Thesis for the degree of Doctor of Philosophy in Human Technology Design

User Experience Insight

Steering Experience Design Through Meaningful Incorporation

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Paper 3:

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Other Publications by the Author

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Abstract

Interest in User Experience (UX) is on the rise; however, designing for User Experience presents unique challenges because of the subjective nature of experience. Whereas UX theory is plentiful, there is a distinct lack of precedent when it comes to practical UX design knowledge. The aim of this work is to contribute to the field of interaction design with knowledge on how to conduct a UX centered design process. Specifically, the thesis' goals are to define and exemplify a UX design process through use of design methods and strategies that promote UX design. The User Experience design process is demonstrated through case studies on the design of in-vehicle systems, therefore a secondary goal of the thesis is to generate knowledge for the User Experience design of in-vehicle systems. A series of studies have been conducted within the frame of the thesis with the ultimate result being the concept of **Meaningful Incorporation**.

This thesis proposes **Meaningful Incorporation (MI)** as a design approach for adapting the design process to focus on designing for User Experience. MI is achieved by collecting **User Experience Insight** as the first step in one's design process. User Experience Insight consists of UX data with special attention to the UX aspects of time, emotions, and context. UX Insight is then systematically incorporated into subsequent phases of the design process by using design methods that mandate its use. With Meaningful Incorporation and the utilization of the methods and insights found in the thesis, design professionals can take on UX design without compromising designerly intuition. Instead, Meaningful Incorporation can enhance their process to create solutions that can support desirable User Experiences.

Contents

1 Mission Statement

I am a pragmatist. That is to say, I see value in understanding a problem and then coming up with solutions based on actionable insight. I am also very much interested in relationships between people and technology; how do people think and why do they do the things they do when they use technology? Naturally, User Experience —the study of human experience with technology— is a fitting topic for my interests, and interaction designers are a fitting audience because they are the ones shaping human-technology relationships, at least for interactive systems.

Since the beginning of this thesis work I set out to expand my understanding of people's experience with technology in order to be able to produce actionable knowledge for interaction designers. Theoretical contributions are important but practitioners may also want more hands-on knowledge that can be readily implemented in a project. Since bridging theory and practice is something academia strives for, it is only natural that I would work towards building a bridge between User Experience theory and practice, in order to bring people back into design in a meaningful way.

It is my hope that Meaningful Incorporation and User Experience Insight will be not only a (small) original theoretical contribution to the field of User Experience but also inspire design teams to create new meaningful ways of interacting with technology built on empathy for the user and an understanding of technology as part of modern life.

2 Introduction

Experience is defined as "the process of doing and seeing things and of having things happen to you" (Merriam-Webster dictionary). User Experience (UX) concerns the experiences that people have with technology. Indeed, it is evident that technology has changed the way we experience our lives, sometimes for the worse but often for the better. For example, when one of the participants in a study was asked about the most notable experiences that they had regarding his smartphone, the participant recollected the first moments after the purchase of the device when the (dreaded) setup process had to be done; the participant took the new phone out of a well-made packaging, turned the device on, and then entered his account's username and password. Magically, all of his media, contacts, apps and browsing history were downloaded to the new device, and the participant looked in wonder as the phone took care of the tedious task. The surprise, satisfaction and relief of not having to take the steps of setting up the device were a profound User Experience for the participant, one that left an impression and set the stage for future positive experiences with the device.

The design of technology that interfaces with humans has always been challenging and thus a topic of study both in academic and industrial circles. The personal computer is an apt example of technological advancement. As computers have moved from large, temperature-regulated rooms to a status of personal ownership and ever-presence, there has been great interest in the improvement of the interface between human and computer. Currently, User Experience is a dominant topic of interest for Human Computer Interaction (HCI) in both academia and industry [1], [2]. In order to understand why UX came about to be of such importance it is necessary to take a short trip down memory lane, specifically looking at how UX became a part of HCI.

The academic field of HCI flourished as a result of the popularization of the personal computer. HCI was brought about by the need to make computer interfaces understandable and usable to more than expert users that had specialized training in operating a computer [3]. HCI has been studying the relationships and interactions between humans and computers since the early days of the field in the 1980s [3], with the ultimate goal of improved computer-human interactions. From its conception, the field of HCI has seen many advancements, some of them being paradigm-shifting. These advancements, while in reality gradual rather than discrete, can be described as a series of waves (as per [3]–[5] with each wave bringing about changes in the way that the human-computer relationship is viewed, and as a consequence, the way HCI is practiced.

During First wave HCI the focus was placed on understanding and studying the human with methods similar to those used for the study of the computer [3]. Human factors and information processing psychology contributed to early HCI by providing guidelines, rules and formal methods [4] with which to study and understand human capacity, as it now was a part of the human-computer system. The computer user was, at the time, an expert whose job and training was centered around operating the computer.

Second wave HCI was brought in the 1990s by the need to address "discretionary use" [3] where the user was not a trained expert in computer use, but rather operated the computer as a means to an end. A change of focus towards user needs, group work and a move from rigid guidelines -such as those coming from performance metrics- of the first wave to proactive methods, such as usability testing, characterizes second wave HCI.

The third wave of HCI started in the early 2000s, with great paradigm shifts. Now, focus was placed on non-work, non-purposeful activities, with special focus on aesthetics, emotional factors and a pragmatic focus on the user's experience with technology [4].

As a consequence of the many changes in the field of HCI, theory and practice have been in an ever-evolving state. Initially, the research and industry traditions that were inherited by the human factors researchers that poured into the new field of HCI, sufficed in addressing the research questions of the time. However, by the third wave, issues of culture, aesthetics, and experience evidently required different research approaches than the ones practiced thus far in the field [6], [7].

Since the beginning of third wave HCI, UX has been a primary topic of interest. Experience has unique attributes (as discussed in section 3.2) that require research approaches different than what traditional human factors, psychology and computer science have had to offer. There have been important advancements in terms of UX theory, with many significant researchers contributing their own models and frameworks in order to describe UX from a theoretical standpoint (presented in section 3.3).

Yet, in stark contrast to theoretical abundance, there have been few if any contributions towards structured or formalized ways to research and practice UX when designing interactive systems. This lack of know-how has been previously identified, for instance by Kuuti in 2010 and is still a topic of discussion in the HCI community [1], [2].

2.1 Cars and HCI

Computers have penetrated into many aspects of human experience, and the modern automobile has been no exception. There has been a steady increase of in-car systems, both in quantity and in complexity ([8], Section 1). With the increase in computer systems, there are many human-computer interactions that now take place in the car [9]. Drivers use computer systems to stay safe in the car, to entertain themselves, to navigate and to socialize.

However, the car is not only a technological artifact, but also a context within which users are challenged to balance the ever-important-for-their-safety driving task with other tasks that may interest them more than the driving activity itself. It is the driving task and the safety requirements that driving entails that place special restrictions and require special consideration as to the kind of HCI that should take place in the car. Research on the human-machine interface (HMI) in cars has been predominantly centered on safety, and the methods used originate from the fields of human factors and psychology, with vehicle simulators being used to simulate the driving situation in studies.

2.1.1 Cars and UX

In addition to safety concerns, the User Experience of the driver and passengers are slowly being recognized by the automotive industry as being an important factor of differentiation that can offer competitive advantages to automakers. This means that besides performance and looks, automakers now strive to improve the experience of using the car's interactive systems. One of the characteristics of the automotive industry is that change comes slow, with development cycles lasting many years. This means that while UX may have advanced significantly in other technological fields, in car UX is still very much in its early developmental stages.

In addition, the methods traditionally used in HMI research are unsuitable for User Experience research, as UX research requires holistic, contextual and ethnographic approaches (as detailed in section 3.2). A central issue is that much of the work labelled as car UX work, is really not addressing important aspects of experience in cars such as temporality, context and emotions (for some examples of this practice see [10]–[12]. This may be due to the fact that many studies that are labelled as UX studies have little to no connection with UX theory, but rather use methods from other fields that are traditionally used in car research. Therefore, this type of work is not considered directly relevant to this thesis, since results do not address experience in a holistic way, but instead focus only on certain pre-selected aspects of experience.

There are a few authors whose work is relevant to this thesis since they have been working with experience and aspects of experience in a methodologically grounded way, with the aim to contribute to a UX design process. Knobel has presented doctoral work based on Hassenzhal's model of User Experience (detailed in section 3.3.4).

Specifically, Knobel has used Sheldon's need model [13] to generate questionnaires and interview questions related to these human needs [14]. The data produced is analyzed into experience patterns and then experience stories [15]. An experience pattern contains recurring user activities, related thoughts and feelings and other elements that shape an experience. The experience pattern is meant to be a blueprint for designers in supporting new, similar experiences. The experience pattern is then contextualized into experience stories. An experience story is a story that contains a "contextualized" experience pattern and thus describes how an experience in meant to unfold. Both stories and patterns should aim to fulfill psychological needs, as those identified by Sheldon. One example of the practice described by Knobel is the clique-trip, which is a GPS system meant to enhance relatedness between two drivers in different cars heading towards the same destination [16]. In a similar way, the concepts of ExplorationRide [14], keepClose [14], and Last Gentlemen [17] aim to fulfill different psychological needs. Knobel's work is sharply focused on car User Experience, as the author states he aims to contribute to automotive UX design by having "joy while driving" as a goal as opposed to only having "joy in driving" [15].

Other authors have worked with exploring User Experience in the car with a focus on collecting insights related to in-car experiences. Karlsson & Pettersson explored how users may envision futuristic autonomous cars [18] with a focus on context and understanding users' needs. The authors invented a novel technique based on participatory design where users were asked to design their ideal autonomous car. Cycil examined routine family car journeys by using video recording and interviews [19]. In a similar vein Jain and Lyons explored travel time in the car and found that commuting time is not necessarily wasted but can be utilized for positive experiences instead [20].

The studies mentioned above are most relevant to the work in this thesis although their aims are different to the main aim of this work, as they either target only in-car experience design by applying a pre-existing UX model, or they focus solely on studying experiences that car users have.

All of the studies in this thesis have been targeted towards understanding User Experience in cars. I have–on purpose–not limited the scope of this research to a specific instrument in the car, or to specific situations. Instead, the user data has directed

attention towards aspects of experience that the users found worthy of discussion. The aim of this decision is avoid missing important aspects of experience due to being limited in scope by preconceptions.

2.2 Aim

The aim of this thesis is to support interaction designers in designing for User Experience. The support is presented with the concepts of **User Experience Insight** (described in 6.7 and 7.2.1), **and Meaningful Incorporation** (described in 6.7 and 7.2).

The User Experience design process is exemplified through a series of case studies in the domain of in-vehicle interaction design. The data produced from the case studies serve as examples of User Experience Insight and can be used in designing for the User Experience of interactive car systems.

2.3 Research Goals

1. The primary goal of the thesis is to define and exemplify a User Experience centered design process by using design methods and design strategies that promote UX design.
2. The secondary goal of the thesis is to generate knowledge that can be used for the User Experience design of interactive car systems.

2.4 Scope

The scope of the thesis is determined by the contributions of the work, in the form of findings. There are two types of findings present in this thesis; design processes with designs methods, and car User Experience Insight.

The design methods and design process that are described in the following chapters are targeted towards interaction designers, with case studies in the automotive domain, but with resulting methods and processes that can be used for interaction design, or other types of design as well. It is up to the discretion of the reader to decide whether the tools and knowledge presented here are applicable to their domain of interest and whether adaptations and modifications of these tools are warranted before their application [21, p. 226].

The car User Experience Insight can be used as a guide for the User Experience centered design of automotive systems, bearing in mind that the population from which the data originates is mostly of Swedish nationality and driving culture.

2.5 Research Projects

During the period of this thesis I have been involved in two research projects that have been funded by FFI-Vinnova.

The first project is titled EFESOS (Environmental Friendly Efficient Enjoyable and Safety Optimized Systems). The general aim of EFESOS was to "make driving of future cars more environmental(y) friendly, enjoyable and safer by means of optimized systems." Within the scope of this project, my aim was to collect knowledge that can help promote the enjoyment and satisfaction of the driver, as well as investigate different ways to evaluate the perceived satisfaction and enjoyment of the car driver.

