Peer-reviewed version available at Multimodal Technologies Interact. 2018, 2, 74; doi:10.3390/mti2040074

Article

Participatory prototyping to inform the development of a remote UX design system in automotive

Stavros Tasoudis [1], Mark Perry [2]

[1] Brunel University London London, UK ; Stavros.Tasoudis@brunel.ac.uk
[2] Brunel University London London, UK ; Mark.Perry@brunel.ac.uk

Version August 1, 2018 submitted to

Abstract: This study reports on empirical findings of participatory design workshops for the development of a supportive user experience design system in the automotive. Identifying and addressing this area with traditional research methods is problematic due to the different UX design perspectives that might be conflicting and the related automotive domain limitations. To help resolve this problem, we conducted research with 12 User Experience (UX) designers through individual participatory prototyping activities to gain insights on their explicit, observable, tacit and latent needs. These activities allowed us to explore their motivation to use different technologies; the system's architecture; detailed features of interactivity and describe user needs including Efficiency, Effectiveness, Engagement, Naturalness, Ease of Use, Information retrieval, Self-Image awareness, Politeness, and Flexibility. Our analysis led us to design implications that translate participants' needs into UX design goals, informing practitioners on how to develop relevant systems further.

Keywords: User Experience; Remote UX; Participatory design; Co-creation; Prototyping; Automotive user interfaces; Autonomous Vehicles; Automotive.

1. Introduction

Autonomous driving is transforming the driving experience in the 21st-century vehicle. Automation is using Artificial Intelligence, to enhance safety and reduce accidents on the streets at the expense of the traditional driving experience and the sense of being in control. This new paradigm results in a shift of the traditional driving experience paradigm. Even though part of the driving experience is taken away by automation, people have the convenience of using their free commuting time to explore different driving experiences and in-vehicle interactions in the car context. Given the possibilities of web 2.0 and the Internet of things (IoT) what we previously considered as a secondary task or activity such as interacting with in-vehicle information systems, infotainment, in-car productivity or social interactions and real-life experiences with other passengers in the car is slowly growing into a primary activity. Previous research investigated non-driving-related activities drivers want to perform while driving partly or entirely automated and identified the potential for mobile and ubiquitous multimedia applications in the car[1]. As a result, the recent focus of attention in automotive UX research includes design techniques for exploring automotive interaction in the drive towards Automation [2]. Furthermore understanding what it means to drive in an autonomous vehicle; potentials of a shift from a 'joy of driving' to a 'joy of being driven' and the exploration of new forms of connectivity, entertainment, productivity, gaming as well as transportation-related services[3]. This new space hands designers new opportunities for innovation yet the deficiencies [4] that go along with the context of the car add layers of complexity to the research and design practitioners. Drawing from previous research, the main disadvantage of the traditional context-aware methods including Contextual inquiry, Ethnographic study, Cultural probing, is the effect of the physical presence of the researcher in the driving experience itself. Adding other secondary limitations such as motion sickness of the researcher while taking notes inside the car; intrusiveness; privacy; organizational challenges; and effort as previous researchers have mentioned [12].

Peer-reviewed version available at Multimodal Technologies Interact. 2018, 2, 74; doi:10.3390/mti2040074

Previous attempts to mitigate some of the domain-specific deficiencies and support designers in the exploration of new user experiences led to driving simulator platforms [5] that support the rapid iterative development of in-vehicle user experiences. Other researchers attempted to explore this space in-context, which led to new methods and tools, such as 'trip experience sampling' (TES)[6] a context-aware low-tech method of remote user experience research in the car. TES is a tool addressing the immediateness and situatedness of user experience research in automotive. Similar tools are designed but Niforatos et al. [7] address in-situ measurement methods and avoiding the disruption of users, a limitation for which TES attracted criticism. Their work introduces EmoSnaps, a mobile application that captures pictures of one's facial expressions unobtrusively throughout the day and uses them for the later recall of her momentary emotions. Most recent research [8] introduced systems that attempt to make sure that the in-vehicle automotive interactions can be designed, tested and understood before mass production. Inspired by previous knowledge in ubiquitous computing and remote user experience research systems including "Momento" and "Dart" [9,10] to support a holistic understanding of safe driving experience. Previous research is attempting to overcome the limitations as mentioned above and capture the situated context holistically, by developing supportive user experience design systems to meet the needs of the automotive UX designers.

