Travelling from Fascination to New Meanings:
Understanding User Expectations Through a Case Study of Autonomous Cars

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Designers are continuously exploring and suggesting possible futures, often consulting user studies for insights to guide the process of inventing novel designs. However, user studies are typically employed retrospectively with little regard to future use, or face challenges for users to express relevant reflections on the future. In addition, users' experiences of products are not stable over time and user studies typically do not sufficiently address the temporal aspects of future use. This paper uses autonomous cars as a case study with the aim of understanding characteristics of user expectations, highlighting the temporal aspects of expectations in particular. The study employed a qualitative, experimental, user research methodology encompassing 11 participants, encouraging participant reflection through enactment and drawing. From the results, expectations were structured around three temporal layers: acquaintancing, situated use and practice and meaning transformation. The model highlights and describes the temporal and transformative aspects of expectations. By breaking down the temporality of experience into layers, it suggests that designers and researchers can be helped to understand and approach experiences from the initial stages of development.

Keywords – Design Research Methods, User Participation, User Experience, User Expectations, Automotive Design, Autonomous Cars.

Relevance to Design Practice – This study adds to knowledge of how research on user expectations can be employed and understood in early, prospective stages of product development. The model of expectations and methodology presented is suggested for use to support both the design and evaluation of novel technology, in research as well as industry.

Introduction

> What seems natural to us is probably just something familiar in a long tradition that has forgotten the unfamiliar source from which it arose. And yet this unfamiliar source once struck man as strange and caused him to think and to wonder. (Heidegger, 2001, p. 24)

Designers are continuously in the process of exploring the future, imagining the use of what is not yet present. Recent research underlines the importance for designers to recognize that there are different temporal stages in using artefacts (see, for example, Bødker & Klokmose, 2012; Karapanos, Zimmerman, Forlizzi, & Martens, 2009; Wright & McCarthy, 2010). However exciting and strange at first, most ground-breaking designs inevitably become mundane everyday objects of use. Having empathy and sensitivity towards how future users will experience the product across everyday use is necessary. The temporal stages of users' adoption of artefacts have been studied in fields such as consumer behaviour (see, for example, Rogers, 1995; Silverstone & Haddon, 1996). Silverstone and Haddon's (1996) *domestication theory* describes the process of how artefacts become adopted into the user's life, transforming the user, the product and the environment around the new technology as time passes. This research, as well as other research in consumer behaviour and psychology regarding adoption, is *retrospective*, tracing usage back over time (see, for instance, Huang & Stolterman, 2014; Karapanos, Martens, &

Hassenzahl, 2012; Kujala, Roto, Väänänen-Vainio-Mattila, & Sinnelä, 2011) or studying the present. Plenty of effort in design research has thus been devoted to understanding the user's past and present everyday life and needs. Interesting research into *future* technologies can be seen in approaches as *Design Fictions* (Blythe, 2014; Linehan et al., 2014), but forward-looking, prospective *user* research is rare. Prospective user research would have the benefit of providing information at early stages and on designs that have no predecessors. These products may be disruptive, that is, changing the former needs and context of use of the product, making research into past experiences less relevant.

That said, researching user expectations of novel products can prove difficult (Brandt & Grunnet, 2000; Zhao, Hoeffler, & Dahl, 2009) given the challenges of expressing what is not yet

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there. Study participants are prone to over-estimate future designs (Zhao et al., 2009) and may face difficulties in expressing their needs and wants in words (Sanders, 2002). User research that concerns future technology faces challenges as the study design must support a shift in focus from the current to the future; the participant should ideally be able to transit from the problems of current designs to possibilities for the future. Methods like the *Future Workshop* (Vavoula, Sharples, & Rudman, 2002) explore how users can contribute to visualizing future products and use. The participants join the designers in exploring current situations with technology, identifying problems and coming up with solutions for these problems. Another example of a method concerning future use is *Generative Sessions* (Visser, Stappers, van der Lugt, & Sanders, 2005), which involves the participants in the generation of artefacts. The creative element of making artefacts facilitates a shift as the role of the study participant changes from being predominately an informant to that of a co-actor in the research process. However, these methods principally focus on solving the problems of existing designs. Additionally, they do not specifically address the *temporality* of experiences and use; what it will be like to use the artefacts over time and the challenges posed in this.

This study aims to extend knowledge of user expectations and how understanding the characteristics of such expectations can inform design at early stages of development. Based on the participants' narratives, the study presents a tentative model of user expectations that describes the transition from fascination to incorporation in life. Temporality and creative involvement from the participants incorporated with the intention of shifting the mind set to future use and deeper reflections aims to reach data beyond the apparent, or over-estimation. Being challenged to express visually and in words can aid the creative process. Roam (2011), for example, describes the process of how drawing can help ideas to evolve and become easier to discuss. The study exemplifies how creative prospective research can provide user data at early stages of a design process.

