the kindergarten is a form of fear and social rejection on her part.

Simplicity

Once you have bought the car, it is generally simple to use. The car is available most of the time for immediate use. You have already paid it (or at least it is not a part of your regular spending budget,) so the daily running costs might be invisible. Unless you do not have access to permanent parking, you know where it is and it does not require much physical effort in locating and using the car. If you are a seasoned driver, you might not need to allocate too many *brain cycles* towards the operation of the car, and if you have other assistive technology (like a GPS), that might be mitigated even further. Since it is reasonable to say that much of our cities are built around the premise of car use, there is no real fear of deviating from the norm either. Finally, the longer you have had a car, the more a part of your normal routine it becomes.

Triggers

For this target behaviour, I argue that the simplicity-aspect of the behaviour far outweighs the motivational factor. Therefore, triggers in the form of "negative facilitators" would be the best

choice to hinder this behaviour. Triggers need to be a part of a proposed technology, so unless I consider the entire transport system to be a part of the persuasive technology (which it might well be,) triggers should be a part of the car itself or some other ubiquitous personal technology. The simplicity and relative predictability that would also counter frustrations and the likes, and might be a reason why the car remains a first choice. These triggers should focus on:

- Communicating real expenses of car use, both money-wise and environmentally (either by explaining the cars pollution or the lack thereof for competing transportation)
- Informing about lost time spent in rush traffic.

If I imagine the entire city as a part of the persuasive computer, there are numerous other options as well for altering this behaviour. As mentioned previously, lowering simplicity by introducing restrictions on where and when you can drive, or how much it costs, can make driving a car less attractive. This might be further hampered if I introduce other target behaviours into the mix.

Take public transportation to work

For this target behaviour, I will look at the perspectives that will aid this behaviour instead of trying to push it below the "Activation line."

Motivators

As stated by Fogg, *"People often resist attempts at motivation, but we humans naturally love simplicity"* (Fogg, 2009, p. 6*).* This means that it is easier to design for simplicity rather than "trying to pile on motivation." I believe that since the domain and the issue is generally the same, and we are only trying to shift behaviours within one system, the same factors apply to "take public transportation" as "drive a car." I will therefore look closer at making this target behaviour simpler. The pleasure – part of Ola's worry-less relationship with the city bikes and the shared economy car solution is also a driving motivator.

Simplicity

Almost a polar opposite from the previous example, taking public transport seems to flip the simplicity factors when the behaviour is compared to driving a car. At least in some respects. Public transport generally requires more time from door-to-door, at least it will certainly seem

that way. In reality, when you look at queuing, finding parking and so on, it will often require more time driving a car. Hence, as argued in the previous example, the car will probably operate on your bills-budget, and not your daily budget, making the immediate investment seem higher per trip than the car. (Unless you are actively using tools like electronic tickets, but then you might have employed an autogenous persuasive technology to ease yourself into the target behaviour.) It might come with an increased physical effort, and by that, I mean carrying capacity for groceries and goods, or having to stand for extended periods of time. If taking the car requires next to no planning, brain cycles (and time) might be spent on arranging the entire trip from start to finish, while the drive in a car can be altered on the fly. On top of that, you will have most of the information on the car's capacity easily available. Finally, if you are used to having to rely on public transport, this will also be a part of routine, but it might also make you yearn for the perceived "freedom" of the car (Hiscock et al., 2002, p. 133). To make public transport simpler, you could argue that to make the entire trip require less planning and less brain-cycles to complete is essential, and for that to succeed you would have to create a system that would allow the non-car transport solutions to rival the car on its main forte: simplicity. Reducing uncertainty and knowledge about the transport modes involved in the chosen route would then be important.

Triggers

Again, facilitators are the key triggers here. A successful persuasive technology could:

- Use mobile technology, high-speed data communication and sensors to provide real-time information on the capacity of the chosen mode of transport (By this I mean available seating or stroller space on the next 2-3 buses, information on whether the bus is crammed but the next one is almost empty etc.) This allows the user to better plan the trip.

- Provide context-aware, accurate information on common trips and behaviour patterns when that information is needed. This alleviates brain cycles as well as being non-intrusive when it is not needed. This could also apply to exception handling, so that alternative means of transport can be scheduled on-the-fly in case of delays, re-routes or similar.

- Display or communicate savings in emissions, effective time and money compared to the same trip in cars.