The second project, titled AUX (Automotive User Experience). The main aim of AUX is to "improve the competitiveness of the Swedish automotive industry by providing meaningful and significant metrics and methods for a User Experience (UX) focused design process." The tasks I was assigned in AUX are a continuation of my work in EFESOS, but this time much more focused on the exploration of the driver's User Experience. The purpose of my work in AUX was to collect UX Insight and then explore how this data can be used in a User Experience centered design process.

3 Foundations

User Experience may have appeared in the field of HCI during its third wave, but the study of human experience has been ongoing for quite some time now; the Greek philosopher Protagoras is one of the earliest examples of placing human experience in the forefront with his famous statement *"man is the measure of all things."* In modern times, the philosophical stance of Pragmatism has significant impact in the study of experience, and particularly in the field of Interaction Design. Further, HCI traditions have also shaped the ways that User Experience design is currently studied and practiced, as HCI researchers have delved into theoretical and practical explorations of experience with IT. The rest of this chapter is dedicated in providing background that can illuminate the reasoning for the approach, methods and tools that were selected for the study of User Experience in the domain of interaction design.

3.1 HCI and Experience

As mentioned, HCI has gone through a series of incremental changes that have slowly pushed the priorities of the HCI researcher from optimizing tasks to enabling desirable experiences. These incremental changes can be organized—for the sake of clarity—as a series of waves of change, as seen in figure 1. With each wave, the view of the computer operator, and thus the way the operator was studied and treated, changed, and with it changes and additions were made to the methodological approach that was popular during each wave.

Human factors, computer science and information processing psychology contributed to early HCI by providing guidelines, rules and formal methods [4] with which to study and understand human capacity as it now was a part of the human-computer system. First wave HCI started in the 1980's and focused on specialist users whose training and exclusive job was to operate complex computer systems [3]. Users were viewed as another cog in the machine, and HCI's primary goal was to improve machines to reduce mental and physical strain in order to optimize user performance.

Wave of HCI	First	Second	Third
Time Period	1980s	1990s	2000s+
View of Computer Operator	Humans	User(s)	People
Influential Disciplines	Human Factors, Computer Science, Psychology	Sociology	Design, Ethnography
Methodological Approach	Formal methods, Rigid guidelines	Proactive methods, Usability	Ethnographic, in-context

Figure 1: The Waves of HCI

The Second wave of HCI came about in the 1990s with the popularization of the computer as a personal artifact meant to be used by everyday people with no special education in computer science. The concept of Usability, steadily gained popularity as "good" usability became one of the primary goals of HCI experts of the time. Usability compromised system effectiveness and efficiency with user satisfaction in an attempt to bridge what the experts of the past thought was important with what users considered as important. Sociology lent its proactive methods to HCI in that period [4] in order to enable user research that could capture user satisfaction along with task efficiency measures.

With the turn from second to third wave HCI the main focus changed from being placed on the study of Usability towards the study of experience, as industrial goals also shifted in the same direction. However, the methods, tools and approaches used did not necessarily change as well. In order to understand the significance of this very fact we must examine the differences between Usability and experience.

3.1.1 Usability

The International organization for Standardization defines usability as:

> *"The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use."*
>
> ISO, 2000

This definition is quite specific in outlining the components of Usability, namely the **effectiveness, efficiency and satisfaction**, as well as the necessary conditions that must be fulfilled in order to be able to define Usability with an acceptable degree of specificity, namely the **specified users, specified goals** and **specified context of use**.

Effectiveness refers to the ability of an artifact to accomplish a specific goal. The answer to the question of effectiveness is a binary answer, a yes or a no.

Efficiency refers to the amount of resources needed for an artifact to accomplish a specified task, and often this is measured in time needed to complete said task.

Satisfaction is an indicative of how satisfactory of an experience is carrying out and completing the task by using the artifact, and cannot be measured with the same quantitative methods as effectiveness and efficiency, as the first two are objective measures whereas satisfaction is subjective.

The three conditions that precisely define usability are also well-defined:

- The **"specified users"** condition indicates the importance to clearly outline the type of user that the usability assessment is done for. Is it a computer expert with years of experience or a first time user?
- The "**specified goal**" condition indicates the necessity for specific goals in order to be able to assess usability. Are we evaluating the usability of a hammer in hammering a nail on a concrete wall or a wooden wall?
- The "**specified context of use**" is also of great importance. Is the task to be completed outdoors, in variable lighting and weather or indoors?

An applied example of a usability assessment would be to evaluate the effectiveness, efficiency and satisfaction of finding and playing a specific song using the interface of a streaming music system in a car (specified task) driving with a certain speed on an empty highway (specified context), for a technologically skilled person in their mid-20s (specified user). Goals that are specified in an amount of detail that afford the usability professional to determine whether these goals are accomplished or not would need to be selected. The measures of effectiveness and efficiency are quantifiable, and therefore respond well to quantitative study designs. The measure of

Studies support that factors such as the user's needs, wishes and emotions have great impact on user satisfaction.

satisfaction, however, does not behave in the same way, as it is a subjective measure heavily dependent on subjective interpretations. Adding to this difficulty, Hornbaek and Law [22] have shown that measures of users' perceptions of phenomena do not generally correlate with objective measures of phenomena, i.e. good efficiency and effectiveness scores do not always correlate with high satisfaction levels. These authors conclude that some usability models are problematic since they are unable to properly address the very important subjective components embedded in the very definition of usability.

Furthermore, studies support that factors such as the user's needs, wishes and emotions have great impact on user satisfaction. Den Ouden et al. showed that 48% of product returns are attributed not to a violation of the product's specification or usability flaws, but to inabilities of these products to meet the user's needs (28%) or buyer's remorse (20%) [23]. Another study of ATM machines showed that subjective usability judgments of these machines correlated strongly to aesthetic elements of these machines and not usability metrics [24] and these findings were replicated by Tractinsky et al. [25].

While Usability is a well-crafted measure for effectiveness and efficiency, it is clear there are aspects important to interactions with computer—some of which are even in the definition of usability—that the concept fails to properly account for. User Experience fills in the space needed to cover these aspects as we will see in the section below.

3.2 Towards User Experience

In contrast to Usability, User Experience is defined as *"a person's perceptions and responses that result from the use or anticipated use of a product, system or service" (ISO)*. The term of User Experience has been increasing in popularity since its inception in the mid-1990s when Norman helped bring the term into HCI [26]. Third wave HCI is dominated by a focus on User Experience, with an ever increasing number of publications on the topic (715 out of 936 articles at least mention the term "User Experience" in CHI 2015 alone). Experience has been a focus of research long before computer users, and *User Experience*, existed as a concept. In the following section we will take a closer look at the study of experience in pragmatism, a philosophical stance that informs the study of User Experience in HCI.

3.2.1 Pragmatism and Experience

While the thesis aim is to be close to practice, as evident by the appended studies, there is much to be gained through deliberate, applied use of philosophical principles that are relevant to User Experience.

The study of experience is central in Dewey's pragmatism, a philosophical stance that informs the epistemology of modern User Experience research. In his seminal work, Art as experience [27], Dewey argues against the predominant ideas of the time that the value of art hang solely on the resulting object of a work of art (e.g. a painting). Instead, Dewey states that:

> *"An experience is a product, one might almost say bi-product, of continuous and cumulative interaction of an organic self with the world. There is no other foundation upon which esthetic theory and criticism can build"*
>
> Dewey, 1934

The author thus places focus on the experience of art, which is a function of the art, the person that is experiencing art and the myriad of factors that have an influence on the experience. McCarthy and Wright examine Dewey's teachings in the frame of HCI, and state that *"…experience is constituted by the relationship that forms between self and object, the concerned, feeling person acting and the materials and tools they use…"* In other words, **experience is emotional, personal, subjective, and unique to each person** [6]. Indeed, we humans *experience* our lives and this is how we go about in the world. Further, Hookway describes how **experience is hard to define for us humans because we are partial to it, therefore we cannot separate the experience from the self**:

> *"Experience is a process through which we interact with our surroundings, obtaining information that helps us to meet our needs. What we experience is shaped by our habits of expectation and there is no basis for extracting from this complex process the kind of 'thin given' beloved of sense datum theorists. We experience all sorts of objects, events and processes, and we should not follow philosophers who seek to impose a distinction between the thin uninterpreted data of experience and the inferential processes which lead us to interpret what we experience as books, people and so on. The dichotomy between the passive given of experience and the rich result of our active conceptualization is not supported by our experience."*
>
> Hookway, 2010

experiences are formed in through the dialectical relationship between the self, the artifact and the environment.

Karapanos signifies the importance of the self through his framework of factors that cause diversity in User Experience [29], where he states that even with everything other variable, such as the artifact and the context, kept constant, different people can have vastly different experiences.

Imagine two different people encountering the iPhone for the first time. The phone is a demo unit, carefully placed on display. These two people pick up and try the phone for the first time. The first person tests out the customization of the home screen layout. This person likes to organize their home screen in a particular way, and they find the iPhone lacking. The second person is captured by the thin metal frame of the device and appreciate the craftsmanship. Two very different experiences of the same artifact in relatively the same context. [6] exemplify the individual, subjective nature of experience much more vividly, by contrasting the relationship a nurse has with their patients, to the relationship a hospital manager has with the same patients. The nurse cares for and ensures the patient's well-being in an intimate, individual level, whereas the hospital manager must look at the bigger picture. For the nurse, filling in hospital paperwork is just time away from patients in need, whereas for the manager, this paperwork may be essential in running a better hospital.

Experiences are formed through the dialectical relationship between the self, the artifact and the environment.

Experiences shape who we are, how we behave and how we think about the world. Wakkary [30] discusses the impact of the pragmatist standpoint regarding experience in interaction design. The author finds that:

> *"Dewey committed to the non-metaphysical notion that human knowledge is provisional, incomplete, and probabilistic. This disavowal of metaphysics left no room for absolutes and certainties. Such a commitment was neither a reason for despair nor false comfort but a practical matter of philosophically engaging with human experience as fully as possible without recourse to underlying absolutes or transcendental truths."*
>
> Wakkary, 2009

As a consequence, Wakkary supports that human experience cannot be described by transcendental truths and underlying absolutes, but instead experience possesses the characteristics of being provisional, probabilistic, and fully dependent on an abundance of ever-changing, ill-defined factors. These insights have dramatic impacts in the way that User Experience research and design should be practiced.

Indeed, Sengers, writing about the study of User Experience and UX design, finds that a pure efficiency-oriented approach aims to design the most optimized solution through use of formal experience models. This kind of approach can be easily found in traditional HCI where cognitive models of users are employed in order to predict human behavior and thus design optimal human-computer interactions [31]. When it comes to UX design it seemed that these models fell short and somehow failed to accurately capture the complexities of human experience according to the author. Sengers suggests that in order to solve this issue we must realize that we cannot fully represent experience within the designed software so instead we can try to set up more nuanced relationships between the computer and targeted experiences, and then let events (and experience) unfold and emerge through use.

3.2.2 Activity Theory and Experience

Yet another tool that can support the study if experience as well as designing for experience originates from the philosophical works on Scandinavian Activity Theory [32]. Activity theory provides a conceptual framework for HCI in order to better understand the relationship between human and an activity, the same relationship from which experience spurs as we discussed in the previous section. The conceptual tool describes three levels of an activity (as found in [33]; The **Activity** itself (e.g. travelling to meet one's parents), **Action** (e.g. driving a car) and **Operation** (e.g. operating a steering wheel). This division places focus not only on Action and Operation, but the Activity itself.

More interestingly each of these three components must be studied in different ways, however it is necessary to study all three in order to study the User Experience since all three influence UX in different ways: Operation of a grippy steering wheel can provide a positive initial, visceral experience; The car driving action tests the car's use qualities as a responsive car can be fulfilling whereas a car that drives like a 'boat'—what some car enthusiasts call cars with poor handling—can degrade the experience. Finally, the Activity of visiting one's parents can have deep effects on the experience: for instance, visiting a seriously ill father can influence the driving experience in dramatic ways. Activity theory can help UX researchers and designers to shift from a task-driven view

of human activity and experience, to a more holistic, narrative-driven approach that can be inclusive of factors that significantly influence the experience of the user yet, would have been overlooked in standardized questionnaires.