As an empirical study case on user expectations, the study presented in the paper takes a closer look at future users' expectations of autonomous cars. Autonomous cars have been present in fiction since the 1930s (see, for example, Keller, 1935), fascinating their audiences, but not yet a reality for consumers. This is about to change. For example, in 2015, Google completed 1 Mkm of accident-free autonomous driving (*Waymo*, 2009) and most premium car brands are in the process of prototyping such cars. The subject itself is currently attracting considerable interest from the public and the media (see, for example, Bilger, 2013; Vanderbildt, 2012), making it an iconic and interesting case study of user expectations.

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Methodology

In order to construct an understanding of the expectations, this study uses the *setting the stage* method (Pettersson, 2014). The method is a qualitative experimental approach to interviewing users about future artefact use, allowing the participant a more dynamic role than purely being an informant. The method's ambition is to move the participants into a tomorrow, different from today, but importantly still situated in their own life (i.e., not relating to sci-fi visions or what *others might think*). By means of enactment of future use, the possibility to draw interfaces and a placement in a lo-fi set up of the driving context, the method aims to entice the experiential dimensions of expectations, such as values and emotions (for reviews of experiental dimensions of products, see Forlizzi & Ford, 2000; Law, Roto, Hassenzahl, Vermeeren, & Kort, 2009). Enactment of future use, where both body and mind are engaged in the reflective activity, enables a flow of interactions to be studied, eliciting information on a detailed level (Pettersson, 2014).

Study Procedure and Rationale

Each session was individual and typically lasted 1½ hours. The study set-up was informal with the researcher taking the role of a discussion partner, more than an experiment leader. Each participant was allowed to bring up new topics and the researcher adapted the interview to how much drawing and enactment the participant appeared interested in. As the study was performed in an automotive company setting, an automotive designer was present in the room as photographer and note taker. The designer was welcome to join in on the conversation at the end of each session.

A vehicle can encompass many levels of automation from partly automated to full. The SAE international organization for aerospace and vehicles describes five levels of automation from driver assistance (level 1) to full (level 5) (SAE International, 2014). The chosen level of automation in the study was a high, but was not a full level of automation; it was explained to the participant at the start of the session that *the car could perform most driving, but not for all situation or road types* in line with the SAE levels 3-4.

Each session contained the following main steps:

- After a short introduction of the study, the participant was placed inside the outline of a car drawn on the floor (see Figure 1). Simple and open designs to relate to have been claimed to stimulate participants' fantasy to a greater extent than more developed designs (Ehn & Kyng, 1991). The simple set-up in this study of the on-road, in-car context offered a beneficial contextualization.
- The participant was first asked about the current daily commute, such as the emotions and activities connected to it. This was to anchor responses in the participants' individual perspectives.
- The participant was then asked to imagine a daily commute in an autonomous car and encouraged to act out future use. This could, for example, be activities they expected to undertake in an autonomous car, influence of social settings

in the car, as well as how they expected to interact with the car. The enactment was led stepwise by the researcher, following the basic steps of the commute journey, preparing for the ride, settling into the car, leaving the driveway and so forth. Enactment thus probed for both a snapshot of overall expectations from an autonomous car and a process of interactions and daily routines.

Each participant was also encouraged to draw human-machine interfaces and any other important design elements (such as trays, holders, etc.) and rearrange or remove seats to make desired design changes. This was asked to encourage reflection, imagination and engagement. If the participant did not feel comfortable in drawing, they were not prompted to do so in detail. In addition to this, interview questions concerning topics such as expected value, emotions and attraction were posed during the process.

Participants

Eleven participants, six men and five women, participated in the study, which took place in Los Angeles, USA. The oldest participant was aged 54 years, the youngest 27, averaging 46 years. An external recruitment firm recruited the participants, preferring *early-adopters to early-majority* (cf. Rogers, 1995) and the ability to express themselves regarding technology and personal needs. All participants were technology-apt, owning modern vehicles featuring advanced functionality such as cruise control. All participants were engaged in commuting within Los Angeles. The city was selected as an interesting context for inquiry, being a city with dense traffic and extensive time spent in cars.