If I imagine the entire traffic system to behave as one, it is possible to take advantage of the ubiquitous wearable devices in today's society (Julsrud, Denstadli, & Herstad, 2014) and design persuasive technology that draws on all that information to simplify the target behaviour.

Relating to Underveis

One more aspect mentioned in "Underveis" is the one regarding the users being "overstimulated" by apps vying for their attention (Julsrud, Denstadli, Herstad, et al., 2014, p. 27). Also, unless these apps were "tailored and hyper-relevant" this information would be "filtered out by the consumers to a large degree." This reflects the notion by Fogg that maintaining a behaviour that consumes brain cycles is hard, so having a system that would influence your travel behaviour would need to be constructed so that all the information was just-in-time and relevant.

6.3.3 Rethinking habits in a phenomenological context

The habit loop relies on a notion that habits exist in the brain as primitive, neurological impulses that dictate our basic functions, and although you can learn how to ignore or redirect them, they are always present to react to environmental cues. As a model, it expects habits to be mostly about behaviours that trigger based on environmental or internal cues. However, this model has been criticised in a number of ways, and in the domain of transport research alternatives exist. When confronted with the richness of the human experience and the complexity of travel as a situated experience, I found the cue-routine-reward-loop to be hard to apply properly without resorting to gross simplifications. Because of these limitations in defining travel patterns, goals and rewards within the confines of the habit loop, there are other models that deserve mentioning in this context. A paper titled "Rethinking habits and their role in behaviour change: the case of low-carbon mobility" (Schwanen, Banister, & Anable, 2012) examines the popular "attitude-based" models prevalent in personalised transport planning research (Schwanen et al., 2012, p. 523), and challenges this view on what can only be described as an epistemological basis. The proposed understanding presented by Schwanen et. al has its roots in Aristotelian traditions as developed by John Dewey etc. and Merleau-Ponty etc., respectively, as opposed to the mechanical and automatic view presented by Cartesian and Kantian traditions (Schwanen

et al., 2012, Chapter 3). I refer the main points that differ this model from the "normal", i.e. habit-loop or similar based, in Fig. 19.

Table 1
Different understandings of habit.

Prevailing understandings (in transport research)	Our understanding
Habit as a behaviour that is automatically cued	Habit as a tendency brought about through repetition
Emphasis on repetition; automaticity; stability	Emphasis on repetition as well as (gradual) alteration and spontaneity; stability and change
A consequence of how cognition and the mind function	A consequence of the coming into existence of relatively stable body-mind-world assemblages
Individualistic: habit as contracted and held by an individual	Non-individualistic: habit as emergent property of a body-mind-world assemblage
Habit is linked to self	Habit is linked to society and community
No direct links of habit with morality and ethics	Habit as the basis for morality and ethics

Fig. 19 Different understandings of Habit. "Our understanding" is (Schwanen et al., 2012, p. 527)

The paper argues that there are two current trends in habit research that relate to personal transport. First, the emphasis on changing attitudes[18] are diminished and the focus on constraints on behaviour is becoming more important, and secondly, habits' role in transport mode selection has become increasingly important (Schwanen et al., 2012, p. 523, section 2). To set up their claims later on, Schwanen et al. conducts an overview on current trends in habit research, and comments on limitations these models present. The paper presents claims set forth by psychologist Bas Verplanken about how normal models governing behaviour, such as the Theory of Planned Behaviour, or TPB (Ajzen, 1991), does not take into account how habits "*…mediate the link between behavioural intention and actual behaviour"* (Verplanken et al. 1994, 1997, in Schwanen et al., 2012, p. 523), and they then proceed to describe a view on habits that closely resembles the one from the habit loop model. Schwanen then goes on to demonstrate that models based around cues have gained some fame in transport research, and this includes the FBM, although this is not mentioned directly in the paper. These cues initiate actions in the form of scripts, which is a terminology coined by Bruno Latour and Madeleine Akrich to describe pre-prescribed actions inscribed in artefacts (Latour 1992; Akrich 1992, in Verbeek, 2008); in this case the artefact is the cue. Bas Verplanken also points out that timing matters regarding when the cues are to be delivered, and that these might be most effective when change in life situations occur, such as having a child or moving, and this reflects the experiences retold by the informants: The car use started when having a child for both Ola and Kari, and the car use stopped when Ola had his child permanently move in to his household.

> *"-We had a car donated to us, and then the brakes broke down on that one and we had to dispose of it. Then I realized that my life is much lousier without a car: it takes over*

[18] In this context an attitude is a preconceived notion that influence certain behaviours

an hour for me to work door-to-door [with public transport], and just fifteen minutes with the car." – "Kari", on the origin of her transport mode.