What the needs of UX designers are in any domain have been the subject of debate within the scientific community. Much of the available literature in experience design is in line with the needs that TES is addressing supporting the capturing of an experience, momentarily, when it happens [11]. Per contra, other researchers [12] disagree that UX is a momentary emotion and the designer's need is to capture it, evaluate it with psycho-physiological measurements and later design for it. Supporting, that it is the long-term user experience that matters and not a momentary emotion that could even be meaningless to the user. Recent work explains eudemonic user experiences, which compared to hedonic experiences, is about accomplishing personal goals through technology use [13]. This use of technology can support people's values, such as keeping up with fitness through technology. For instance, eating healthy food is hard and sometimes unpleasant, but it can serve the personal values and eudemonic goals of being healthy in the long term.

Respectively, specific needs of the UX designers for the design of the autonomous car new driving experiences are as Horst Rittel, and Melvin Webber proposed a "Wicked Problem". An ill-defined or wicked problem that because of the conflicting perspectives of the stakeholders cannot be accurately modeled and cannot be addressed using the reductionist approaches of science and engineering [14]. In our study both the automotive domain limitations and the conflicting perspectives on how to approach automotive UX design lead us to use a pragmatic epistemological paradigm and apply participatory prototyping methods.

We aim to identify these under-constrained needs of UX designers so that we can inform the development of a new remote UX design system that democratizes automotive innovation. To achieve that we applied participatory design to design the supportive system by actively involving UX designers in the making process. The exploration of implications including the participants' motivation to use the supportive technologies; the detailed interactivity of the system; and the system's architecture; allowed us to translate participants' (UX designers) needs into UX design goals which serve as actionable insights for the development of relevant systems. Thus, we conclude on a pragmatic interpretation of our findings to inform the design of such systems and offer directions for future work in automotive user experience design.

2. BACKGROUND

Following a pragmatic epistemological standpoint, a critical review of previous work resulted in the collection of design guidelines and deficiencies. In the interest of multidisciplinary work, there are various domains that this first knowledge derived from and even conflicting perspectives as previously explained. As a result, there are no set requirements for the design of a compatible remote system but a set of guidelines. We highlight the most relevant guidelines from previous work in

Peer-reviewed version available at Multimodal Technologies Interact. 2018, 2, 74; doi:10.3390/mti2040074

the three research areas identified. The UX design process; the design of remote communication systems; and the deficiencies in automotive design systems; We have aimed to use these guidelines as stimuli in our participatory design methods to stimulate discussion and action around them. Thus, we use these guidelines to design the components of a toolkit we are using in the early stage of our participatory design, illustrating a sufficient suggestion of what can be 'afforded' in our design and how the participants are to interact with these affordances. We present some of the guidelines in the following subsections.

2.1. UX Design process guidelines

User experience designers follow different methods and processes when designing for interactive experiences. Following on the most relevant manifestations of design methods and processes, we used Design thinking approaches (IDEO), at the early stages of the design Circe. As a result, the design of a supportive system regarding tasks and processes should be able to help the designer through the understanding of the challenge, the preparation of the research and the gathering of research inspiration supporting the 'Discovery' circle. The system would also require supporting storytelling, the search for meaning and the framing of opportunities at the 'Interpretation' circle.

Previous researchers also mentioned the need for insights on the emotions of the users. The fact that consumers are feelers as well as thinkers [15] suggests the need for supporting the identification of emotions in user behavior. A system that supports the user experience design process according to [16] will need to support the designer to identify the user's internal state and the environment and the context when the interaction occurs.