3.2.3 Human Needs and Experience

Human Need theory has been used to summarize and generalize the motivators that drive human behavior. Understanding the user's needs can provide a deep understanding of what kind of experiences the user may find desirable. Needs embody the assumption that all humans strive for "certain, fundamental qualities of experience" [13]. Therefore, if human needs can be defined, captured and designed for, the resulting experiences will have greater chances of being positively received by the user, a user whose aim it to maximize thriving and development [34].

The most popular early example of a human needs model is Maslow's hierarchy of needs, a hierarchy that was initially embraced by academia and industry as shown by the surprising amount of pyramid variations that have popped up over the years [35]. Maslow's model has been criticized as lacking necessary empirical foundations to support its claims and verify its accuracy [36].

A more modern human needs theory is the Self-Determination Theory (SDT) [37]. This theory postulates that there are three main human needs and that all of them must be fulfilled for an individual to be happy. These are: *Autonomy*, *Competence* and *Relatedness*. ***Autonomy*** captures the human need to be free to make decisions and determine one's future. ***Competence*** describes the need for any human to feel useful and be able to use one's skills to respond to challenges that arise, and ***Relatedness*** describes the need to be social and connect to people that are dear to us.

There are several other need models. Sheldon performed three studies in order to compare all these models (including Maslow and Deci & Ryan) and generated a unified needs theory [13]. The study resulted in the SDT needs of **autonomy, competence, relatedness** and the addition of **self-esteem.**

Human Needs Practical Implications

The Needs add a lot of value towards designing for User Experience in their use as a focusing mechanism that can allow designers to look for design solutions that service one or more of those needs. However, it is important to state that these needs are extremely abstract and therefore cannot guide design sufficiently in many cases. When most possible design solutions fulfill these needs, it is evident that the needs are no longer useful. Max-Neef has introduced the concept of a *need satisfier* [38] which is a

specific way that a person satisfies a human need. For example, I may satisfy my need for competence by learning how to brew artisanal coffee, whereas someone else satisfies this need by partaking in volleyball. These activities can both be satisfiers for the need of competence yet they have little else in common.

3.3 User Experience

The effort to bring experience into HCI did not stop with the teachings of pragmatism. Many researchers that have been working with HCI have introduced models and frameworks of experience in HCI, or User Experience. The most popular frameworks and models of User Experience are summarized in this sections. In order to better examine the available theoretical work on User Experience, especially considering practical use of frameworks and models each of the theoretical approaches is accompanied by an example from the automotive field. The aspects of experience that the frameworks outline are described in the context of the car and its owner. Further, and in order to stay true to the aim of the thesis, the interrelations and practical design implications of these frameworks are briefly discussed in this section as well.

3.3.1 Emotional Design

There is a considerable amount of theoretical work that surrounds the concept of User Experience. There are frameworks that focus on certain aspects of experience, with *emotion* being one such aspect. Donald Norman introduced the framework of *emotional design* in his 2004 book [39]. The framework describes three levels in which design can be meaningful for the user.

The first one is the **visceral** level that occurs when the user first interacts with an artifact. First impressions are constructed in this level, and immediate emotions arise from the interaction with the artifact and form the user's experience. For example, interacting, for the first time, with a car that a user is considering to purchase brings about visceral impressions that color the user's experience. The smell of the car, the colors, the feeling of the interior seats and that first interaction with the car's HMI shape the user's opinion. Visceral level design is easy to design for but also fleeting, as first impressions are quickly replaced with behavioral level experiences.

The second level in the emotional design framework is the **behavioral** level. Interacting with the artifact adds to the User Experience by building on to the visceral impressions of the user with the experience of using the artifact, along with the artifact's functionality and usability. In the car example, part of the behavioral level can be driving the vehicle, getting a feeling for how the car performs and how the car's HMI functions.

Is it easy to use the GPS function? Can the user easily connect their smartphone? Is android auto or apple car available? How do the advanced driver assistance systems (ADAS) behave in use? The answers to these types of questions provide the user with the experience of using the artifact, and how it behaves in different usage scenarios. Behavioral level design makes a more lasting impression than visceral design. With each use, the User Experience of and with the artifact is shaped further, as determined by how the artifact behaves in different situations.

The third level in Norman's framework is the **reflective level** of design. In this level, the artifact forms stronger, longer lasting connections with the user through enabling meaningful experiences that may correspond to the user's ideals, values and beliefs. For the environmentally conscious car owner, a reflective level design can be an electric car that is designed to minimize the carbon footprint of using the vehicle, or a liberal use of renewable materials in the making of the car. Adversely, for the accomplished business person, the car can be a symbol of prosperity and financial success.

Norman's emotional design can be helpful in highlighting behavioral and reflective aspects of experience that are not immediately visible to designers, as well as assist designers by providing some structure that can help prioritize certain user needs through, for instance, the use of the framework in the analysis of narrative data. The designer can look for components that refer to visceral, behavioral or reflective issues in user narrative and then use this insight in the design more improved interactions.

3.3.2 Pleasurable Design

The four pleasures framework by Patrick Jordan [40] aims to explain four discrete ways in which interacting with products provide pleasure to the user. The framework aims at emotions and similarly to Norman's emotional design, can be seen as an aspect-oriented approach to UX.

Physio-pleasure is the first type pleasure of the framework. Physio-pleasure concerns physical pleasure that originates from the stimulation of the five senses. The smell of a new car, the feeling of the leather seats, or the excitement that comes from turning the car on and seeing the animations of the HMI for the first time fall into this category.

Socio-pleasure concerns rewarding feelings connected to being social. Humans are social animals and thrive when being able to meaningfully connect with people that are significant to them. For the car owner, socio-pleasure can be facilitated through use of the travelling time to connect with beloved family members via car Bluetooth calls or through sharing the experience of a road trip with dear friends.

Psycho-pleasure is derived from psychologically rewarding activities such as learning, engaging in a stimulating activity and entering is known as "flow" [41] where one's skills and abilities are matched with the task at hand and the person can find satisfaction and fulfillment in accomplishing the activity. Psycho-pleasure may originate, for instance, from operating a usable infotainment car system that affords a seamless interaction experience.

Ideo-pleasure originates from products and activities that somehow speak to the user's values, beliefs and ideals. Environmentalism, fulfilled through technology that assists the driver in spending less energy, or a sport mode that fulfills the car owner's needs to express youthful vigor are examples of ideo-pleasure.

3.3.3 Framework of Product Experience

Yet another framework that aims to describe UX is the framework of product experience by Desmet and Hekkert [42]. In the framework, which is focused on product use, the researchers distinguish three levels of product experience: **aesthetic pleasure, attribution of meaning, and emotional response.**

The **aesthetic experience** is enabled "by the product's capacity to delight one or more of our sensory modalities" [42]. In other words, this level of experience corresponds to stimuli that our senses perceive, similar to the *physio-pleasure* in the 4 pleasures framework and the *visceral level* in the emotional design framework. The first impressions of the HMI of a car fall into this level of experience.

The level **of attribution of meaning** encompasses experiences that, through interpretative cognitive processes, memory and associations ascribe symbolic value to aspects of the product. This type of experience is also represented in Jordan's psycho-pleasure level and Norman's behavioral and reflective levels of design. An example could be the meaning attached to a car because of the memories that the owner associates with the car.

The level of **emotional experience** is comprised of emotions that arise related to the product or product use. Here, Desmet and Hekkert use appraisal theory [43] where emotions arise from an internal process of appraisal of a stimulus regarding whether the stimulus is beneficial for the person's well-being. For instance, a car may be appraised positively if the car owner's interest is to have freedom of travelling, yet, a car can be appraised negatively if it does not match the car owner's interest for frugality.

3.3.4 The Be-Do model of Experience

Inspired by Activity theory (e.g. [44], Hassenzahl introduced a model of experience consisting of a user goal hierarchy of **motor-goals** that have to do with users operating technology, **do-goals**, that have to do with the user's actions, and **be-goals**, that have to do with the user's motivations, emotions and meaning-making [45].

These three levels are also described as answers to the questions **Why?** (be goals, for instance I use a car in order to get to work, that is my reason for the activity), **What?** (do goals, for instance I operate the car by using the wheel and pedals) and **How?** (motor goals, for instance using my arms, hands, legs and feet to operate the car). According to the author *"...the distinction [that these three levels offer] is a valuable conceptual tool to address the different levels of interacting with technology"* [45]. The Be-Do model of experience broadens the scope of the designer through use of Activity theory in an experiential frame. Designers are urged to consider not only how users interact with technology, but also *why* do users bother in the first place? While it is obvious that, for example, very few people drive a car because of the driving activity, but instead they drive because they wish to transport themselves, it is easy for designers to forget these *why?* questions especially when focusing on details of the design.

3.3.5 The Four Threads of Experience

McCarthy & Wright [6] draw from Dewey's and Bakhtin's pragmatist approach in order to argue that experience must be studied as a whole and in context, and not removed from the situations in which it emerges. The authors introduced four threads of experience as a way to focus, and not leave out, important components UX more so than to suggest that one should include some of these components while excluding others.

The first component is the **sensual thread**, which relates to the human senses much like the visceral emotional design level of Norman [39] and the physio-pleasure of Jordan [40].

The second component is the **emotional thread** that highlights the importance of emotions in the shaping of an experience. McCarthy and Wright make a point to highlight the undeniable relationship between the emotional and sensual threads which could be exemplified by the experience of someone visiting a showroom interested in purchasing a new car, and being overcome with sensual stimuli when entering a car for the first time: the bright showroom lights, the new car smell, and the modern interior and instrument cluster stir emotions that shape the first interaction experience with the car, and set expectations for future experiences.

The third component is the **compositional thread** of experience. With this thread the authors place great importance in how the experience unfolds, and evolves as a dialogical relationship of its parts. Similar to an orchestra that is more than just the sum of the individual musical instruments that participate, the very existence of an experience relies in the relationships that unfold between its components. Take the example of a driving experience through the woods with a convertible car: the empty road allows for a smooth ride with no stops, the sun peeks through the tall trees and the breeze delivers the smell of the forest to the driver, further enhancing the emotions of the moment. The car can, for instance, withhold any secondary information to minimize distractions and allow the driver to immerse themselves in the moment. The overall experience is inseparable for these parts, but instead it is the composition and the relationships of the elements that amount to the driving through the forest road experience.

The fourth component is the **spatio-temporal thread** of experience. This thread of experience concerns the effects of a User Experience on the user's perception of time and space. Drawing from Bakhtin's idea theory that *"all contexts are shaped by the quality of time and space that they produce"* [6] (p.91) the four thread framework recognizes the importance of the impact that an experience makes on the time and space in which it takes place. Indeed, one can relate to the fact that time seems to pass by slower when one is waiting for something, perhaps remembering the seemingly ever-lasting last few minutes of a lecture. Or perhaps time and space can be influenced by a thrilling driving experience that makes time fly by and also distances seem shorter than they really are.

3.3.6 Factors That Cause Diversity in Experience

Instead of presenting a framework of User Experience per se, Karapanos [29] chooses to place the focus on four salient factors that cause diversity in experience. With this, the author highlights the uniquely personal and individual nature of experience. These factors are: the **individual**, the **product**, **time**, and the **situation**.

The **individual** factor describes the obvious, but very significant effect of individual characteristics on the User Experience with a product. For example, one's upbringing and previous experiences with automobiles may steer that individual to be positively predisposed towards future experiences with cars. A young woman that grew up in a family of car mechanics may indeed feel comfortable with cars rather than a young man who has never seen a car engine before.

The **product** is another evident factor that influences User Experience. For example, car features, and the design of the exterior and interior can drastically shape the kind of

User Experience to be had with the car. Cars perceived as sporty will cause users to expect and anticipate a sporty driving experience, whereas a luxurious limousine will incite expectations for a smooth, comfortable

Time has a significant effect on experience. As time passes experience unfolds, develops and changes. For example, a user that is initially reserved and distrusting towards an automated parking system in a car may, over time and after testing the system, change their opinion and therefore future experiences that they have with parking the car, as trust in automation builds over time [46].