"-When he [my son] moved back with me, I sold the car, because the need for the car was no longer there." – "Ola", on the origin of his transport mode.

Schwanen et al. (2012, p. 524) argues that the key advantage of "attitude-theory based studies" of travel and habits is that these models are easy to transfer into policy due to their mechanical nature, but fails to recognize the more complex aspects of causality to focus on attitudes and beliefs as the main causal originators.

So what is their alternative? The authors base their primary argument on the critique of psychology-based transport studies for one-sidedly regarding habits as automatic and mechanical repetition coming from within the structure of the mind, and not take reflective thought into account. They advocate that habits are more central to everyday behaviour than habit psychologists suggest (Schwanen et al., 2012, Chapter 3, intro), and that habit should be thought of as a vector or tendency, rather than an automatic response. As mentioned previously, this point of view on habits is mainly rooted in the phenomenological viewpoints of Félix Ravaisson on one hand, and contrasted with the work of John Dewey. Ravaisson states that receptivity – the ability to undergo change, decreases with each repetition of a task, while spontaneity, the ability to initiate change, increases, to make the initiated change reproduce with less effort with each repetition (Schwanen et al., 2012, sec. 3.1). Additionally, this view suggests that you approach situations in both an active and passive manner, so that you adapt to your situation and begin to anticipate and cherish the changes that are brought on, according to Schwanen et. al (2012, p. 525). The example used is that of someone stuck in a car during congestion at peak rush hour. At first, this scenario elicits frustration, but over time and with repetition, the driver adapts and starts to use this time for different purposes, including activities such as audio books, thinking or relaxation. They might even begin to "need" this downtime and will get annoyed again if they have to partake in transport that does not allow this[19]. This way of relaxing mirrors the idea from "Underveis" about "charging" mentioned earlier (Julsrud, Denstadli, Herstad, et al.,

[19] Note that this exact scenario was described to the researcher of this thesis during casual conversation with an acquaintance – the person had grown accustomed to listening to audio learning books while stuck in traffic, and had grown to miss this "just me" – time when moving on to public transport at a later stage

2014, p. 26), as the need is the same but expressed in a different context. IT's useful to understand here that Ravaissons view is no hindrance to also view habits as automatic, or "not following from reflective thought," as the actions involved have become embodied and enables other activities, creative or reflected, to form as a consequence.

Schwanen et al. also presents the differences between Ravaisson and Dewey to validate their argument: Dewey uses the terms predisposition and not just tendency, where the actions are open-ended rather than pre-determined. He also puts more focus on the individual nature of habits than Ravaisson does: *"'Habits are ways of using and incorporating' objects, tools, the physical surroundings, other human beings in which all these have their 'say as surely as the former'"* (Dewey, 1922, p. 15, in Schwanen et al., 2012, sec. 3.2). He also states that habits formed in a *body-mind-world assemblage* endure and linger, to be re-activated at a later stage. Finally, Dewey makes the point that differences in habit is one of the key differences between cultures, and one of the driving forces behind social change (Schwanen et al., 2012, sec. 3.2).

To conclude, Schwanen et al. makes the following points:

- Habits should be understood as propulsive and generative tendencies, rather than as behaviours.
- *"The brain is the mediator, rather than the originator or container of habits"*, and *"a habit is an emergent property of a body-mind-world assemblage."*
- *"A car habit is that what makes it possible for car, driver, road, signs, passengers, traffic rules to merge into a seemingly effortless whole and what underpins the routine use of cars to access places"* (Schwanen et al., 2012, sec. 3.3).
- They urge the reader to avoid understand habits as dualistic oppositions because they simplify structures and often favour one pole rather than the other.

The issue then is to *displace* "carbon-intensive habits and *nourish* "low-carbon habits," which the authors suggest are only really possible through a reconfiguration of the transport system top-down, and provide alternate habits early in life or when significant changes in the life-situation occurs (Schwanen et al., 2012, sec. 4.1,4.2).

The final remarks that can be taken from this, rather thorough, account for an alternative way of looking at habits in general and transport-related habits specifically, is that the effectiveness of purely behaviour-based methods for altering habits in transport is disputed.