Analysis

The general outline of the analysis was based on qualitative data analysis (Denzin & Lincoln, 1998) combined with Visser et al.'s (2005) description of analysing generative methods for user studies. In the tradition of Visser et al., all sessions were videotaped and transcribed in full. All drawings and rearrangements of seating were photographed. As the first step in the analysis procedure, the researcher and the note taker constructed a summary mind map on a whiteboard after each session. The summary board identified and summarized main themes in the session. Examples of themes are values, emotions, expectations of use and trust. The researcher

later made a detailed summary from the transcripts and the photographic material. Thirdly, the impromptu summary of the session was combined with the detailed summary to give insights both from immediate impressions as well as more subtle findings. Finally, the summaries from all participants were combined and the themes were concentrated in number. The focus was strictly kept on experiential values, whereas findings regarding detailed expected activities and so forth were excluded. To make the findings regarding expectations more addressable in a design process, the themes were established in a temporal structure at the end of the data analysis so the themes could be related to different stages of experiencing the product. The temporal steps can be seen as a result both of the study set up (as questions both about expectations on attraction and daily use were asked) and the nature of the participants' narratives.

Findings

The empirical findings in this section are presented in the order of the temporal stages discernible in the participants' narrations. Firstly, a number of expectations concerned the anticipation of getting to know the cars; *I'd probably want to see it out there (...) if they (an automotive car supplier) put some of these cars out there and let them exist to show consumers that these cars are on the road, super safe, and that nothing's happened* (Participant 1). These expectations are gathered in the following section, named *Acquaintancing*. Other expectations were placed in a use context; *Like the Internet, you're relying on a network and it's only as strong as the weakest link, you'd need a default kill switch to the manual mode* (Participant 7).

These expectations are included in the section named *Situated Use*. However, other expectations were more far-reaching, concerning how daily life would change with an autonomous car. These are summarized in the last section of the Findings—*Practice and Meaning Transformation*. These insights were commonly contrasted to the reality of driving in LA today. One participant expressed her feelings of daily driving as compared to an autonomous car: *Even when I'm not in a hurry I have this hurried feeling, like everyone in California should move out of my way! But in reality…if I'm not in a hurry and I could do other things (in the autonomous car), I think I would really condition myself to just relax and sit down and chill out* (Participant 2).

Figure 1. Before, during study and after.

Acquaintancing

From the participants' narratives, expectations of getting to know the artefact appeared to circle around becoming aware of the design through *social influences*, expecting appealing *aesthetics* and *novelty* to become attracted. Expectations in the acquaintancing layer were mainly positive. In essence, this layer of expectations in the case of autonomous cars concerned expecting an *object of fascination*; a novel and minimalistic design was expected, signifying a new automotive era. These attractions were the enablers for moving from acquaintancing to actually engaging with it in a situated use context. Among the reasons for not becoming attracted to the technology were unattractive aesthetics and hearing negative reports from the media and one's social circle.

Social Influence of Acquaintancing

The study participants had clear expectations of getting to know the autonomous car through media, social connections, on the road and in showrooms (cf. Roger's research of early adopters or Forlizzi's work on social product use). As in previous research (see for example Forlizzi, 2008; Jordan, 2000; Leary & Kowalski, 1990; Rogers, 1995), it was thus apparent that expectations are not formed in isolation, but are heavily influenced by hearing others talking about the cars, reading reviews and later seeing others use them. An object like an autonomous car was expected to be an interesting conversation piece during the acquaintancing phase. As was expected, questions of trust and unease also appeared in this layer of expectations. However, trust concerns were expected to be influenced and diminished by information and social influences, for example, hearing from one's social circle about experiences with the technology and relying on brand reputation: *(Trust) would depend on the vehicle manufacturer's reputation and people I know in my social circle who may have experienced the technology* (Participant 6).

Even before using the autonomous car in person, the participants expected their potential unease to be mitigated in the acquaintancing phase through social influence and by their desire for the novelty and the new possibilities of the autonomous cars. Some participants expected to need a substantial amount of time to get to know the technology, hearing about successful use and updating of technology before trusting the technology enough to use it themselves, where others expected to be among the first users of the technology. These expectations depended on individual differences of control need, motivations, backgrounds and social mechanisms (Burger & Cooper, 1979; Jordan, 2000; Lee & Moray, 1992).

Aesthetics and Novelty

Aesthetics has previously been recognized as giving a first important impression of a new design (Norman, 2004) and are a commonly mentioned topic in this study. All participants anticipated an autonomous car would have a beautiful and different interior. *Clean* was an often-used adjective for a desired minimalistic design with spacious interior, a blank slate on which

to project visions of a less stressed tomorrow. The desire for simplification in life was evident and for an attractive social image to be displayed by a structured, well-organized life in a spotless car. Aesthetics were also linked to trust. Being able to trust the car was imagined to be easier by getting to know a design that was characterised by simplicity and a minimalistic design language.