Contextual understanding is undeniably a need for user experience designers. As previously mentioned [17] the social environment of the interaction; the physical environment either the space of the interaction is dynamic or static; and the time dependence of the interaction in a specific situation; should be observed by the designer in order to trigger inspiration or to help them in gathering insights and achieve a deep understanding of the user. Supporting the mapping of the context is both of great importance to a holistic understanding of the interactions taking place and necessary in designing for people and their experiences while involving them [17].

According to [18] productivity or learnability are not primary thus the system should support the identification of the person's experience at the moment experienced. Other research highlights the right timing for communication or interruption [19] when exploring behavior in its context which favors intrusiveness avoidance at the expense of time dependence. There is a controversy in regards to the time dependence of the contextual understanding when designing for UX. Some research suggests supporting the previous process of understanding the user immediately after the interaction when the situation occurs [20]. Other research [12] suggests supporting the long-term understanding of context that helps design for the overall UX.

2.2. Remote communication Guidelines

When designing for remote systems, the social context of the communication and the communication medium are of great importance. What is most important though is that the context has been found to influence the medium's perception and effectiveness [21]. In a remote communication, this can be frustrating since the so-called 'social appraisals' are more likely to play an important role when others are present than absent [22]. For instance, a person may perceive a communication technology as inappropriate because his or her friends or family who are present got intimidated. As a result of these abstract social, moral codes, the system is suggested to support the avoidance of disruption to situations of co-presence [23].

Choosing the medium for a remote system is controversial and dependent on the context as we previously highlighted. Different mediums are better equipped to disseminate information - called 'conveyance' and others are better at engendering mutual understanding which goes by the name 'convergence' [24]. Guidelines on previous research suggest that mediums used in remote

Peer-reviewed version available at Multimodal Technologies Interact. 2018, 2, 74; doi:10.3390/mti2040074

systems should support the avoidance of Face-threatening acts (FTA) including acts of criticizing, disagreeing, interrupting, imposing, asking a favor, requesting information or goods, and embarrassing [25]. Besides, the system should support etiquette in communication to make social interactions more pleasant and polite [26] by using the right medium.

The system's effectiveness also depends on the medium used. To support UX designers in observation of a hidden or latent need the medium used should support the identification of cues such as frustrations, confusion, or unexpected usage. Other guidelines on the communication mediums and the effectiveness of remote system include studies in social presence. These studies suggest that to communicate effectively, one should match the social presence of the medium with the level of personal involvement and attention of the communication task [21]. For example, when the medium allows teleconferencing, employees are more aware of others' status and reactions, they are more cautious about their self-image and behaviors[27].

2.3. Automotive domain deficiencies

When designing for interactions, context refers to the social environment of the interaction; the physical environment either the space of the interaction is dynamic or static; and the time dependence of the interaction in a specific situation. Any of the above can have a direct effect on the interactive experience. Designers and researchers [17,28,29], generally agree that context is both of great importance to a holistic understanding of the interactions taking place and necessary in designing for people and their experiences while involving them. In automotive HCI there are a few studies [30–32] that have previously investigated the influence of the automotive context in a systematic way using qualitative methods in real time driving situations based, on a somewhat holistic research approach. Automotive studies of ethnographic research are not conventional; nonetheless, we can identify some most recent studies using it for applying sociocultural understanding into the driving experience research in collaboration with Nissan [18]. Other researchers in collaboration with BMW even introduced early remote open innovation and co-creation paradigms [33] involving the users in the creation of value.

Previous research [28] already highlights some of the most important limitations for the researchers and designers in the automotive domain. At a higher level supporting the holistic understanding of the automotive context dictates that we mitigate these limitations. Previous research [4] is summarizing the so-called deficiencies which affect automotive design and communication. These include the distortion of the experience by the physical presence of the researcher in the car; Secondly intrusiveness regarding privacy as well as minimization of the effort of traditional contextual methods; Thus, the avoidance of cognitive effort, safety, and privacy of the driver/passenger while the interaction takes place. Thirdly avoidance of the motion sickness effect of the researcher taking notes inside the car.