6.4 Research and design ethics

There are two ways of looking at ethical issues in a work of research: The first is to think about the ethics involved in conducting the study, and the second is the ethics of what the study leads to. The ethics involved in working with informants are detailed under chapter 5, Findings. The reason ethics is discussed explicitly is that it seems clear to me that there is no reason to present ethics as its own research question, since ethics, according to Verbeek (2006, 2008), is imbued in every tool and action that human beings perform. Ethics is thus an inherent aspect of technology, and warrants a discussion embedded with the technical discussion. Captology also dictates that research and design into persuasive technologies require defensible ethical standards, and that researchers should employ the "watchdog-role" (Fogg, 1998b, p. 230). This is yet another reason that ethics are discussed separately in this thesis.

This study discussed technical solutions to issues in personal travel, solutions that have several different components, all with their own unique but also overlapping ethical and legal aspects that needs to be addressed. The system should exhibit ubiquitous traits, as laid out by Mark Weiser (Weiser, 1991) and be accessible via a multitude of platforms, both mobile and stationary. Early inquiries suggest that it should be able to make predictions about travel patterns based on multiple data points such as positional data, and Big Data analysis on the sets that emerge from those data points. One example application of this technology would be to inform someone that their normal mode of transport is delayed as they are leaving their house, and presenting another viable route enabling that person to arrive at their destination(s) on time. Another one would be to relate in real-time the availability of wheel-chair or pram spots in the coming bus and advice for alternate modes of transportation if full.

The imagined system will also play a role in manipulating habits related to transport patterns in general, and public transport in particular, captology. This technology can help move people's transport habits from one mode of transportation onto another. Both Big Data and Persuasive Technology can be imagined in various ways depending on your philosophical outlook on how

technology interacts with society. I will try and focus on how we can understand how this technology works, what kind of ethical issues can arise, and what kind of frameworks can be used to discuss and alleviate these issues.

6.4.1 Mediation analysis

To conduct this mediation analysis, I will try to look at some of the existing frameworks for reflecting on ethical issues, as well as looking into specific areas of the design space that are known to hold contested views on ethical issues. The two largest of these will inevitably be the field of Geolocation / Big Data, and the field of Persuasive Technology.

Big Data

The main concerns with using Big Data as an analysis tool are privacy and discrimination, especially in the realm of Public Health (Docherty, 2014), and the flip coin of privacy is surveillance. And even though data are "publically available," does not mean that it's ethical to use them without restrictions (Qiu, 2015). Big data can also reveal patterns that the subject of analysis didn't know, or that they didn't want anyone else to know. For instance, you might believe you are a good jogger, but the GPS might disagree. Or, as evident in the real world (Duhigg, 2013, Chapter 7), shopping practice analysis can alert your surroundings to the fact that you are pregnant, even though you want to control that information yourself. Big data analysis of meta-information and logged data can be both a legal issue and an ethical issue, but privacy law is also based on ethical concerns (Schartum & Bygrave, 2011, Chapter 1). According to Anita Ramasastry (2012), geolocation data can, if not protected properly, be used in ways that the user providing the data did not intend or want. The original data points can be interpreted and utilized very differently from the original intent when viewed in a different context, so mechanisms for handling that will be important.

Big data can mediate our praxis by off-loading certain tasks to the automated algorithms, or on the flip-side, opt-out of certain practices because of the fear of how the data related to that practice will be (ab)used. A travel planner based on location specific data can also mediate our perception by limiting what kind of choices we are presented on our travel patterns.

Captology

Persuasive technologies are all about altering habits and routines, what Verbeek called *behaviour-steering technologies*, and he argues that they might bring up "*associations with the totalitarian technocracy of Orwell's Big Brother"* (Verbeek, 2006, p. 363). So, in this context, I imagine a system that presents choices at the opportune time that effectively nudges the user and promotes a specific choice of action. In that respect, the technology seeks to alter both the praxis by only emphasising certain travel patterns, who are chosen above others based on design[20]. Compare this intentionality to the notion mentioned in a previous chapter about technology and intentionality in the discussion about the morality of technology (Verbeek, 2008), which is another point further proving that design lends ethical aspects to artefacts.

Additionally, perception can be altered, but on a more fundamental level, since persuasive technologies are partially drawing on unconscious mechanisms such as the habit loop, and how the most basic parts of our brains relate to the world around us (Graybiel, 2008 etc.). This means that special ethical care will have to be taken when designing technology that draws on this way of mediating perception, since there is a chance we will not know that it happens.

6.4.2 Addressing the issues

Now I have defined some core issues:

- Privacy (personvern/personopplysningsvern)
- Context awareness
- Altering behaviours
- Technocracy concerns

The final task will be to look at each of these issues and mediations and see how they can be addressed properly.