The participants expected that an autonomous car would be something *different* and that this would add to the attraction. In this, an expected metamorphosis of the car space was an important enabler. This was shown in many of the drawings of moving wheels and seats in the car (see Figure 2 for examples), enabling the car to physically become something other than purely a driving machine, to generate attraction and fascination. However, there was a reluctance to let the car venture into something unrecognizable or too eccentric in line with Raymond Loewy's long-lasting and well-known principle of designing for MAYA—the Most Advanced Yet Accepted solutions (Loewy, 1951). It was felt that expectations of attraction could all too easily tip over into users distancing themselves from the product if the design was perceived as being too alien (cf. Rogers, 1995). This concern appeared to be mainly social (image building) rather than connected to trust: *I want the vehicle to be contemporary with style, not too weird-looking. I want a normal car* (Participant 6).
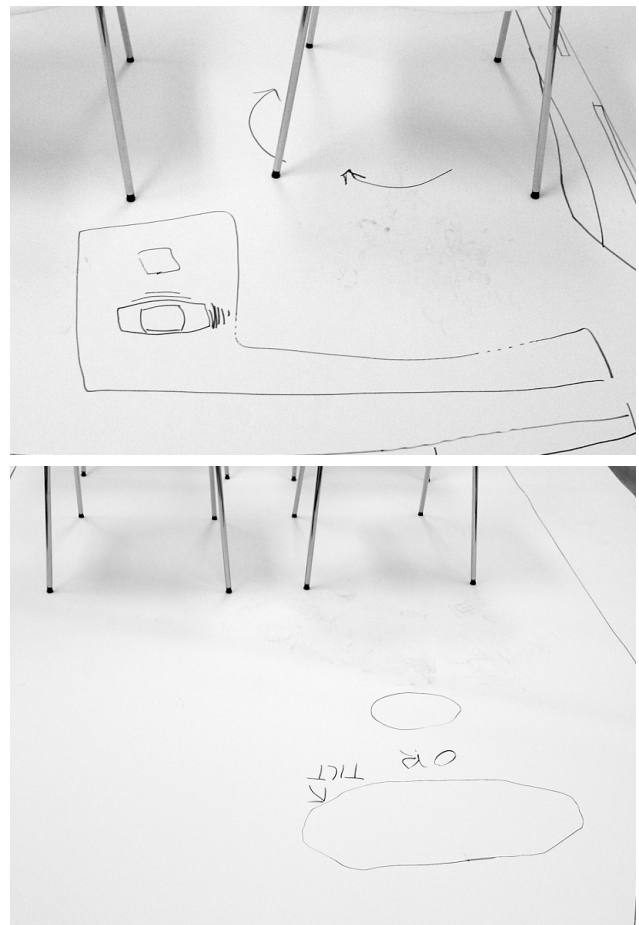
Figure 2. The desired metamorphosis of the interior manifested in for example the drawing of swivelling seats and tilting steering wheel (Participant 4 & 11).

Situated Use

During the sessions, extensive information about expected interaction with the car was communicated. Expectations on use contained requirements on must-have functionality, for example, a *kill switch* for interrupting the autonomous functionality, as well as mental models on interaction patterns. The expectations of situated use mainly concerned *ease-of-use, trust building and previous experiences* of related technology as well as *stimulation*.

Ease-of-Use and Stimulation

Exceptionally uncomplicated handling of the car was expected to add to satisfaction with and trust in the car. This was exemplified by expectations on clear feedback on actions and intuitive handling, and also by the freedom of not having to control functionality unless specifically requested to do so by the user. Even if participants expressed a heavy focus on ease-of-use, there were still expectations of stimulation and exhilaration through novel interactions and designs, giving the car an air of smartness and novelty in interaction. This was, for example, reflected in the expected metamorphosis of the car space (e.g., retracting steering wheels) and the intelligence of the interactive technology.

Previous Experiences

Expectations from use were clearly affected by previous experiential knowledge, for example, from using semi-autonomous systems such as adaptive cruise control in cars. This materialized, for instance, in the mental models of handing over the driving task to the car, bearing similarities to the logic of cruise control. The participants also discussed physical aspects of expectations of interactions by building on previous experiences, for example, expecting to feel the car jerk and start to drive on its own, similar to when activating cruise controls.

Participants frequently made analogies to experiences and technology in their lives other than cars. For taking back control of driving, a common analogy was to the end of a long-distance flight, being gently notified by lights and voice communication

of the distance left, conditions at the destination, etc. The participants clearly differentiated between how they expected to behave during the first, more alert, instances of use and later use where they would allow themselves to relax.

Trust Building

The car was expected to outperform the participant's own driving, matching or exceeding the user in driving smoothness, safety and route planning for a trust-building use situation. Trust-building through usage over time was an ever-present topic in the interviews. Although the principal decision to trust the car was expected to have already been taken before entering the car for the first time, the participants expected a transition period until they completely trusted the car. Drawings of *kill switches* and information about surrounding traffic showed the importance of still having safe exits from automation, letting the human being have the final say if needed. These types of must-have expectations were fairly homogenous among the participants. However, in terms of expected information during autonomous driving to create trust and a sense of reliability, two categories of users appeared to take shape: one wanting information at a strategic (route planning) level and one in need of information at a direct control level, with, for example, more information on traffic close to the car. Figure 3 shows drawings illustrating the two perspectives, the first displaying route information, the second displaying distance to immediate vehicles. This resonates with previous research highlighting individual differences in terms of need for control (Averill, 1973; Lee & Moray, 1992).

