SETTING THE STAGE FOR SELF-DRIVING CARS:

Exploration of future autonomous driving experiences

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ABSTRACT

Self-driving cars are under development and are predicted to reach the market within a few years. There is a need to understand how users will respond to the technology, and what possible benefits or difficulties they perceive. User involvement is a prerequisite for eliciting this information at the same time as several studies have demonstrated the problems associated with investigating “the future”. In this paper, two different approaches for exploring future automotive technology were applied in two studies of users’ future experiences with self-driving cars. Both studies used materials to mediate a shift in focus from today to tomorrow, but the outcomes varied with the different approaches. The results of the two studies provide insights into users’ expectations of autonomous cars and contribute to our knowledge on how different studies on the same topic can elicit different types of data.

1 INTRODUCTION

Self-driving cars are under development and are expected to reach the market in a near future. The major benefits of such solutions are argued to be safety, convenience, fuel economy and lower emissions (Davila & Nombela, 2012; Rupp & King, 2010; Verberne, Ham, & Midden, 2012). These issues are being extensively researched from a technical perspective but there is also a need to understand how the users will react to the technology, and what possible benefits or difficulties they perceive. This information is needed when designing the interfaces and interior of autonomous cars; as the driver’s role will change, opportunities to design for entirely new types of future in-vehicle experiences open up. User involvement is a prerequisite for eliciting information on user experience at the same time as several studies have demonstrated the problems
associated with investigating “the future” (Brandt & Grunnet, 2000; Vavoula, Sharples & Rudman, 2002). This calls for new user research methods, which allow a transition from the current situation to the future possibilities of technology, without falling into stereotypes. One possible way of bridging the difficulties in performing user research of what is yet not testable, is to allow the user to have a more active role in user studies (examples can be found in Halse, Brandt, Clark & Binder, 2010). Self-driving cars are a close future, but with an opportunity to be very different than today’s cars, if given the chance to move from incremental design changes to new design opportunities. This paper takes on the challenge of performing user research of what is not yet there.

2 FRAMEWORK AND INSPIRATION
The creation of the methodology was founded in the tradition of Participatory Design, where props and triggers often are used to stimulate imagination and conversation. This has, in combination with the enactment of future activities, proven fruitful in probing into users’ future experiences with technology and creating empathy with users (Brandt & Grunnet, 2000; Buchenau & Suri, 2000). Inspiration for the methodology development was also found in the film industry. Film and theatre have an inherent power to convey experiences of others. This power is particularly strong in Lars von Trier’s film “Dogville” from 2003. The representation language is limited to a minimal design with white lines on a concrete floor representing walls and objects. The audience will have to imagine what is not there in this minimalistic setting, and the usage of the audience’s imaginative power results in a strong, artistic film. In studies of future designs, simple and open designs have been claimed to stimulate participants’ fantasy to a greater extent than more elaborated designs (Ehn & Kyng, 1991). Also, the use of both body and mind, by for example enactment of future usage, appears fruitful for obtaining more informative data from user studies about future technology (Brand & Grunnet 2000).

3 STUDIES
Two different approaches were applied in two studies (A and B), designed to investigate users’ future experiences with self-driving cars. Both studies were
grounded in the process of relating to the users’ current driving experiences, envisioning the future autonomous driving experiences and finally imagining how this could be embodied; how would time be spent? What emotions would this experience bring? What would be the value of self-driving cars? How would the design of the car change? However, different materials for stimulating responses were applied in the respective studies as experimentation on how study designs on the same topic can elicit different types of data. The first study had a broader material scope, giving the participants the opportunity to collage their vision of self-driving cars, in terms of types of cars but also cityscapes. The power of imagination and acting, supported by a minimalistic representation language, was an inspiration for the second study. All together, 18 persons participated in the two studies situated in Denmark and Sweden.

### 3.1 Study A – Drawing and Collaging Future Automotive Experiences
The first study included drawing, collaging and interviews about future experiences with self-driving cars. The approach was informal and spontaneous engagements by altogether nine participants, six men and three women, in a Copenhagen shopping mall. Props were used in form of collage material of existing car models, car concepts and images of Copenhagen. The participants were asked to choose one type of car that represented their vision of autonomous driving. They were also requested to choose one cityscape important for them, and note down how they expected that to change with the introduction of autonomous driving. In addition, they were encouraged to draw or narrate any car design and city change they thought autonomous driving would bring about. The participants were asked what their imagined journey back home with the self-driving car would be like. Qualitative data was generated in terms of the user’s collages, drawings and narratives, and was sorted into themes.