[20] This is what Fogg calls endogenous intent (Fogg, 1998b, p. 226)

Pathetic Dots

In the book *Code: and Other Laws of Cyberspace*, Lawrence Lessig (1999, pp. 86–88) introduces the concept *Pathetic Dot Theory*, which lists how lives of individuals, "the pathetic dots," are regulated by external forces: Market, Law, Social norms and Architecture. Although the concept originally applied to behaviour on the internet, it can be adopted to create a framework for analysing all the agents that regulate a technology. Note that in addition to regulating the Dot, the four forces are also interrelated, and issues and areas of responsibility might overlap.

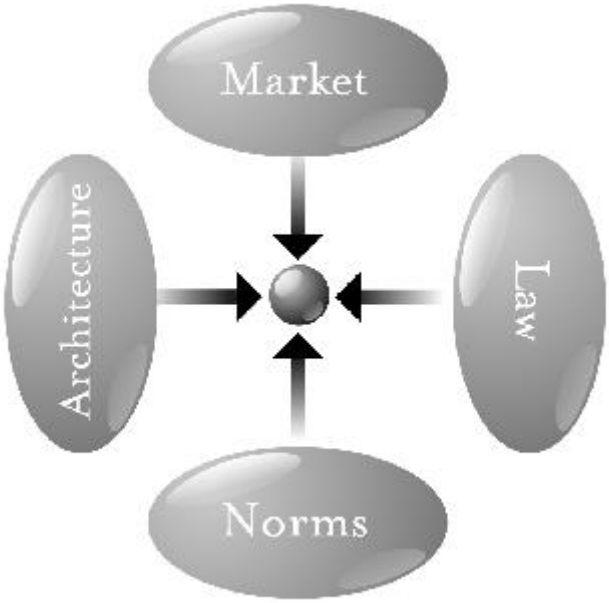

Fig. 20 The basic illustration of the pathetic dot theory, by Lawrence Lessig. This file is licensed under the Creative Commons Attribution-Share Alike 2.5 Generic license. https://creativecommons.org/licenses/by-sa/2.5/deed.en

This way of looking at external factors enables us to understand how each of the "forces" can be responsible for mitigating the ethical issues.

The Law

Since the context of this system is that it is intended to operate in Norway only, the Norwegian law is the legislative mechanism. Norwegian privacy law is based on the European Data Protection Directive[21] (Schartum & Bygrave, 2011, p. 86) by form of Personopplysningsloven (*popplyl*, 2001), and thus should harmonize with the laws in other EEC – countries. This means that by law, there are strict limitations on what kind of information is possible to collect, for how long it can be stored, and for what purpose it can be used. All this has to be decided before the gathering of such information commences. Especially the pre-defined purpose – part is paramount, and would more often than not alleviate issues such as the abuse of data outside of context as presented by Ramasastry (2012). There is, however, a big issue about the privacy law, and that it *only* concerns data that can be connected to an individual, and metadata might not fall under that definition. As of now, it is not clear as to what point the law regulates data that is not yet sufficient to identify an individual, but might be so on a later date due to the *cocktail-effect*. For persuasive technology, there is similarly no real legislation apart from the intentionality paragraph in Personopplysningsloven (*popplyl*, 2001, para. 1), which states that the purpose of the law is to prevent the violation of privacy based on basic privacy theory.

The market

It seems that communicating your intent and being open, honest and transparent about your decisions is good in a market setting when dealing with handling of private information. Although some forms of secrecy in development are unavoidable ('Black-box of design', Quan-Haase, 2012, p. 63), being open could provide a market opportunity. This can also apply to the visibility of compliance with current law. NSB, Ruter, etc. are examples of actors involved in the market. The findings suggest that users appreciate handlers of personal data that communicate their intents and the limits of what data is gathered and the possible use for it.

The architecture

Verbeek (2006) states that designing mediations into the technology can be considered a step on the way to a technocratic society, so using democratic processes in the design would help with preventing this scenario. Open-source platforming and allowing for a broad scope of user

[21] Directive 95/46/EC of the European Parliament and of the Council of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data

choice would also be good. Adhering to the national guidelines for research (NENT, 2007) is also one way of minimizing any potential ethical issues. App-developers, researchers and technology partners are part of the architecture, but also more abstract materials like the code the applications are made of can mediate the way the technology is being used. It's worth noting that the larger socio-technological structures that encompass the entirety of the way we live in cities are very much a part of the architecture for a transport system, and tackling ethics imbued in this large context is similarly difficult to the habit changes in the same context as presented by Schwanen et. al (2012).