Practice and Meaning Transformation

Expectations also concerned the long-term routines, values and identification with new designs in a participant's life. These concerns required deeper reflection during the session. In the case of autonomous cars, these expectations were, for example, consequences of choosing where to live, how the car would change daily routines and what it would mean to social image
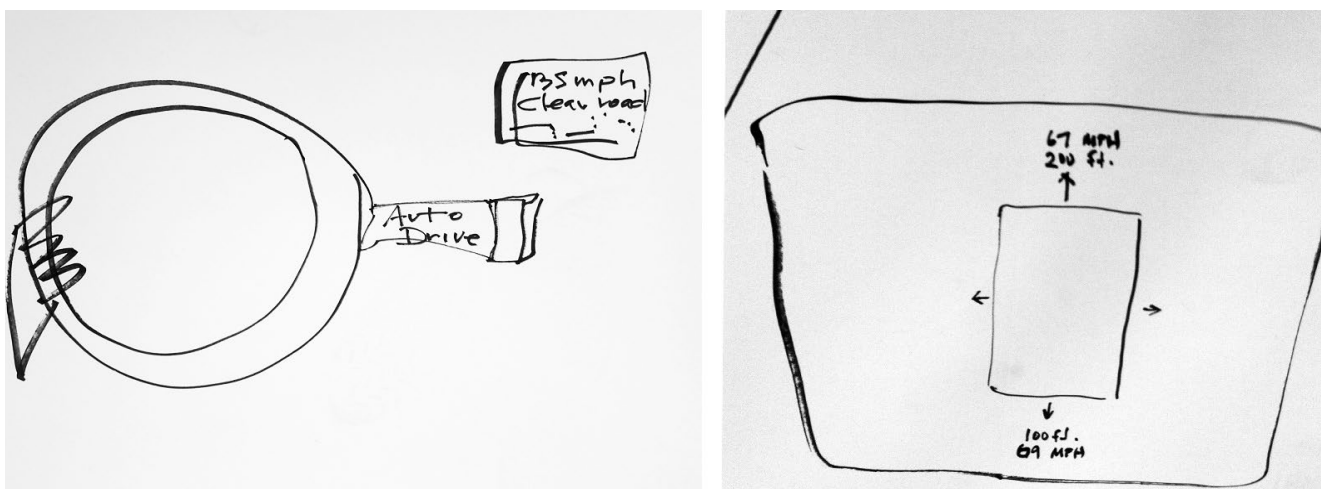

Figure 3. Driving information expectations differed between users, as exemplified by Participant 5's (left) **and Participant 1's** (right) **drawings.**

and identity. These expectations of values were well beyond the stage of building trust in the technology; they were part of the expected long-term, day-to-day use. Eventually, the practice and meaning of the car would be transformed from a place where driving was the primary focus to a space that would permit double effectiveness to a much larger extent than today, seeing the user simultaneously travelling and performing other activities.

> You can't be involved (in the car) because you're completely immersed into another thought (when in autonomous mode). That's not what that's (the autonomous car) supposed to be. It's not like cruise control. (Participant 11)

Long-term values are what would make users form a bond with the product and use it continuously, creating the technology's transition from the fascinating to making a difference in everyday life.

Values

All participants felt there was massive value to be found in autonomous driving, which can to a large extent be explained by a traffic situation like the one in LA. Many of the participants were in need of relaxation in everyday life, a time to break away and shut off from the world. Efficiency shaped a large part of the attraction, such as being able to simultaneously travel and work or relax. Figure 4 presents the range of values.
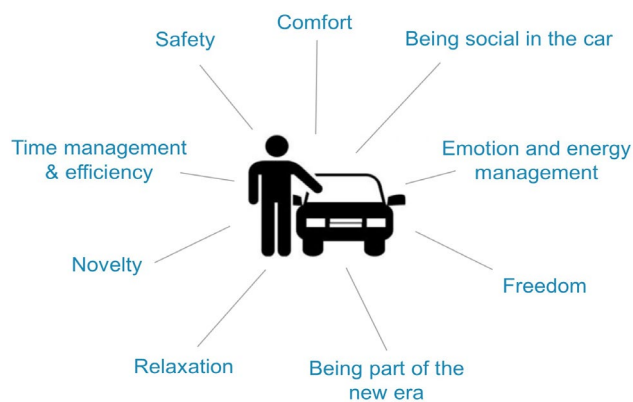
Figure 4. Values of the autonomous car expressed by the participants.