#### 3.1.1 Social implications of the self-driving car
All but one participant drew rotated seats for a more social setting in the car,
emphasizing the increasing social capabilities. Being able to engage more in other passengers was perceived as one of the main values of self-driving cars. However, there was also a concern that other road users would be worried and even afraid of a self-driving car. On one hand, there was an aspiration to not scare others with the cutting edge technology, and on the other hand a desire to show off the novelty of such a hi-tech and futuristic car. Six participants, interestingly all men and no women, wanted to keep the exterior very traditional to allow a smooth transition into the realm of autonomous cars. The three women that participated desired a futuristic image to display on the roads, enjoying the novelty of the technology. One woman was even imagining a flying car and another woman imagining that the car would interact with her and teach her to become a better driver.

3.1.2 Every-day life in the self-driving car

Some would use the time to catch up on sleep or prepare/conclude the working day. One participant opened up for a giant sunroof, as to be able to gaze up at the sky and relax during the ride home to his family. The mental transition between places was expected to become smoother. There was a hope that future travel will be more predictable and exact, giving the users greater control of their time. As timing would be more predictable, the car would allow the traveller to disconnect from time management, free to rest or work. One participant who regularly travelled between Germany and Denmark saw a great value in extending his morning activities into the car, resting and finally arriving more energetic and prepared for the day’s meetings. Another participant imagined having more freedom to take longer and more demanding trips by herself. But on shorter trips, there would also be a value of disconnecting from driving.

3.1.3 Anticipation of a smarter way of using resources

Many were expecting smarter ways of using resources with the introduction of autonomous cars. All the participants had high expectations for the self-driving car’s intelligence, and that the power of automation should be used for more than just transporting the owner from A to B, for example transporting other family members, doing errands and driving to the car wash and garage by itself. Sharing their car with others would lead to more efficient and economic car use and fewer cars in the city. There was an appeal to think of how the “robotic car” would fit neatly into its spot in robotic parking
houses, leading to fewer parking lots. Two participants expected the cars being closer to each other in traffic, resulting in less queues.

3.1.4 Trusting self-driving cars

In terms of trust, the views of the participants diverged. One participant would rather trust the technology to drive him home the 90 kilometres from Copenhagen to Sweden, than his friend (a devoted car enthusiast). In addition to communicating a message concerning his friend’s driving style, his views were an example of a readiness to take this technology to his heart which was expressed by many users, while others were much more reluctant. For some, it would take months of close surveillance until they could finally relax and trust the car. Although some worries about the initial phase of usage, all were convinced they would sooner or later take it to practice, as the possibility of disengaging from driving was attractive.

3.2 Study B – “Setting the stage” for Future Automotive Experiences

In study B, the method focused on a more embodied experience, investigating how this approach might spur imagination and reflection. Chalks and sparse scenery was used as material on a parking lot in Gothenburg, Sweden. A car was drawn on the ground and a few chairs were placed on it to represent possible seating, giving the methodology the name “Setting The Stage”. By-passers, one by one or in groups, were welcomed to imagine and design a new self-driving car, using the chairs and chalks. In total nine persons participated; seven men and two women. This meant that they were also collectively building upon each other’s ideas. The participants were also asked what their imagined journey back home with the self-driving car would be like. In contrast to study A, a scenario was also presented at the end of the session, where the car asked for the driver’s attention and control. The participants were encouraged to imagine the process of entering-the-loop again (i.e. driving). The scenario aimed at encouraging imagination and enactment of an interaction situation with the “car”. Again, photos taken during the session, the participants’ drawings and stories were analysed by
categorizing them into themes.