Finally, the **situation** has drastic effects on experience similar to how context of use is important to usability. Driving in a crowded highway in Los Angeles may very well change the experience with the car as functions that support this type of activity become more important to the user. Can they make calls, listen to music or otherwise keep busy while slowly going through the heavy traffic? Is the noise isolation and the connectivity options of the car up to par? Now consider a drive in rural area during spring. Does the car have an open rooftop in order to enhance the enjoyment of nature? Are there navigation options that make the user feel secure in finding their destination? These examples show that the situation changes the user's priorities and therefore the potential experience to be had with and through the car.

3.3.7 Aspects of User Experience

The models and frameworks above share some common aspects as shown figure 2 below.

Author	**Experience Model**	**Aspects of Experience**		
		Initial	With Use	Through Use
Norman	Emotional Design	Visceral	Behavioral	Reflective
Jordan	Pleasurable Design	Physio	Psycho	Socio- Ideo-
McCarthy & Wright	Threads of experience	Sensoral	Emotional Spatio-Temporal	Emotional Compositional
Hassenzhal	Be-Do	Motor	Do	Be
Desmet & Hekkert	Product experience	Aesthetic	Emotional experience	Emotional & Meaning

Figure 2: Experience models and how they relate to each other.

The models and frameworks of User Experience that were detailed above have their elements organized in three categories based on how experience unfolds over time [47], and on a division inspired by Activity Theory [48]:

- Initial Experience: These elements describe first impressions and experience that arises from these first interactions with the artifact. The Materials that the artifact is made of, the UI elements that the artifact may possess e.t.c., heavily influence this initial experience.
- Experience With Use: These elements include the usability of an artifact and other experiences that arise with and by using the artifact.
- Experience Through Use: These elements include parts of the experience that arise through use of the artifact. The value and meaning of the artifact is defined here. For example, the freedom and independence that a car affords its owner by enabling visiting remote places, does not stem from the experience with the car, but is a valuable experience that occurs through using the car nonetheless.

3.3.8 Practical Implications

Pragmatism and Activity Theory have stark implications regarding how UX research and design should be practiced. The pragmatist stance informs UX work by underlining the importance of **context**; that is to not only take a reductionist approach and study singular factors in a controlled experiment, but to study lived experience where it emerges, and with considerations of whatever factors may influence the experience, even though these may not originate from the artifact itself. Further, Activity theory places focus on **time**, and the user's ultimate goals instead of only looking at tasks in a vacuum, which is something that often occurs in usability studies. User research methods that allow for the necessary wide scope that can capture the fine nuances that make experience unique are rooted in Ethnography and situated, contextual user research. Therefore, these philosophical disciplines clearly pave the way for the researcher and designer that aspires to work with UX. Finally, according to the described UX models, **emotions** are a significant aspect of experience that must be considered in UX design. If we are to design for experience, we must understand what motivates users to commence different activities in a deeper level, and then design in order to enable them in their pursuits in all levels of an activity.

Context, time and emotions are significant aspects of experience that must be considered in UX design.

3.4 The Design Process

The thesis concerns designing for User Experience, and it is therefore imperative to examine the design process as a general activity before one can proceed with a specialized, experience-centered design process.

Design is a complex activity that rests in the in-between of science and craft. The goal of this work is to support an experience centered design process with tools and design methods that will help designers to improve upon the experiences that they design for. While design research has an established scientific tradition, there are few researchers that have given descriptions of the design process. This can be attributed to the fact that design is a non-linear activity but rather a set of steps that must be re-configurable in order to adapt to a wide variety of design problems.

Design problems have been described as *wicked* problems [49] and this is a major differentiating factor between design research and other types of research, as well as the main reason for the scarcity of models of the design process. Wicked problems are problems "that is impossible to solve due to incomplete, contradictory, and changing requirements" [49]. Similarly, Jones states *"Designing, like navigation, would be a straightforward matter if one did not have to depend upon inadequate information in the first place."* [50].

Jones has presented a design process model that is purposefully abstract in order to describe the design activity while still allowing for the iterative approach that permits designers to tackle a variety of design problems. Jones' design process consists of the phases of **Divergence, Transformation and Convergence**. This process model is suggestive and should be adapted to fit the unique circumstances of each design problem.

Divergence requires legwork as opposed to armchair speculation.

Divergence "refers to the act of extending the boundary of a design situation so as to have a large enough, and fruitful enough, space in which to seek a solution." [50] (p.64). The primary objective of this phase of the process is for the designer to increase their understanding of the design problem, and convert this understanding into requirements that can be used in later stages of the process. Often, this phase is where user research methods, such as ethnographic observations [51] and interviews [52] take place. Jones makes a point to state that divergence requires legwork as opposed to armchair speculation; that is, the designer must attempt to understand the fears, wishes and

motivation of the user in context where people and their behaviors can be observed, studied and hopefully understood.

Transformation is the idea generation phase of the design process. The designers convert the possibly complex requirements into design by *"deciding what to emphasize and what to overlook"*, [50] (p.66) using their design skills, and an array of design methods. Through ideation, possible design solutions are created, iterated and turned into prototypes. Examples of transformation methods are the future workshop method [53] used in *Study 2* and Skewing [54].

Convergence is the phase of the design process where possible solutions are reduced into a final design outcome through a process of rigorous evaluation. The prototypes and ideas that result from the transformation phase are tested against the requirements from the divergence phase and against the designer's intuition and sensibilities. Evaluation methods such as checklists, and ranking & weighing [50] help designers conduct evaluations and make decisions.

Similar design process models to that of Jones can be found in several other academic texts. In his book "designing interactive systems", Benyon [55] presents what he calls the "techniques for designing interactive systems" section with chapters ordered as follows: **understanding**, which includes user research methods such as interviews and probing, **envisionment and design**, which include design methods and **evaluation.** Preece, Rogers and Sharp [56] p. 15) outline the process of interaction design as one involving four basic activities: **establishing requirements, designing alternatives, prototyping and evaluating**. Jarvis, Cameron & Boucher [57] present annotation of a design process where there are clear steps of **gathering requirements**, and then **ideation** and **evaluation** in iterations and with increasing attention to details. Cross [58] presents a design process with the stages of **exploration, generation and evaluation** in iterations, and then **communication**. Lawson [59] outlines a design process of **Formulating, Representing, Moving, Bringing problems and solutions together, Evaluating and Reflecting.**

The models above can be summarized by a model of the process as a three step model (as per Jones, [50]) of Analysis, Synthesis, Evaluation shown in figure 3 [8].

Analysis	Synthesis	Evaluation
Defining the problem space Requirements collection	Idea generation Prototyping	Evaluation against requirements Selection of final concept

Figure 3: The Design Process

Analysis is often the initial phase of the design process. During this phase the design team has to define the design problem, often by collecting requirements for the design outcome. A good analysis phase summarizes the main requirements that will guide subsequent phases of synthesis and evaluation while balancing the interests of different stakeholders. Concrete requirements can be a guide for the synthesis phase where designers can use requirements as inspiration, or even as material in different ideation methods, and requirements can be the benchmark for evaluation where the design that best fulfills the requirements is selected.

Synthesis is where ideation happens and the requirements along with other user data are turned into design ideas through the creative process. Ideation methods help designers to produce ideas by implementing various degrees of structure on the creative process of design.

Evaluation is where potential design solutions are evaluated against each other using the requirements set during the analysis phase.

Each of these three phases depend on the others for either input or output; meaning that Analysis generates requirements that are input in Synthesis and Evaluation, Synthesis generates designs that are input in Evaluation, and Evaluation may highlight the need for further iterations of Synthesis or even Analysis. The three phases are interconnected and not strictly delimited but rather suggestive of an overarching process.

4 Research Approach

There are two goals for this chapter. The first goal is to list and describe how theory was used to shape the work in this thesis, and the second goal is to provide a chronological account of the studies in order to better motivate why each study was conducted and how each study contributes towards fulfilling the research aims of this work.

4.1 Theory in Use

The work presented in this thesis has made use of qualitative user research and a pragmatist stance towards the study of experience. As mentioned in section 2.2, a pragmatist standpoint requires that if the whole experience is to be studied, experience must be studied in context, and without the researcher reducing parts of the experience, which would occur if a quantitative approach were used instead. The UX frameworks summarized in section 2.3, and as well as Kelly's personal construct theory [60] have guided some of the work to focus on aspects of experience, namely collecting user needs in paper 2 and focusing on specific aspects of experience during data analysis in papers 4 and 7.

It is important to support designing for experience throughout all phases of the design process.

The model of Analysis-Synthesis-Evaluation of the design process was used to decide the aims of each study in order to produce knowledge that can address all of the stages of a design process for User Experience. As the primary goal of this work is to define and exemplify a UX design process, it is important to support designing for experience throughout all phases of the design process. This means embedding UX in analysis, in synthesis and in evaluation. For each of these phases relevant theories were used in order to plan and execute studies that would result in findings that can contribute in adapting the design process for User Experience.

4.2 Methodological Approach

As the case study for this thesis is in-car User Experience, the aim of the first study was to use user research methods in order to collect insight regarding current User Experience practice in the automotive industry. Findings from paper 1 and further insights collected through literature review were used to plan paper 2, with the aim to collect need requirements from users of modern cars. The data produced in paper 2 are the basis for further rounds of analysis, synthesis and evaluation. Paper 3 was conducted

with the goal to test existing evaluation methods in an industrial setting, as industrial requirements may differ from those found in academic contexts.

After these studies, a halftime presentation was done that gave valuable feedback and defined a future direction for the remainder of the studies. Specifically, there were two points of focus: the first was the collection of more holistic UX Insight in order to better understand not only aspects of experience but also experience as a whole. The second point was to exemplify ways of using UX Insight such as those produced in papers 2 and 4 into the synthesis phase of the design process. This decision was made because while the analysis and evaluation phases of a design process inherently use requirements (that can be in the form of UX Insight), the synthesis phase does not usually integrate such requirements in a methodical manner. Finally, paper 7 summarized the main findings and insights from the PhD work in a practical setting and exemplified use of the findings in a real-world design case of an in-vehicle system.

Paper Number	**Paper Title**	**Design Process Phases**	**Relevant Theory**	**Paper Goals**
1	The use of Affective Interaction Design..	Analysis	Q. User Research	Understand Current UX Practice and Collect State of Art
2	Investigating Dimensions of Automobile User Needs	Analysis	Personal Construct Theory	Collect User Needs for Use in Design
3	Evaluating Pleasure of Use	Evaluation	Emotion Measurement	Explore Evaluation Methods
4	UX Themes	Analysis, Synthesis	UX Frameworks, Activity Theory	Confirm & Enrich User Needs
5	Skewing	Synthesis	Design Research	Explore Synthesis Method for UX
6	Concept Portraits	Synthesis	Design Research	Explore Analysis / Synthesis Method for UX
7	Meaningful Incorporation	All	Design Research	Connect Previous Findings with Practical Example

Figure 4: Papers included in the thesis with corresponding design phases, relevant theory, and study goals

5 Methods

There are two ways in which methods are used throughout this thesis. The first is methods used as research tools in order to collect information and gain deeper the insight into User Experience. Such methods are interviews, the Repertory Grid Technique (RGT), and the UX curve among others. The second way is methods used as a way to act on the collected UX Insight actively by making use of the knowledge gathered through these methods. Such methods are Skewing, Concept Portraits and KJ method among others. All of the methods used in some way during the thesis are briefly described below. Ultimately, methods are tools that can be used for a variety of different purposes depending on their user.

5.1.1 Concept Portraits

The Concept Portraits (CP) method is a way of analyzing thick, complex concepts that are often loaded with diverse meaning in order to gain a better, shared understanding of these concepts for design teams in the early phases of the design process. Section 5.6 describes how to do a concept portrait in detail, and the attached paper 6 (titled Concept Portraits) presents example cases for the method. Concept portraits are best suited in the analysis phase of the design process, but unlike many other analysis methods, CP does not collect user data but rather develops a shared understanding of difficult to work with requirements for the design team.

5.1.2 Future Workshop

The future workshop in a synthesis method used for ideating designs for a futuristic world. The method works by shifting the designer's focus away from current problems that may be blocking creativity, to envisioning solutions to future issues. The focus on the future also has the added benefit of helping designers overcome the limitations that existing technology and technological configurations may pose [61].