Time was expected to be more manageable with an autonomous car. For some participants, arriving at a meeting well-prepared and with newly applied mascara would provide a very different start to the working day. The transition between locations was expected to become a much more positive experience as the driver would be left out of the loop and spared the negative emotions associated with commuting by car in heavy traffic. The participants expected an autonomous car to bring relief from unwanted emotional engagement in the driving task such as involvement in bumper-to-bumper traffic, creating a better bridge between work and home life in the long run. One participant imagined coming home with a smile on his face instead of experiencing lingering negative emotions stemming from stressed driving situations.

Routines

The study participants expected the adoption of new daily routines to be successfully established over time in an autonomous car. In addition to creating routines for values such as relaxation and efficiency, an autonomous car could even influence where the participants chose to live or what routines to engage in during a day. Simplification of daily routines was a recurring value mentioned by the participants, who expected a comfortable interior allowing for the new activities. For example, morning routines like work and eating could be postponed so they can take place in the car.

Small changes in routine like these were expected to become highly valued over time. Driving appeared to be predominantly a lonely business for the participants, most trips being solitary. However, the increasing social value of cars commonly surfaced as an issue, with expectations of more social interaction in the car. Allowing for more interaction between passengers was anticipated to require changes in the layout of the car interior. There were also other requirements for the physical space to enable new habits, such as better storage opportunities, work surfaces and charging possibilities for various electronic devices. These design changes would mediate the transformation of the car's meaning to become a space where activities in addition to transport were given more extensive focus than at present.

Identification

For many of the participants, there were positive anticipations of and identifications with being part of the paradigm shift—being some of the first users of a novel technology that would signal a smarter, hi-tech and more efficient life in cars. Research indicates that product attachment emerges when a product becomes part of the user's self-concept (Meschtscherjakov, Wilfinger, & Tscheligi, 2014), which appeared to be the case in this study. Impression management plays an important role in interpersonal behaviour (Leary & Kowalski, 1990) and the designed objects with which we surround ourselves are a part of this ongoing management. The autonomous car could be a social conversation starter, for example, by sharing images of oneself in an autonomous car on social media:

> I'd probably share that with everyone online and make a movie with myself not touching the steering wheel and just letting the car the car do all the work. (Participant 1)

Trusting emerging technology was crucial for long-term self-image and identification. One participant even expressed trust in technology as a requirement for success in today's society. In this pursuit, the autonomous car held a strong symbolic value.

A Tentative Model of Expectations

The findings show that expectations of the future were clearly not based on a single representation, but rather divided into an expected process over three distinct steps (See Figure 5. See also Pettersson & Karlsson, 2016). This paper thus presents a tentative
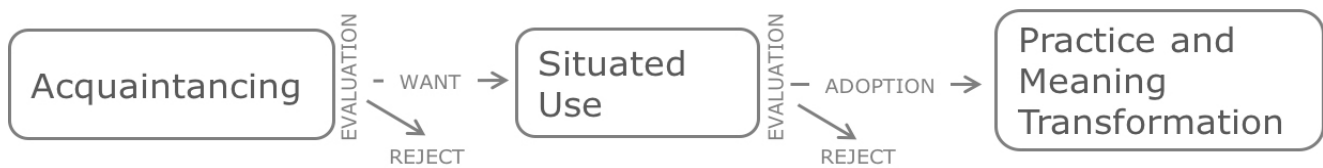
Figure 5. A tentative model of expectations.

model of user expectations as a tool for designers and researchers in understanding and approaching expectations. The temporal steps in the model were affected by earlier experiences of technology adoptions in the car and elsewhere. However, replicas of today's technology were not desired, but rather a car that could offer a new meaning to the user by new possibilities of rewarding habits and interactions.

- The first layer of the model includes reflections on getting to know the artefact, *acquaintancing*. In general, this was expected to imply an appealing, novel design as a clean slate to imagine a less stressed life of tomorrow. Acquaintancing was heavily influenced by social factors, such as friends talking about the technology or reading about it in social media. If the design were found to be attractive enough to make the user trust and want the artefact, this *want* would be the lever to enable the next phase, actually becoming engaged in use. An example of possible rejection was if the car had negative media coverage from incidents, or the perceived value proposition was too low.

- Reflections of *situated usage* in an everyday-life context contained the expectations of ease-of-use, stimulation and building of trust in the artefact by interacting. A successful use situation would then be the next lever into the final layer, the design causing long-term effects. A degraded trust or perceived value, caused by, for example, low quality, low ease-of-use, or unattractive designs were expected to lead to unsuccessful adoption into long term use.