The social norms

Respecting people's basic human rights is an important way of not preventing ethical violations. Having ethical reflexivity and understanding that ethics is not absolute (pluralism, Ess, 2010)) is one way of making sure that your product does not violate the norms of others and alienate large user groups. Privacy is arguably a virtue that emerges from the social setting, but the notions on privacy are not identical across cultures or even within one culture. "Ola" understands that privacy is an issue that needs to be discussed, but he does not feel that it applies to him "because he has nothing to hide." There is no data supporting or debunking this stance in the "Kari" – persona. On the topic of behaviour altering, most people would probably not take kindly to the feeling that they were being manipulated, so it's important to employ mechanisms of choice. Commuters, interest organisations etc. can affect norms.

7 Conclusion

> *"Seriously, I would have easily taken the bus to work if it had taken less time. If an express delivery service from home to work had been available, I wouldn't have used the car."* – Informant A, "Kari."

In this thesis, I have looked at how habits that form personal transport can be changed by using ICTs, particularly during the planning stage. This has proven to be a composite inquiry wherein the relationship between technology, habits, feelings and behaviour is inter-dependant and affecting each other. The main topic has been guided by three main research questions.

I have presented two over-arching models on habits, with one model relating more directly to transportation habits, and one more basic, targeting the routine – part of habits. If I then look at habits as at least part routine, there are behaviours connected to those routines, and the routines operate on triggers from the environment. There are technology frameworks such as the FBM and captology that can aid that specific part of behaviour and routine. They do this, both as driving the triggers themselves, based on personalised or customised input, but also by lowering or raising the threshold for motivational or ability-based triggers to succeed or fail, depending on the desirable target behaviour.

- **RQ1: How does these families regard predictability as an important aspect of their daily travel patterns?**

Of all the topics that emerged in the discussions with my informants, one of the topics that they had strong feelings about was predictability in some form or other. But predictability is not the same for everyone: Predictability can be perceived as a prerequisite for a feeling of security when the lack of predictability leads to uncertainty about emergency situations. In this context, predictability interacts with speed and reliability to induce a desired peace of mind that you are able to react to unforeseen situations. On the other hand, predictability can mean that you don't waste your time on doing unnecessary trips, thus reducing frustration and stress. So, even though predictability is an important aspect of travel planning, you can't see the full picture just looking at the topic isolated, because it seems that predictability is just an aspect of more fundamental needs.

- **RQ2: In what ways can mobile ICTs support the need for predictability?**

Predictability seems to have been a desired aspect of transport for a long time, and this is evidenced both from the findings, other research, and business practice. However, even better and more accurate information about the trip is needed. This information can manifest in various ways. The car, being your possession and mostly under your control, is predictable and known. Public transport has some unknown variables compared to the car, such as position, speed, capacity and accuracy, and although some of these unknowns has become more known through ITS applications such as Ruters Real-time system, even more information could be communicated to rival the perceived simplicity of the car. To minimise unnecessary trips and reduce frustration, better fidelity for information in systems that have a finite amount of available items should be implemented. This goes for capacity and availability of buses etc., but also for city bike rental spots. Good travel planner ICTs with the aid of ITS applications and telemetry can help elevate the public transport experience to that of the car, by using open data sets about various interconnected modes of transport, and this is most efficiently achieved with big data analysis. However, big data poses ethical issues about privacy and surveillance that needs to be communicated clearly and dealt with in a proper manner, through co-creative design practices such as service design or participatory design.

- **RQ3: What are the strengths and weaknesses of using captology and more specifically the Fogg Behaviour Model to persuade these families to begin or keep using public transport?**

The Fogg Behaviour Model thus functions on the premise that you have a reasoning for what you do, and you have a routine that enables you to reach your goal. It's thus important to both know what you do and why you do it to be able to see how it can be changed. Since the model describes ways of motivating you or aiding/hindering what you do, the application of persuasive ICTs in order to change what you do will only be effective if the proper motivators or ability-modifiers are present. Captology, and subsequently the FBM, however, assumes that habits are mostly behaviour-based and routines involved can be diverged onto other routines. In the domain of transport technologies, it's also suggested that this way of looking at habits is simplistic and chosen because it's easy to prescribe simple solutions in the form of isolated remedies.