The method is comprised of the following stages: The design team must first define a problem (analysis methods may be of great help here). The team is then placed on a futuristic alternative world where the design space differs from reality in a substantial way [62]. The designers use the futuristic characteristics as inspiration to generate design solutions for the problem that they identified, and finally a plan is made to realize these solutions [53].

Future Workshop Scenarios

The future workshop method can be supplemented by adding pre-made scenarios to the future [62]. Scenarios populate the future by detailing a sequence of activities that a

user would take in said future. For instance, if the future is a utopian one where teleporters exist, a scenario would detail a Swedish user's morning routine of getting ready for work and then teleporting to Brazil, where her company's offices are located. Scenarios help designers imagine how people would experience and react to events in the future, while also showcasing user's needs and aspirations. [63].

5.1.3 Interviews

Interviewing is a staple method in user research often used in the analysis phases in interaction design (as mentioned in for instance [56]. Interviews have been used in many UX studies (for instance in [64]–[66] in order for the design team to obtain valuable experience narrative from the users. Interviews were used in the studies included in this thesis for the same reason; to collect rich narrative descriptions of people's experiences with computers. There are different types of interviews with a major differentiating factor being the amount of pre-determined planning and structure introduced in the interview process.

Unstructured interviews have very little structure, with the only guiding factor being the general theme of the interview. The interviewer is then free to guide the interview in the pursuit of interesting topics through questions that arise. Unstructured interviews can, however, yield radically different results based on individuals' answers, and thus generalization and pattern finding becomes that much more difficult.

Semi-structured interviews add more structure to the interview process by the introduction of themes of interest and specific questions that must be asked. The interviewer can still diverge from the interview protocol in order to pursue interesting topics that may arise.

Structured interviews have the highest amount of planning with specific questions that must be asked, and there are no possibilities to change the protocol in any way after it is set.

5.1.4 KJ (Affinity Diagramming)

KJ is a technique (also known as affinity diagramming) that can help design teams organize complex data through a structured pattern-finding process. KJ gets its name from Jiro Kawakita, its inventor, and involves the following steps [67]:

Everyone in the group doing KJ is given blank sticky notes and pens. The designers are then asked to write as many problems/insights/data snippets or opinions as they can, in silence. The participants then post all of their sticky notes on a whiteboard and take

turns speaking up, in order to explain each of their notes. The group then discusses the notes and moves them around to form groups of similar notes, thus creating an affinity diagram. KJ is suitable both in research and design settings where there is a complex data set that needs to be analyzed qualitatively in order to find patterns of similar concepts.

5.1.5 Likert Survey

The Likert Survey is a survey method created by Rensis Likert in 1939. The method is widely popular in many academic contexts (for instance in [40], [68], [69] due to the ease of use of the method, the low resource requirements and the easy scalability that the Likert survey affords. A Likert item consists of an affirmative statement that participants are asked to assess based on their feelings and opinions regarding that statement. An example of a Likert Survey from the field of HCI is the System Usability Scale (SUS) [68]. The SUS is used to assess the usability of a system using a "quick and dirty" approach. An example Likert item taken from the SUS is the statement "I thought the system was easy to use", along with assessment options (typically these are: strongly disagree, disagree, agree, and strongly agree).

5.1.6 Repertory Grid Technique

The repertory grid technique (RGT) stems from Kelly's personal construct theory [60]. According to Kelly, each person has their own unique view of the world that is determined by internalized dimensions of similarities and differences. For example, for Bob, all teachers are judged based on their grading policies ranging from very stingy to very giving. Bob had a teacher in middle school that was extremely harsh with grading so every other teacher is measured up to that one middle school teacher. The dimension of grading policy is called a *personal construct*. Similarly, Bob has many other such constructs for different situations, objects and people in his life.

The RGT is a way to externalize these personal constructs, and thus reveal dimensions that are important to users when it comes to a particular topic. The RGT works by presenting triads of things to people and then asking them to split each triad into two groups based on which two of the three presented items are most similar. The participants are then asked to name this similarity, as well as the opposite of the similarity. If Bob was presented with photos of teachers that he has had, he would group them based on grading policy scale and name the poles of the scale from giving to strict, for example. The RGT collects these personal constructs (scales) therefore revealing needs and important factors for users related to a certain topic. The RGT can be used

as a user research method and is suitable when there are ample resources for user research and mainly for academic work.

5.1.7 Reflexive Photography

Reflexive photography is in an analysis method that consists of a photographic assignment conducted by the user, often prior to them meeting with the researcher [70]. The photographic process is used as a process meant to help the user in focusing on important issues, product features or other depicted material that somehow represents the user's primary concerns relating to the photographic assignment. For instance, if a user is asked to photograph subjects of importance to them relating to their cars, they may produce photos of a steering wheel button that always seems to be in the way when the user operates the car.

5.1.8 Self-Assessment Manikin

The self-assessment manikin (SAM) is a pictorial emotion evaluation method developed by Bradley and Lang [71]. The SAM "measures valence, arousal and dominance associated with a person's affective reaction to a wide variety of stimuli". The method consists of three scales, each of them assessing a different emotional attribute. The attributes are **valence, arousal and dominance**.

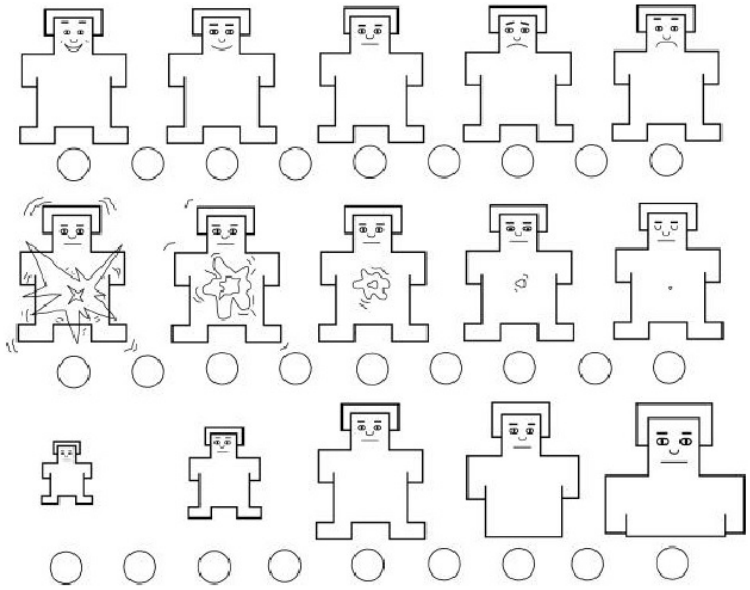

Figure 5: The Self-Assessment Manikin Scales of (from top to bottom) Valence, Arousal and Dominance

Valence measures whether an emotion is positive or negative. Arousal mentions the strength of the emotion, and dominance measures whether the person experiencing the emotion felt in control/taken care of or not. The SAM has been used extensively in many studies (for examples look at [72]–[75]. It is important to note that through testing, the dominance scare has been found to be difficult to interpret [71], [74] and is often omitted in many applications of the SAM scale. The SAM has been used in both design and research settings when the objective is to quickly collect Likert-type data regarding emergent emotions. The SAM scales are shown in the figure below in the order or valence, arousal and dominance from top to bottom.

5.1.9 Skewing Artifact Properties

Skewing is a structured ideation method that is suitable for the synthesis phase of the design process only if the designers have an artifact to be redesigned [54]. The method is described in detail in section 5.5. Skewing can produce design ideas that lie on the borders of the design space, and therefore may bring about non-obvious designs that could inspire the design team towards the final design.

5.1.10 User Experience Curve

The UX curve [76] is a user research method designed to reconstruct the user's experiences over time. The users are asked to draw a curve that represents positive and negative experiences that the user has had with a product. The method starts by providing the user with pen and a paper that has a timeline drawn as shown in the figure below. Positive experiences are to be placed as points, and named above the line, where negative experiences are placed as named points below the line. It is up to the user to assess the significance of an experience and place it accordingly on the paper. The user is then asked to connect all the dots, thus producing the UX curve as seen in figure below. The curve provides information on the user's experience over time without the need to continuously follow the user as they experience interacting with the artifact. The UX curve can be used as stimulus material for further narrative collection as described in paper 4. An example of a UX curve is displayed in figure 6.

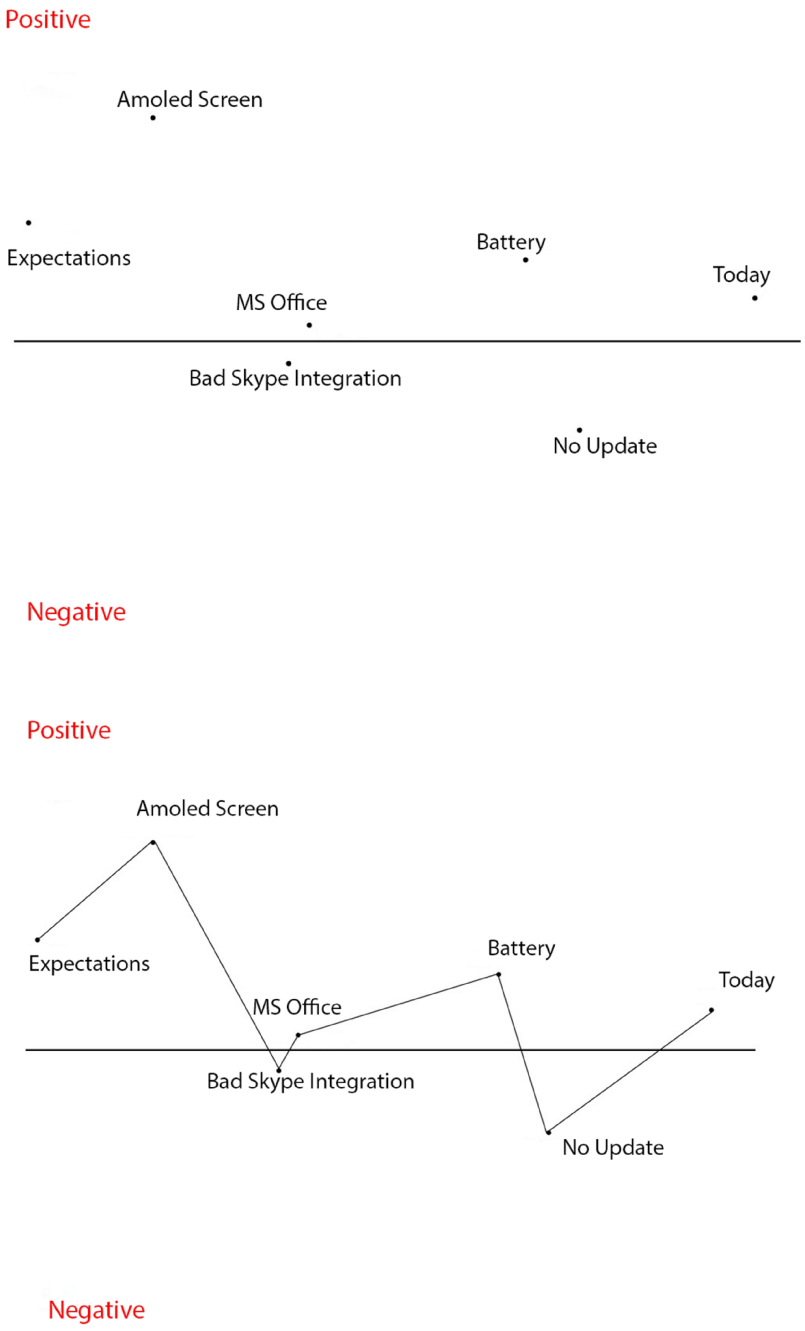

Figure 6: An Example of the UX curve. On top, with only the dots filled in and labeled, at the bottom, with the Curve drawn.

6 Findings

This chapter contains summaries of the papers that are included in this thesis. For each paper there is a summary of the aim of the study, a summary of the process of how the study was conducted, and then a summary of the findings and/or discussion points for each study.

6.1 Paper 1: The Use of Affective Interaction Design in Car User Interfaces

The aim for the study in this paper was to investigate the automotive industry's user practices and traditions regarding In-Vehicle System (IVS) design around emotion and User Experience. Special attention was given to methods and tactics the automotive professionals use for IVS UX design as well as problems they face with such tasks.