- The final layer of *practice and meaning transformations* states the possibilities of how the artefact would make a difference to the user in a longer time perspective. This is the layer where the technology finds its final fit into everyday life if the value, identification and interactions with the product are perceived as sufficiently satisfactory. This is demonstrated in the tentative model constructed of user expectations in Figure 5. In short, it is suggested that the technology needs to successfully attract the user, fulfil expectations of usage situations and finally make a difference in the user's life.

Discussion

Considering the need to evolve knowledge within prospective user research, the study set out to explore user expectations using a methodology with generative user participation, emphasizing the temporal aspects of future use. The methodological possibilities for the participants to express and reflect with the help of mediating tools and inclusion of the temporal dimension appeared to be useful in gaining rich and experience-related data. Focusing solely on solving problems with today's products or leaving out the

temporality of using new designs in user studies would arguably leave out important information, especially for disruptive designs. Future projections of experiences were narrated and enacted by the participants while maintaining a tangible link to their personal situations and needs.

Successful adoption of new technology is often linked to *previous experiences* with similar technology (Guinan, Cooprider, & Sawyer, 1997; Thompson, Higgins, & Howell, 1994). Previous research in the automotive based on surveys (Kyriakidis, Happee, & de Winter, 2015; Rödel, Stadler, Meschtscherjakov, & Tscheligi, 2014) points out that prior experiences of advanced driving assistance systems have a positive effect on the attitude towards autonomous cars. The narratives of expectations in this study included many references to previous experiences. Previous cars and other technology that the participants had used were an anchor for their responses, but not a blueprint. An autonomous car was expected to hold new possibilities for activities and meanings. It may not be possible to anticipate a valid version of future use, but being aware of users' underlying motivations of wants, needs and expected interactions can be a key to pleasurable, safe and trustworthy design solutions. Innovation needs to be seen as a process that involves both producers and users in a complex interweaving of activities, where understanding user expectations is suggested as one of these activities.

As previously stated, the majority of user research deals with the use of existing artefacts. Research of futures, such as Design Fictions, have no explicit links to information from users. For prospective user research concerning novel artefacts, the model and methodology presented in this paper are promising means of eliciting and understanding user expectations. The research effectively provides early insights to feed into a design process. However, not all participants were comfortable with drawing, resulting in drawings of different levels of detail, although all made some kind of representation of the expected car interfaces. When drawing was used in a detailed manner, there were many more examples of and reflections on the reasoning behind wanted interaction solutions. The process of drawing often resulted in evolvement of reflections as well as a better understanding for the researcher of the study participants' needs and motivations, for example, the individual differences in needs for information from the car. As stated by Pettersson (2014) concerning the method used: "The *designs* created by the participants are not to be seen as design solutions as such; they are intended to be seen as indicators of areas where users' design concern lies" (p. 7). Design remains with the designer, but user studies with creative elements can inform the process. The creation of something tangible added to the outcome of the study, as also showcased in similar approaches using other means of creativity such as interactive scenarios

(Strömberg, Pirttilä, & Ikonen, 2004) or video prototypes (Westerlund, 2007). These creative and prospective aspects of the employed methodology differ from traditional retrospective ethnography and interview-based user research methods and appeared useful for transitioning the participants into future projections of autonomous cars while maintaining a tangible link to their personal situations and needs. A similar motivation and approach, however without enactment, can be found, for example, in research on *co-constructing* stories of future technology with users in which previous experiences are incorporated into the process of imagining new possibilities for future technology, overcoming some of the barriers when performing prospective research (Buskermolen & Terken, 2012).

A more complex interdependency was found to influence the 'want' for an autonomous car than an attractive design, thus moving beyond product-focused experience design frameworks such as Norman's levels of design (Norman, 2004). The tentative model proposed in this paper ventures beyond the typical predominant focus of the usage situation of an artefact. Time is the unit of structure and highlights how expectations are formed around anticipations, moving through different layers of experiencing and creating bonds to artefacts over time. The layers are characterized by different attributes.

Acquaintancing was heavily influenced by social factors such as seeing the car in social media and hearing others talk about it. This social aspect is not particularly acknowledged within user experience research, especially not regarding automotive design (see, for example, Knobel, 2013; Tscheligi, Meschtscherjakov, & Wilfinger, 2011 for further argumenation). In the acquaintancing phase, there were expectations for a minimalistic, clean and attractive design that would symbolize the easier life of cars of tomorrow, this being expected to influence later experiences. These dream images of the designs resonate with prospective research from related fields such as consumer research, for example, in Christensen's *theory of consumption visions* (Christensen, 2002). Christensen's theory underlines that future consumption is anticipated in personalized visualizations of future use as found in this study. However, the theory of consumption visions does not include the temporal aspects of anticipation.