So, the strengths of the FBM is that it's effective at targeting behaviours and is supported by a widely acknowledged routine-centric view of habits, and it's easy to design and make applications that support the model if you just look at your issue "through the lens of the FBM."

The weaknesses of the model manifest themselves in the struggles in defining the travel routine within the confines of the model's definitions, since these routines have varied causes that are not just neurological in nature. For complex domains such as personal transport, the underlying habit model on which the FBM relies might not be adequate to describe the complete nature of these habits, and a phenomenological approach to habit understanding and on how transport habits are shaped by the surrounding society might need to be considered. The FBM might be good for small changes, but can probably not be used as a basis for permanent and wide-spread change on its own.

If we then look at the now critical cases of Ola and Kari, I found that the FBM is only partially applicable to their travel reality, and its utility for these kinds of habit changes might not be generally valid.

So, how can ICTs help with changing habits? Understanding what the users do is a key point, and I have looked at predictability as a key aspect, and there are technologies that exist but can also be improved in this respect, like real-time information etc. The habit models do not agree on the best course of action, whether it is change in behaviour on a small scale that is needed, or change in the social constructs and societal systems that is most effective in the long run. They do, however, agree on the notion that you have to have alternate habits or routines in place, and that the "unwanted" habit needs to be supressed *at the same time* as the "wanted" habit is nourished. In reality, this means that ICTs that help you make that transition must support you on one hand, but deter you on the other hand. Captology and by extension the Fogg Behaviour Model can do this in ICTs, the question then becomes if the application fits it's niche in the larger socio-technical context.

7.1 Further Work

During this study, I have uncovered a vast field of research, in which this thesis is but a drop in the ocean. This study falls short on the number of informants that were available to the researcher, although the methodology should support an adequate data validity nonetheless. To

get an even better understanding of the needs and routines within travellers, more informants and larger studies should be conducted. This also highlights the need to include good, qualitative methodologies in transport research in addition to the quantitative studies that exist today.

When it comes to behaviour change, habits and how to affect what people do, the methodologies that are a part of gamification have not been discussed in this thesis and should be taken into account when envisioning permanent changes within public transport. The mechanisms involved are already a part of the previously mentioned Waze inter-personal app ecology, so further research into other applications of that perspective should be conducted.

What my informants have also shown, is that there are problem areas within their travel patterns that the ICTs alone cannot fix. The frequency and capacity of the rolling stock and infrastructure are beyond the scope of ITS-technology and travel planners, and those concerns needs to be fed to the proper authorities for consideration. The opening hours of the kindergartens are also reliant on both legislative and private bodies, such as the city council and the boards of the individual kindergarten. I should be able to discover all these aspects by using the Pathetic Dot theory as well.

Since noticing that there are many issues with traveling in a city that span a wide area of technical, legislative and organizational areas, I am convinced that looking at travel patterns through the wrappings of service design can yield a good break-down of these issues. Both in the way it enables the user in a direct, co-creative manner, and the way service design thinking forces the designer to include all the actors that provide technology, other services or interact with the entire system on an equal and important level. Travel habits are not easily understood by looking at single incidents alone, and a deeper understanding on how the environment, society and social norms shape our behaviour is surely needed.

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Appendix

Appendix 1: Interview guide (Norwegian)

Introduksjon

Mitt navn er Christopher Neumann Ruud. Jeg holder på med et forskningsprosjekt innenfor samferdsel, og ser på komplekse reisemønstre og hvilke behov og rutiner som er knyttet opp mot disse.

Formålet med denne undersøkelsen er å se hvilken rolle teknologi kan spille i å forenkle valg rundt komplekse reisemønstre, og det er derfor nødvendig å forstå hvilke behov som driver hverdagens rutiner når det gjelder valg av transportmidler i et komplekst reisemønster.

Informer igjen om at deltagelse er frivillig, og at deltageren når som helst kan avbryte intervjuet. All data vil deretter bli destruert.

Spørsmål

«Oppvarmingsfase»

Lette spørsmål, speile statistiske data fra innledende spørreundersøkelse.

Hvilke transportmidler disponerer husstanden i dag?

Hvilket transportmiddel føler dere at dere benytter mest i løpet av en vanlig uke?

«Hovedfase»

Henvise til ett eller flere reisemønstre fra spørreundersøkelsen.
Hvordan oppstod dette spesifikke reisemønsteret?
Var det noen andre alternativer til transportmidler?
Hva er det som gjør at nettopp denne kombinasjonen av transportmidler benyttes?
Hvilke forskjeller er det fra ukedager til helgen? Sommer eller vinter?