6.1.1 Process

The study consisted of a literature review, and a set of interviews with experienced IVS designers. The literature review was conducted for the purpose of forming a summary of different emotional design and User Experience models such as Norman's three levels approach and Jordan's four pleasures model. The literature review revealed that —during 2011 when the study was run—there was very little research concerning applied User Experience design, and therefore the impact of such practical knowledge was minimal in the automotive field as well. Based on the literature review findings, twelve industry experts with various positions relevant to IVS design were interviewed using semi-structured interviews with questions around the following four themes of interest:

- Background and previous experience
- User Experience and Emotional Design knowledge
- Challenges in applying Emotional Design theory
- Opinion on an emotional design support tool

6.1.2 Findings

The interview data was analyzed using thematic analysis [77]. The major findings were that the IVS designers were familiar with the terms User Experience and emotional design, as well as with relevant theories such as those by Norman [39] and Jordan [40], as these were explicitly mentioned. However, all of the interviewees expressed a lack of methodology and practical know-how regarding the practice of User Experience design

and design for emotion. The vehicle domain added to this difficulty by having a unique context that may require specialized knowledge as well as a slow evolution pace compared to other fields such as IT, in which UX may have advanced further. Finally, the strict safety requirements along with the strong tradition in engineering practice that characterizes the vehicle domain, make the introduction of UX design principles that much harder.

6.1.3 Discussion

More than anything else this first paper pointed towards an emergent need both in IVS design and in interaction design for applied UX. Further, practical examples that can showcase the possibilities of practicing UX design can be beneficial for design professionals who can sometimes have trouble with bridging the gap between theory and practice. The study also highlighted the unique characteristics of the automotive domain, with the characteristic context of use that is the modern car, the safety issues that must be considered and the rigidity of the automotive industry who is—justifiably—slow to adopt new theories, methods and processes, as these need to be meticulously tested before deployment.

6.2 Paper 2: Investigating Dimensions in Automobile User Needs

What Drivers Really Want: Investigating Dimensions in Automobile User Needs

The aim of this study was to investigate and identify user-generated needs regarding cars. These user needs should represent concepts that are of concern to the user than thus, these concepts can to be used as material in the User Experience design of in-vehicle systems. Generic user needs do exist, as mentioned in [13], however the aim of the study was to find needs that relate to the car, as these needs could provide guidance for the experience design of IVS systems.

6.2.1 Process

The study design consisted of a series of adapted future workshops [61] enriched with scenarios [63], and then a repertory grid technique study [78] designed as a web survey. The future workshop method presents participants with a narrative of a futuristic society. The participants are then asked to discuss, and populate the future thus creating shared understanding and a sense of ownership of the future. The participants are then given a scenario placed in the future and are asked to discuss needs and goals that may arise from the scenario. The ideas from the workshop are then summarized into prototypes—in this case vehicle prototypes—that represent the core ideas and concerns of the participants. A total of four separate workshops were conducted that generated ten textual car prototypes. As some of the prototypes were very similar, the researchers then consolidated these ten prototypes into five discrete concepts. The consolidation process involved merging prototypes with similar characteristics together while equalizing the amount of detail in each concept, in order for the final concepts to have a comparable amount of fidelity.

The concepts were then used in a web survey based on the RGT technique, in order to elicit user needs that arise relating to the concepts and ultimately automobiles, as per Kelly [60] and Hassenzahl & Wessler [79]. The web survey was completed by 87 participants, and the data was analyzed using content analysis [80] as well as taxonomies as described in Hassenzahl & Wessler [79]. The analysis produced 19 need dimensions (or constructs as per RGT terminology). Specifically, the taxonomies used were:

Construct Originality, which refers to the words used to describe a construct compared to its original textual description; constructs with high originality are described using words not found in their textual description.

Evaluative Ability (EA), which addresses whether constructs have a clearly desirable pole (for instance, safe - unsafe) or whether they have poles that could both be desirable (for instance black - white).

Descriptive Richness (DR), addresses the richness of descriptions within each dimension. A dimension that was made with few repeating constructs i.e. where participants used the same words to describe said construct, is less descriptively rich than a construct that participants used more diverse terms to describe.

Dominance, describes the percentage of constructs in a dimension over all of the constructs that were generated in the study.

6.2.2 Findings

The future workshops along with the scenarios were successful in stimulating participants to discuss issues around transportation, and thus express concerns regarding issues that they believed to be important when driving. The future vehicle concepts that were produced by the participants represent areas of significance for both futuristic but also current vehicles. The RGT web survey in turn used these vehicle concepts to elicit need dimensions regarding vehicles from 87 different participants.

The need dimensions that have certain combinations of evaluative ability and descriptive richness can direct designers in selecting appropriate user research methods during the analysis phase of their design processes. Specifically, need dimensions with high descriptive richness are more rich and diverse and thus should be explored using user research methods that capture narrative as to not miss the fine nuances that may characterize a participant's concerns. Similarly, need dimensions with low evaluative ability should be investigated through collecting user narrative as well, in order to better understand why certain poles are preferable to participants since this isn't self-evident. The 19 need dimensions along with the measures of evaluative ability and descriptive richness are presented in figure 7 below.

Construct Dimension	Evaluative ability	Descriptive richness
Control	18.0%	42.0%
Versatility	34.0%	96.0%
Safety	63.0%	50.0%
Driving Pleasure	85.0%	62.0%
Freedom of Choice	100.0%	80.0%
Self-image	33.0%	66.0%
Efficiency	95.0%	38.0%
Simplicity	90.0%	48.0%
Technology	60.0%	94.0%
Interaction Fluency	77.0%	62.0%
Comfort & Convenience	83.0%	100.0%
Driver Support	67.0%	88.0%
Environmental Impact	83.0%	66.0%
Automation	22.0%	36.0%
Ownership	18.0%	32.0%
Personalization	52.0%	96.0%
Trip context	13.0%	38.0%
Calmness	100.0%	22.0%
Connectivity	83.0%	100.0%

Figure 7: The Vehicle User Need Dimensions

Further content analysis of the data has resulted in three clusters that may be significant to the development of future vehicles. These are: the use of novel technology in the car, the user of the car as something more than just a way of transportation, and the idea of the car as part of a collective where ownership is shared among different people.

6.2.3 Discussion

The main aim of the study was to explore user needs in the automotive domain from a user's point of view. The collected need dimensions can be used as focal points that highlight important aspects of the User's Experience with a car. This information can be used to prime the early stages of the design process. Specifically, and with the help

of descriptive richness and evaluative ability, designers can select appropriate user research methods in order to collect better user data and thus define more appropriate requirements for the analysis and synthesis stages of the design process. The need dimensions could be used as-is, however they may be too "thin" in terms of narrative which may make understanding the motivations behind them challenging at times. It is evidently much easier to design for "control" if one knows of other instances where users have felt in control rather than if only knowing that "control" is important. Finally, the need dimensions can be used to construct surveys in order to quickly collect user data from a large amount of participants, as this discount method can be useful when resources are scarce.

The secondary aim of the study was to test out the methods used in the study for the design of future solution. The future workshop with the scenarios worked well as synthesis methods, even when given to participants not previously experienced with vehicle design per se. The scenarios helped direct the focus of the design teams towards issues that the researchers defined as important. Finally, the RGT helped in collecting the need dimensions, and although the RGT method could be used for design, the method does require a significant amount of analysis and is this recommended mostly as a research method.

6.3 Paper 3: The Challenge of Evaluating Pleasure of Use

The challenge of evaluating pleasure of use in in-vehicle systems.

The aim of this paper was to explore way of evaluating subjective emotions, and pleasure of use in a naturalistic vehicle study.

6.3.1 Process

A method triangulation approach was used for evaluating emotions in a naturalistic vehicle study. The methods used were an adaptation of the SAM [71] where the scales of Valence and Arousal were used, a Likert questionnaire adapted from Jordan [40] targeting pleasure of use, and a question of preference metric. The study was designed as a comparison between two different HMI interfaces, and a counterbalanced, within-subjects design was used. The participants completed the SAM three times for each prototype; once with the vehicle standing still but before being allowed to interact with the HMI systems, once after exploring the HMI systems, and once after driving on a pre-defined route and completing tasks with the HMI systems. At the end of the study the participants were asked to indicate which prototype they preferred during a small interview, and also completed the questionnaire mentioned before.

6.3.2 Findings

The main finding of the study was that even in industrial settings and with very limited time it was possible to quantify and evaluate small aspects of the overall experience. The triangulation approach helped in validating results from each of the methods in order to increase the confidence of the evaluators in the results. However, the methods that were employed did not shed any light into why the users ranked the systems the way that they did. In exchange for the limited time spent with the participants, their motivations remained unexplored, as elements falling outside of the questionnaire were simply not captured, which is a known issue with this type of method.

6.3.3 Discussion

The A-B comparison conducted in the scope of the study was fruitful, albeit the results may not be of much help to a design team looking to iterate parts of either prototype, or even combine the prototypes into a new, improved version. In retrospect, having conducted a more holistic study where the motivations behind the user's answers would have been collected may have yielded data that would be more useful in design iterations. Of course, industrial settings place harsh limits on evaluation resources and therefore, given the limited amount of time, the results were of an appropriate fidelity.

6.4 Paper 4: Exploring User Experience in the Wild

Exploring User Experience in the Wild: Facets of the Modern Car

The aim of this paper is to present findings from a holistic, UX-driven study in the automotive field. The study was conducted in a holistic manner, which means from the user's perspective and with the goal not to exclude any part of the User Experience that the participants found relevant.

6.4.1 Process

In order to capture as much of the experience as possible, the methods of UX Curve, Reflexive photography and semi-structured interviewing were used with sixteen participants who owned cars with modern HMI systems. Reflexive photography was used to help participants recall significant experiences related to their cars through asking them to photograph things about their car that 'stand out' to them prior to the interviews, and motivate their photos during the interviews. The semi-structured contextual interviews took place inside the cars and focused on collecting narratives of the participants' experiences in their cars. During the interviews, the UX curve method encouraged the participants to reflect on their experience by asking them to identify significant experiences throughout the ownership period, placed in a negative-to positive vertical scale over time. This was done to address the integral role that time has in the UX of a system. The data was analyzed using conventional qualitative content analysis where UX themes were established from data categorization and grouping.

6.4.2 Findings

The findings were composed into four experience themes that summarize the majority of the experiences that our participants referred to. Each of the themes are described below.

The **"car as a caretaker"** theme represents experiences of participants where the car was viewed as a guardian, ensuring their well-being. This was achieved by features such as lane departure warning, the tightening of seat belts in sharp turns, and even before and after the car ride through connected apps that allowed the participants to be aware of the status of their vehicle. The **"car as a space for relatedness"** theme represents all of the instances where people sought to connect and socialize with others, supported by the car's interactive systems. Examples were having conversations with relatives and workmates outside the car via Bluetooth connected smartphones, or by collaborating on media playlists with their children during a trip.

The **"car as a space for stimulation"** theme contains experiences of discovery, novelty and enjoyment, supported through high technology available in the car and through the thrill of speed and freedom that the car affords. Some of these experiences were mediated through having seamless connectivity between the car and external devices, or with different driving modes highlighted through visual changes in the car's interactive systems.

The **"car as a space for transition"** theme represents the use of the commuting time as an opportunity to prepare for the activity that is next in the participants' lives often achieved through supporting efficiency or relaxation for the user. Examples of such experiences were participants preparing for work on their commute or listening to relaxing tunes on their way home from a stressful workday.

The **"car as a space for relatedness"** theme contains experiences of connecting with people that are important to the user, whether these loved ones, friends and acquaintances are sitting with the user in the car or are somewhere else. The HMI systems of the car afford shared activities that can enhance togetherness, such as listening to music, audiobooks, podcasts, or playing car games while taking a long trip.

6.4.3 Discussion

The use and value of these themes throughout the design process is illustrated in the full paper with a design example of a vehicle with interactive systems that offer a dynamic User Experience. The UX themes can be used in the design process independently and, importantly, also in connection to each other, in order to address the diverging UX needs of users. The design example and the UX themes derived from the methodology outline the value of having a holistic starting pointing when designing the HCI of interactive products with the aim to support the User's Experience. Starting from the study of people's current experiences with interactive products we were able to identify design opportunities to support UX that users may find desirable, meaningful, and fitting within their lives. The holistic approach offers an alternative way to study, understand and design for UX that is able to complement usability and functional requirements, in order to elevate the value of technology in people's lives.