As for the next layer, the *situated use*, the layer itself contained temporal dimensions, i.e., stimulation and trust were expected to evolve over time. The situated use layer is, however, the layer closest to common user experience approaches. Relating to well-known frameworks within user experience, Desmet (2002) and Desmet and Hekkert (2007) use appraisal theory to explain how emotions are related to using products. Empirical studies then typically address instantaneous emotions. Hassenzahl (2008) defines user experience as *a momentary, primarily evaluative feeling (good-bad) while interacting with a product or service*, constituted along two product dimensions: pragmatic and hedonic qualities. This framework does not address temporality by contrast to the tentative model proposed in this study, which ventures beyond the predominant attention of short time interactions with artefacts in user experience research (see Bargas-Avila & Hornbæk, 2011).

The final layer emphasizes *meaning and practice transformation*, that is, the aspects of user experience that are primarily established through prolonged use, transforming the meaning of the product as well as everyday routines and habits. This further distances the model from the more traditional approaches to user experience (cf. Hassenzahl and Desmet), moving from the use situation to the effects on daily life. The concept of user experience tends to focus on stand-out experiences, but it is also important to understand how mundane and unconscious experiences develop over time. A novel artefact such as an autonomous car faces a transition from the novel and exciting to also encompass the everyday and familiar.

The *setting the stage* method employed in research was developed for cars, but there are no obvious limitations to expanding its use to other technology where a purposeful, lo-fi use context can be constructed. For example, technologies used in medical care, other transportation means or office work could well be researched by the method if sufficient contextual cues for the user to relate to are constructed. Technology not requiring the same large physical space as cars still benefit from introducing contextual cues of use and of simple mock-ups of interfaces even at early stages of design, user experiences being very much related to contextual factors (Beyer & Holtzblatt, 1997; Buchenau & Suri, 2000). As for the model, it likely has limits to its applications where previous experiences of the technology are farfetched, the model of expectations of user experiences being derived from a case with strong links to previous experiences. Likewise, very simple objects with low levels of interactivity may not be well served by the model. To use the model as a tool in design and user research, there needs to be a story or idea of future use to relate to. However, as most technology can be expected to undergo temporal stages of experience, considering these in the design process can be valuable. The model presented in this paper is intended as a tool in design practice, both for designers to consider temporal aspects of novel artefacts and as a tool in user research. The research described in this paper serves as one more empirical example of data regarding user expectations where not much data of this kind is to be found. The results per se are not to be seen as fixed and stable as the introduction of autonomous cars will continuously change expectations. The model will benefit from further investigation and empirical studies, what is assumed in the tentative model needs needing further research as designs emerge. Autonomous cars are soon to be tested by users on public roads (Volvo Car Corporation, 2017). It would be interesting to follow the model's applicability to the actual designs, to research its predictive value. However, one can argue that studying expectations continuously, especially considering the characteristics of different temporal phases, can be an important source of data and an inspiration for prospective and prescriptive user research.

Summary and Conclusions

The study set out to explore user expectations of new technology using the case of autonomous cars. Time was identified as a major axis for structuring expectations. Three layers of expectations

over time were defined; *acquaintancing, situated use,* and *practice and meaning transformation.* The tentative model presented in the paper and the results point at factors that matter to users at all layers of expectation and which can be of aid in a systematic approach to creating not only fascinating objects, but also long-lasting designs.

In the case of autonomous cars, considerable anticipation of a smarter, more efficient and relaxed life with the cars of tomorrow was noted. In the first expectation layer, attraction was expected to arise from social influence, aesthetics and perceived novelty, highlighting the value of simplification of daily life in cars. However, the desire for novelty and stimulation needs to be balanced with the unease at handing control over to a car. The next expectation layer concerns situated use, where expectations were founded on previous use of related technology, ease-of-use, trust-building and stimulation. Finally, the autonomous car would need to make a tangible difference in the user's life in order to be expected to be adopted, such as being able to introduce valuable new habits and routines during the daily commute. The meaning of the car was expected to transform from today's cars —where the primary focus is on controlling the car—to a place of being completely immersed in other various activities while being transported. The car design needs to flexibly allow the user and artefact to go from very conscious handling at early usage —where both stimulation and confirmation of reliability are desired—to allowing the car interfaces and interactions to fade into the background over prolonged use and so let new habits and practices emerge.

In suggesting an alternative future, user speculations on emerging designs can build into designs that do not only take incremental steps based on what is there, but build a space for imagining new activities and values, although without excluding use and attraction aspects. The model proposed in this paper can be used in action (information and inspiration for design), reflection (i.e., evaluating attributes found important in each layer) and in understanding user rationales concerning novel designs. Considering all three expectation layers in a design process can help emerging artefacts to gracefully make the transition from initial fascination to a useful, meaningful and domesticated object.

Acknowledgments

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