Fig 1. Examples of photographs from study B

3.2.1 The extended living room
The results of this study were closer tied to the interaction- and interior design of the car compared to Study A. The car was expected to turn into a living room like space, more adapted to comfort, social activities and relaxation, with a softer, cosier design language. Soft lights and low sounds would result in a calm interior mood. The participants envisioned how everyday life would continue in their self-driving car, relaxing with family, enjoying a good movie, and performing light work tasks. Some participants completely removed the chairs and instead had reclined, relaxed positions (as shown in Fig 1). A number of rotating seats were drawn, expressing the fascination that the participants had for the new, more social interior design opportunities of a self-driving car. Although work tasks would be done, the environment spoken of was more similar to a home environment than an office. Activities like reading and quick replies to e-mails were referred to, not more demanding work like writing longer texts or editing spread sheets.

3.2.2 Interaction and interior metamorphosis
The metamorphosis of the car was a common topic, both in terms of an imagined new interior design language but also by a physically moving interior, for example receding seats and steering wheel. For many participants, the car interface transformed to a very passive role during the autonomous drive. Traditional driving information would continue to exist, but have a more subdued position in the car. The car would only occasionally come into focus, for example when it was needed to re-route the trip. The input of destinations to the car was imagined to be performed via voice command, for comfort and for a hi-tech experience. Big screens in the
interior also provided a sense of hi-tech novelty. This novel, high-tec image was perceived to characterize the introduction of self-driving cars.

### 3.2.3 Trusting self-driving cars

The sense of trust in the technology varied from one extreme to another; from a positive and trusting attitude, with visions of smooth and seamless technology interactions, to one participant's nightmare vision of technology unfit to human reaction capabilities and needs. However, the majority had very positive expectations. In a group of three young men, the extremely relaxed atmosphere with reclined positions was only briefly interrupted for the driver when the scenario called for manual control. He imagined that the steering wheel would smoothly move towards his hands, and his reclined seat would stretch towards an upright seating position. If given a fair amount of time and preparation without stress, the participants perceived that they could conveniently take back control of driving. They expected to be given substantial time to reposition into driving. The designs of the transitions were surprisingly exactly imagined by the participants, with unattractive extremes of "red flashing lights and sounding alarms" to more attractive "soft, smooth sounds" discretely and politely asking for the driver’s attention. Several participants mentioned the need to have a familiar speedometer to quickly glance at from time to time, being reassured that everything was in order. There appeared to be reluctance of entirely letting go of the traditional driving interface; the system could only be trusted if it was continuously and calmly reassuring the user.

### 4 REFLECTIONS AND CONCLUSIONS

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. For example, in the many drawings of speedometers, additional screens and rotating seats, important issues and values manifest themselves; such as a desire for novelty, time management and social relatedness, as well as issues of trust and safety. The result of the two studies provides in this way insights into users’ expectations of
autonomous cars. More importantly though, the two studies contribute to our knowledge on how different studies on the same topic can elicit different types of data. Study B resulted in more elaborate and in-depth reflections on the participants’ trust, interaction expectations and interior car design expectations, whereas study A gave less informative answers about interior and interaction. Instead, study A gave more information on how the technology would shape every day life and the city. In study B, the bodily placement in the “car” appeared to create a situation to act and anticipate future use. The participants were able to express themselves more precise and informative. Less preconceived ideas about the technology (for example of “flying cars”) were aired in study B, and more informative specifics about the designs and expected use were expressed. The situation provided a possibility to bridge body and mind in the enactment of future experiences, in accordance with Brandt and Grunnet previous studies of studies of future technology (2000). Both methods pointed towards possible ways of probing into the future without time taking and expensive prototypes, providing an open surface to more freely project expectations on, as noted also by Ehn and Kyng (1991). The methods applied in this research are best used in early design processes as inspiration for value-creating interior and interaction designs. The methods must naturally be used in concert with more traditional methods for researching user needs and design requirements in a user centered design process. At later stages in the design process, other inquiring materials such as prototypes are available to continue the experimentation and exploration of future users’ every day user experiences, involving both body and mind (Buchenau & Suri, 2000). This can challenge preconceived design concepts, leading to ideas of less incremental qualities.

Both studies contribute to the repertoire of methods that can be used for studying users’ expectations of future automotive technology. Both types of inquiries generated relevant information but the results also show that method props should be chosen and used with careful regard to what the focus of the research question is. Future work is needed to continue explore the future of autonomous driving with human needs and values in focus, and also to obtain further information of what approaches similar to those in this study will result in.
REFERENCES