6.5 Paper 5: Skewing Properties of Interaction

Escaping the Obvious: Skewing Properties of Interaction

The aim of this paper is to present *skewing properties of interaction (hereby referred to as skewing),* which is an ideation method suited for redesigning artifacts. In order to execute Skewing, the designers must have an artifact, analyze its properties based on a pre-determined framework, and then skew one or more of these properties, this re-imagining an alternative version of the artifact.

6.5.1 Process

Skewing was designed to be a design method for the synthesis phase of the design process. After framing the problem by analyzing the available data, designers must synthesize different solutions for the design problem. This phase is known as ideation, and also transformation [50]. Skewing belongs in the category of transformational ideation methods (as per [81] that re-imagine existing design artifacts by redesigning aspects of them.

In order to do Skewing the designers must:

1. Select an object to be redesigned.
2. Select a suitable framework to analyze the artifact with.
3. Analyze the artifact through the chosen framework.
4. Change one or more analyzed properties.
5. Select the most promising, interesting designs.

Note that for step 2, the selection criteria should change depending on the design goals. If the designers want to re-design for UX aspects, then a UX framework should be selected.

6.5.2 Discussion

Skewing was found to be a useful synthesis method with some properties that give skewing unique characteristics. The fact that the method uses a framework of the designer's choice means that the method is a targeted ideation method where the designers can embed their aims for the design into the ideation process itself, in addition to having requirements from the analysis phase of the design process. Naturally, targeting skewing depends on the quality of the framework used in addition to the skill of the design team (the latter obviously influences the entirety of the design process).

Further, skewing is good at helping designers produce ideas that lay on the extremities of the design space as properties are skewed to their limits. This practice may result in a lot of 'too out there' ideas but may also result in surprisingly useful yet unexpected design ideas that the designers might have missed due to them being non-obvious. Skewing's greatest weakness is that the method is limited to re-designing as there must be an initial design for the method to function. Otherwise, the domains and possibilities for the method are only limited by the available design artifacts, frameworks, and the designer's imagination.

6.6 Paper 6: Concept Portraits

A UX Method for Understanding and Designing for Complex Concepts

Concept portraits is a design method meant to assist designers in producing well-defined design requirements from thick concepts [82]. Thick concepts are value concepts that have high descriptive richness (descriptive richness is further explained in paper 2) i.e. they have diverse interpretations by different people. The Concept portraits method supports designers in unpacking thick concepts and creating shared understanding of these concepts, which in turn helps initiate the synthesis phase of the design process and ultimately produce acceptable design solutions.

6.6.1 Process

Concept Portraits is based on a pastime game where players are called to make word associations between different concepts. An example question would be "if (the concept) was an activity, what would it be?" Figure 8 below illustrates the steps that the concept portraits method includes.

Figure 8: The Concept Portraits Process

In short, the design team starts with a concept, and they then make associations by answering six questions for the given concept. Questions may include associations between the given concept and places (e.g. countries, public spaces), animals, famous people, objects etc. The design team must prepare the questions prior to starting, and the questions must be answered quickly, without much thinking. When everyone is finished with individual associations, the members take turns motivating their choices to the rest of the team. Finally, the designers can analyze the results of the CP through qualitative analysis by for instance using the KJ method.

6.6.2 Discussion

Concept portraits are most useful when a design team is working with thick concepts where different members of the team may have different opinions regarding the significance of the concept. By the end of the CP method, team members have explained how they think regarding a concept through associating the concepts with other more familiar terms, thus creating a shared understanding amongst design team

members. Concept portraits do not produce any user data, which is an integral part of the analysis phase of the design process, therefore other analysis methods must be used to collect user data. However, CP is a quick and resource-friendly method that can help springboard designers into the creative process of synthesis by providing them with the common language necessary for the production of successful designs.

6.7 Paper 7: Meaningful Incorporation

The aim of this paper is to introduce Meaningful Incorporation as a way to design for User Experience. By combining findings from previous studies we present a design process that is adapted for User Experience through use of UX Insight in all phases of design. User Experience Insight consists of data that describes and condenses, through qualitative data analysis, experiences that a user group has found profound. In analysis phase UX insight is collected through user research and condensed through qualitative data analysis. In synthesis, the UX Insight is used in design methods that inherently support the utilization of such data. Finally, the UX Insight is used to evaluate the resulting ideas and select the most appropriate design for the task. The UX design process is exemplified with a case study on designing an in-vehicle system.

User Experience Insight consists of data that describes and condenses, through qualitative data analysis, experiences that a user group has found profound.

6.7.1 Process

Meaningful Incorporation (MI) is a new concept, therefore much of the paper is devoted to defining MI and explaining where the concept originates from. Meaningful Incorporation works by first collecting specific instances of UX data concerning significant User Experiences and with attention to the UX factors of Emotion, Temporality and Context. The UX data is then condensed into UX Insight. Figure 9 below illustrates how MI works in a design process:

USER EXPERIENCE DESIGN PROCESS			
Phase of the Process	Analysis	Synthesis	Evaluation
Meaningful Incorporation of UX	Collection of UX Insight	Use of UX Insight as input and use of UX- specific methods	

Figure 9: Meaningful Incorporation

In order to test MI and further exemplify MI in use, we have presented a case study on the UX design of an in-vehicle system.

6.7.2 Findings

In order to jumpstart the design case, the UX Insight packaged in UX themes from paper 4 was used. Two design teams participated in the study. For the sake of

consistency and in order to test out specific methods, the designers were given a design process to follow, as illustrated figure 10 below.

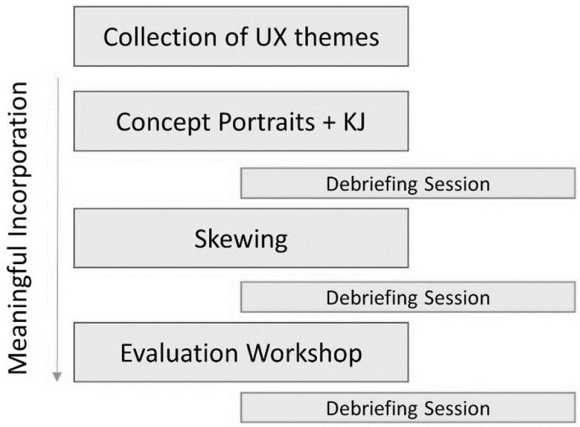

Figure 10: A Meaningful Incorporation Design Process

The results from the synthesis phases of the two design teams were then evaluated in a common workshop, where a final idea named info dial was produced. The info dial concept works by allowing car drivers to adjust the amount of secondary information that the car presents to them depending on their needs. The designers were also asked to give feedback on the methods and process used. Fields such as design ethnography and design anthropology specialize in collecting high quality user data for the specific purpose of design, so these disciplines can help in designing for experience.

6.7.3 Discussion

Meaningful Incorporation is introduced as a way to design for User Experience. In summary, Meaningful Incorporation has two principles: the use of UX Insight whenever possible, and the use of design methods that focus on UX aspects whenever possible. While this is not the only way to go about designing for experience, it is a structured way to approach the task while still keeping flexibility for designers to practice their craft. Meaningful Incorporation, as well as any other design process, depends on the skill of the designer and on the quality of the user data that is provided. Ultimately, a combination of good UX Insight that the design team can understand well (for instance by the help of concept portraits) and the Meaningful Incorporation of such insight into subsequent phases of the process, can improve the designers' chances of enhancing the user's experience.

7 Discussion & Synthesis

The purpose of this section is to outline and interlink the important findings in this thesis, as well as present a discourse on a User Experience design process and the presented findings. The novel concepts of User Experience Insight, and Meaningful Incorporation, which are the main contribution of this work, are discussed in relation to other existing relevant concepts and the goals of the thesis. The first research goal is addressed in section 7.1.1 and the second research goal is addressed in section 7.3.

7.1 On The Essence of User Experience

Experience is an elusive concept. Section 3.2 outlines some of the work done in order to better study and understand experience. The pragmatist stance describes experience as a process of sense-making, therefore, experience is very individualized as each person's character is an active ingredient in the making of experience. Experience is also emergent through a dialogue between the self and the world. This means that in order to study the whole of experience one must consider all of the parts that make an experience what it is. These parts are not always of the same kind, as different aspects of experience become salient depending on the context surrounding the experience.

It is important not to pre-determine the aspects of Experience to be studied but rather leave room for these aspects to emerge through research.

Therefore, most times it is not experience that is being studied but rather certain aspects of experience. Many theorists have defined aspects of particular importance in the study of User Experience, with temporality, emotion and context as discussed in section 3.3.7. As each experience is unique to the individual and heavily dependent on many unforeseen factors, it is important not to pre-determine the aspects of experience to be studied but rather leave room for these aspects to emerge through research. Aspects related to temporality, context and emotions should be carefully considered as well as aspects that are particular for the domain and product/service for which User Experience is being studied, as described in paper 7.

User Experience rests in the in-between of diverse disciplines, some of which are Human Factors Engineering, Computer Science, Information Architecture, and HCI. For the domain of HCI, the three waves of HCI discussed in the Foundations chapter (section 3.1) have a clear impact on the way that the field approaches the study of experience. There are some obvious parallels between design and User Experience

when it comes to the types of approaches that have been championed for studies and work in both these fields. Scientizing design has been a topic of vigorous debate in the past, as the study of User Experience has been polarizing for some professionals and researchers.

For design, on one side, Simon and his proponents supported the systematization of design [83], and on the other side Rittel & Weber claimed that design problems are wicked problems and thus need to be solved differently than the "tame" problems found in positive fields of science [49]. Yet another instance of this struggle is the response to Jones' book on design methods (published in 1970); some made the assumption that the text was meant to be a recipe book for design, thus removing the need to have the "craft" element in design, an element of tacit knowledge. By the third revision of his book released in 1992, it was made clear that *"methods are intended to allow rationality and (design) intuition to co-exist in the design process"* [50] p.12.

In the study of UX there is a similar debate over the "correct" approach that one should follow to study experience. Professionals and researchers with backgrounds in the cognitive sciences, in usability studies and in computer engineering often share the opinion that proper reductionist research methods should be followed in order to maintain a high level of validity and reliability for the studies. A reductionist approach decrees the use of specific methods where the ultimate goal is the production of quantifiable data that can then be generalized through statistical assumptions. There are factors in User Experience that are certainly receptive to such an approach. Performance metrics and error rates, for instance, can have a significant impact on the overall User Experience of a product or service, and these are quantifiable metrics.

On the other side there are those that firmly believe that experience cannot be reduced and quantified into measurable parts (for instance [6], [7], [45]. Instead, and drawing from practices found in the humanities, these experts recommend a holistic approach to studying experience, where fieldwork, qualitative studies and interpretive methods produce accounts of experience that may be more closely related to what the users have lived. Aspects of experience such as emotion, temporality and its contextual nature are conductive to such an approach.

The position that has been a guiding factor in this work is that one does not need pick a side in this debate. Theory, methodological approach and methods are just tools meant to facilitate a better understanding of the world. As such, it is entirely possible to select a tool based on the task at hand instead of always using the same tool out of shear

conviction. User Need Dimensions, and User Experience Insight can be seen as such tools, with each being more suitable for different kinds of tasks, as described below.

7.1.1 On User Experience Insight

One of the most important original products of this work is the concept of User Experience Insight, found in paper 7. User Experience Insight consists of experiential user data condensed through qualitative analysis, and with special attention to the experience factors of emotion, time and context. Along with these factors, the designer /researcher that is creating UX insight must place focus on factors that are of significance given the dataset that has been collected (as detailed in paper 7). User Experience Insight is a way to bring relevant UX knowledge into the design process. With UX Insight design teams can develop empathy through having a clear understanding of previous impactful User Experiences. The Concept Portraits method presented in section 6 is aimed exactly at that; by unpacking "sketching" the portrait of User Experience Insight, designers are able relate to and empathize with the user's experience as they connect their own experiences to what users have described. Typically, blending one's own personal opinions and biases is seen as a negative in research. However, for novel design to take place I believe it is necessary to allow the designer to interpret UX, connect to it by using their own, lived, relevant experience and then be inspired to generate new design ideas.