Dersom reisemønstrene benytter kollektivtrafikk eller ikke, hvorfor / ikke?
Hvilke konkrete behov er det som gjør at kollektivtrafikk ikke fungerer / oppleves som tilstrekkelig?
Stikkord: informasjon underveis/før, tilgjengelighet, kapasitet, usikkerhet, rutine, vane, økonomi, kostnad, preferanse.
Ikke lede samtalen om mulig.

Hva er din/deres største frustrasjon når det gjelder måten dere har løst behovet på i dag?

«Nedkjøling»

Har du/dere noen tanker om hva et datasystem kunne gjort for å gjøre det mer attraktivt å benytte kollektivtrafikk? «Alt er lov!»

Avslutning

Takke for samtalen, minne om kontaktinformasjon dersom det er noen spørsmål eller det er noe mer de ønsker å tilføye. Pakke sammen og avslutte.

Appendix 2: information pamphlet and consent form (Norwegian)

Forespørsel om deltakelse i forskningsprosjektet «Komplekse reisemønstre og teknologi»

Bakgrunn og formål

Denne undersøkelsen er den del av en masteroppgave ved Instituttet for Informatikk, Universitetet i Oslo (UiO), i samarbeid med Transportøkonomisk Institutt. Oppgaven har som formål å se på hvordan teknologi og apper kan benyttes for å forenkle reisesituasjonen til grupper som utviser komplekse reisemønstre. Med komplekse reisemønstre mener jeg alle reisemønstre som ikke utelukkende er hjem-arbeid-hjem eller lignende mønstre av pendlerkarakter.

Grunnen til at nettopp du/dere er forespurt, er at barnefamilier med små barn ofte har komplekse hverdager, og dermed også komplekse reisemønstre. Utvalget er gjort på bakgrunn av kontaktinformasjon i [utelatt], etter samtykke.

Hva innebærer deltakelse i studien?

Studien er bygget opp av to deler: En spørreundersøkelse på nett, som er ment å være en innledende kartlegging av deltagerne og deres type reisemønstre. Noen deltagere vil, på bakgrunn av spørreundersøkelsen, få forespørsel om å delta på et intervju på ca. 30 minutter på bakgrunn av svarene i den innledende undersøkelsen.

Spørreundersøkelsen vil være nettbasert, og samle inn anonymisert informasjon om transportmidler og – former i løpet av en normaluke, samt kontaktinformasjon som skal benyttes til eventuell andregangs forespørsel om deltagelse på intervju.

Intervjuet vil dekke det overnevnte nærmere, samt gå nærmere inn på å forstå bakgrunnen for at reisemønsteret er som det er i dag. Det innebærer spørsmål om valg av transportmiddel, behov i hverdagen og lignende. Intervjuet vil tas opp på bånd for å lette den etterfølgende analysen.

Hva skjer med informasjonen om deg?

Alle personopplysninger vil bli behandlet konfidensielt. Kun undertegnede og undertegnedes veileder ved UiO vil ha tilgang til identifiserende personopplysninger (herunder kontaktinformasjon og lydopptak.) Lydopptakene vil ikke lagres sammen med kontaktinformasjonen.

Innsamlede data vil bli gjenstand for en kvalitativ analyse, og vil bli anonymisert før publisering. Det skal ikke være mulig å gjenkjenne deltagerne på grunnlag av analyserte data.

Prosjektet skal etter planen avsluttes Mai 2016. Da vil alle personopplysninger, notater og opptak destrueres.

Frivillig deltakelse
Det er frivillig å delta i studien, og du kan når som helst trekke ditt samtykke uten å oppgi noen grunn. Dersom du trekker deg, vil alle opplysninger om deg bli anonymisert.

Dersom du ønsker å delta eller har spørsmål til studien, ta kontakt med

Christopher Neumann Ruud, chrinr@ifi.uio.no tlf 986 44 395, eller

Veileder, Førsteamanuensis Jo Herstad, johe@ifi.uio.no

Studien er innmeldt til Personvernombudet for forskning, Norsk samfunnsvitenskapelig datatjeneste AS for kvalitetssikring.

Samtykke til deltakelse i studien

Jeg har mottatt informasjon om studien, og er villig til å delta i (sett kryss)

Spørreundersøkelsen

Eventuelt intervju

(Signert av prosjektdeltaker, dato)