Each UX theme can be considered to be a "working hypothesis"; that is "a hypothesis that reflects situation-specific conditions in a particular context".

As much of the work in this thesis is qualitative in nature, it is important to consider the findings for what they are. The User Experience themes, an instance of UX Insight, are not designed to have the external validity merits that (some) quantitative findings possess. This means that one should not make the assumption that the car UX themes presented will be applicable for all types of individuals, as experience is too subjective to be described in such a generalizable way. Instead, each UX theme can be considered to be a "working hypothesis"; that is "a hypothesis that reflects situation-specific conditions in a particular context" (Cronbach, 1975 referenced in [21] p.225). Therefore, the UX themes describe patterns found in the study that may characterize a subset of the user base. The designer/researcher that intends to transfer these findings into a different context and/or to substantially different users is responsible to affirm the validity of the themes for the new conditions. The User Experience themes do describe experiences that the

participants of paper 4 found meaningful. Further, UX themes were used for the design of an in-vehicle system in the design process illustrated in paper 7. The UX themes are material that can focus the designer's creativity (or designerly intuition as Jones puts it) towards experiential goals that the users found significant and thus **turn a design process into a design process for User Experience, which is the primary goal of the thesis as outlined in Chapter 1**.

On a final note, one may be tempted to assume that since UX Insight draws from experiences that users have already had, the designs produced through Meaningful Incorporation of UX Insight will only ever produce incremental improvements on currently available products, services, and experiences. However, the skilled designer can and will use User Experience Insight not as chains that keep creativity at bay, but as inspiration to find new ways of satisfying the user's needs.

On User Need Dimensions

The user need dimensions from paper 2 are another type of User Experience Insight. These need dimensions are collected from a larger user sample than the UX themes (78 people for the need dimensions and 16 people for the UX themes), however each dimension consists of two words, as opposed to the UX themes which provide a lot more detail of the experience that a user found significant. For example, the need dimension of **driver support** indicates that some users found that being supported by in-vehicle systems while driving is important. The UX theme **caretaking** contains a lot more information, while still touching upon the concept of driver support. Specifically, the theme contains examples of systems that people considered as 'caretaking' such as the parking assist camera (an obvious system for this theme) and the tightening seatbelt (a not so obvious system for this theme). It is hard to assess what kind of caretaking systems the seatbelt hug may inspire, however it is possible that such information can be invaluable to designers looking to foster more caretaking experiences in the car.

For the car context in Sweden, the need dimensions can be useful in two specific ways. First, as the need dimensions can be considered instances of human needs. As such, the dimensions can focus the designer's attention to context-specific aspects of experience that are of importance to the user. The figure below illustrates the need dimensions on a scale of specificity ranging from human needs [37] to need satisfiers [38] with the example of the need dimension "Automation".

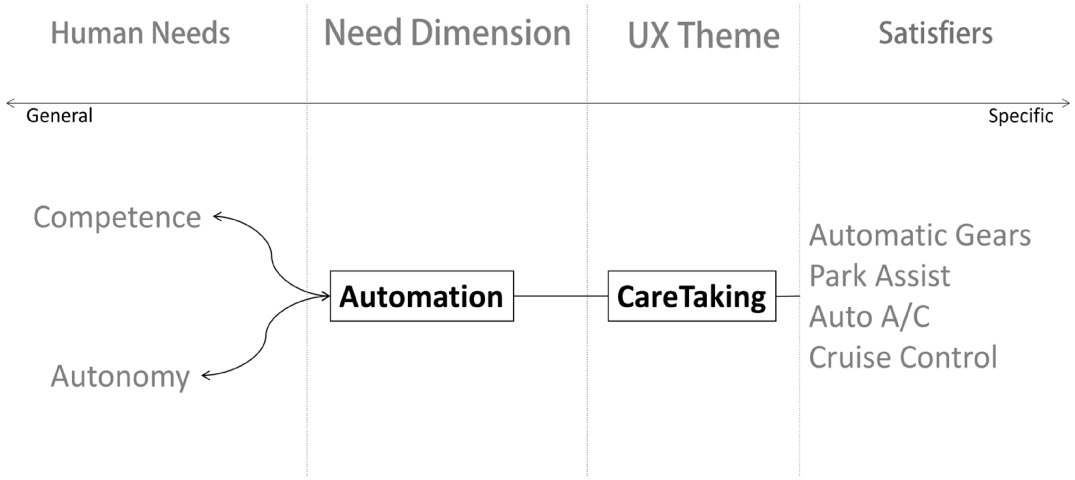

Figure 11: From Human Needs to Satisfiers

Second, the measures of evaluative ability and descriptive richness can indicate which of the need dimensions are the most diverse in terms of how people understand them. These more diverse dimensions are the ones with low evaluative ability and high descriptive richness, and they are prime candidates for further qualitative study in order to unpack their dense meanings. Figure 12 illustrates the need dimensions in a graph with their EA and DR.

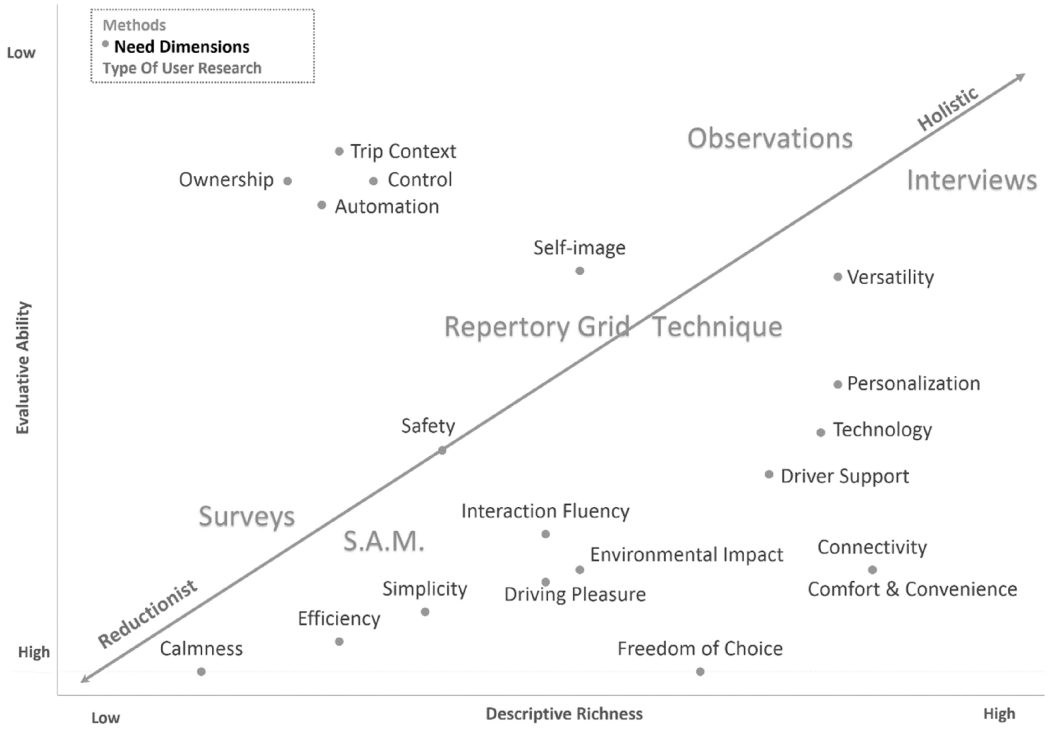

Figure 12: Need Dimensions with EA and DR

Finally, it is important to not use the need dimensions as a way to reduce user research to these dimensions alone, but as suggestions for where to look when it comes to doing research on car related experience.

7.2 Experience Design Through Meaningful Incorporation

The primary goal of this thesis is to define and exemplify a User Experience centered design process through use of design methods and design strategies that promote UX design. In order to fulfill the goal, the design model of Analysis-Synthesis-Evaluation is used in tandem with user research on significant User Experiences. The UX data is then condensed into User Experience Insight with the form of User Experience themes. The UX Insight is utilized in synthesis, through use of ideation methods that mandate the employment of the UX Insight and in evaluation by using the UX Insight as a benchmark for the design concepts that are produced. This process, a process of Meaningful Incorporation, is illustrated in figure 13 below:

USER EXPERIENCE DESIGN PROCESS			
Phase of the Process	**Analysis**	**Synthesis**	**Evaluation**
Meaningful Incorporation of UX	Collection of UX Insight	Use of UX Insight as input and use of UX- specific methods	

Figure 13: The Meaningful Incorporation UX Design Process

A successful User Experience design process is one that manages to stay impartial to theoretical fanaticism and the view that one must "pick a side" between quantitative and qualitative studies. When the aim of the study of experience is to aid design, it is imperative to produce findings that can help designers in moving forward in their process. It is arguably more valuable to know ***why*** a certain design concept has been successful or not in order to be able to build on that knowledge in subsequent iterations of the design concept, rather than only know that design concept (A) scores higher than concept (B) in an evaluation study.

Meaningful Incorporation aims to ensure the use of the UX Insight in a structured way throughout the design process, while still maintaining a level of freedom necessary for designerly intuition to take place.

Qualitative user research has the capacity to uncover User Experience Insight of such fidelity that the designers are able to discern the reasons behind the user's opinions and actions. Meaningful Incorporation aims to ensure the use of the UX Insight in a structured way throughout the design process, while still maintaining a level of freedom necessary for designerly intuition [50] to take place.

7.2.1 Meaningful Incorporation

Meaningful Incorporation is essentially a design strategy on how to collect and make use of UX Insight during the design process. UX Insight alone is not enough to ensure that the design process remains focused on important experiential aspects. This is why UX Insight is not introduced alone, but as a part of Meaningful Incorporation. The easiest way to explain the difference of a MI design process is by providing a short example. If we assume that a design team has UX Insight readily available, the team

could then choose to 'brainstorm' ideas for a concept that corresponds to the UX Insight. However, the UX Insight is not part of the ideation process, but rather used as a limit of sorts, sitting on the side line of the designer's mind. With Meaningful Incorporation the design team instead makes use of methods that mandate the meaningful use of UX Insight in the process of generating ideas. Several methods that facilitate the use of UX Insight have been presented in paper 7. Besides these methods, designers are free to modify and adapt any other method to include UX Insight as an integral part of ideation.

7.3 The Car as a Case Study

The car has provided an excellent, albeit challenging, context for the study towards a User Experience design process. The car industry is slow when it comes to adopting new practice, and justifiably so, as un-tested theories and concepts could have disastrous consequences. Much of the work force in the car industry is devoted to improving safety in the car. It is important that UX design is moderated by what is feasible in terms of driver safety—at least until fully autonomous cars arrive to the market—. While driving may not be the user's primary concern at all times during a commute, their safety will and should always come first. Improving the User Experience of the car can improve the safety for the car's user at least by avoiding negative emotions associated with poor driver performance (as shown in [84], [85]).

The user need dimensions and the UX themes constitute user data that is specific to the vehicle context of use at least for Sweden. **These findings can contribute to the design of in vehicle systems that aim to improve the User's Experience**, with the help of appropriate design methods as shown in paper 7, **thus addressing the second research goal of the thesis**.

8 Conclusion

This thesis set out to support interaction designers in designing for User Experience by having the **primary goal of defining and exemplifying a User Experience centered design process**. The collection and Meaningful Incorporation of UX Insight is a novel concept that supports UX design by providing a structured approach that encourages designerly intuition and promotes the collection and use of knowledge that is particular to the design problem at hand. **The second goal of the thesis was to generate knowledge that can be used for the User Experience design of HMI car systems**; The car UX Themes are such knowledge that can drive the design of HMI car systems, while the car User Need Dimensions provide a way to focus on car-specific factors and select design methods that increase the chances of a successful User Experience design process.

User Experience is a complicated concept that rests in the cross-section of several well-established disciplines (design, sociology, computer science to name a few), each with their own set of methods and approaches. In order to successfully work with UX it is important to view research approaches and methods as tools that are to be adapted and molded in order to accommodate for capturing and designing for experience. Only then can we hope to steer the user's experience in desirable directions and set the stage for users to enjoy the designs that we have worked so hard to create.

9 References

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