Finally, we cannot neglect the fact that the communication involves two people, a researcher/designer, and a driver/passenger. Designing to support this communication also relies on the perceived trust, control, ease of use, fun, attitude towards the methods and tools used to interact and the intention to interact, of both the researcher/designer and the driver/passenger and we add them in our set of limitations.

3. Methods

Even though user-centered design (UCD) influences our methods, our study deploys participatory design and co-design techniques to actively involve non-expert users (automotive domain experts) to the generation and conceptualisation of our prototype system. UCD is a precise design method whose application conducts designers to develop usable design solutions for end users; co-design, as researchers currently describe in many design research contributions, is a set of creative techniques whose aim, is to inspire the design proves. Creative exercises are usually applied to enhance idea

Peer-reviewed version available at Multimodal Technologies Interact. 2018, 2, 74; doi:10.3390/mti2040074

generation and concept design; they are characterized by the presence of non-designers(experts) as participants and led by designers [34].

In the past participatory design results including narratives, games, and constructions have been applied under different contexts [35]. In Co-design, a form of empathic design, the participants are active design partners. Researchers who introduced design for experiences [36] were also the ones who inspired the co-design movement. As previously explained, make Tools and generative techniques [37] are used to access people's feelings, dreams, and imaginations and delve deeper into the explicit, observable, tacit and latent needs of the participants. By co-designing the artifact, in our study the prototype of the system, the designer can gather data on what the participants say, do and make and get a deeper understanding of their needs.

"One should keep in mind that the relationship between designer and user (consumer, recipient) is bi-directional. It is not as if users have well-defined requirements, which only wait to be discovered. Indeed, requirements are co-constructed in the ongoing dialog between the user and designer."[11]. In our study, the users are User Experience researchers and designers working in various domains other than the automotive, familiar with the UX design processes but not familiar with the automotive context as we will later explain.

Previous work in developing remote automotive UX design systems does not provide us with well-defined requirements. Consequently, we followed a top-down approach which initially capitalizes on the available knowledge of the UX design processes; automotive limitations; and remote communication guidelines from previous research. Driven by our pragmatic epistemological standpoint and the nature of the problem we apply individual participatory design workshops wherein we actively involve participants to prototype the proposed remote UX design system and triangulate our findings. Besides, previous researchers [38] highlight the fact that quantitative data are more precise and are useful for attracting investments or convincing stakeholders about the effectiveness of design decisions. Some of our participants also preferred a combination of the two. We gathered and analysed qualitative data primarily as a best practice to meet the above mentioned targets.

Our methodology includes:

- The review of guidelines;
- The design of a tailored to the design problem toolkit;
- The participatory prototyping sessions;
- The analysis of the rich data on user needs;
- The translation of user needs to UX goals;

We are using the right methods to identify the user's needs and provide actionable insights in the form of UX design goals to help practitioners in the development of relevant systems.

3.1. Toolkit

Participatory design tools and methods are widely used to share control, share expertise and get inspired to change [39]. Participation through Co-design has rapidly gained the attention of the researchers in Human-Computer Interaction who need to gain rich insights into the explicit, observable, tacit and latent needs of the participants [29]. In line McCarthy et al. [40] suggests identifying the uniqueness of the individual's experience by eliciting the salient situational circumstances.

Previous research [41] summarizes the terminology used to highlight methods and toolkits in participatory design. They describe a method as a collection of the material components and techniques that are used in combination with PD activities to serve a specific purpose. Previous toolkits [41,42] and techniques [2] used in co-design and co-creation activities, to involve the participants actively. Some of which even delve into the latent explicit and observable needs of the participants. Sanders [43] previously explains, that accessing insights on experiences, thoughts feelings and dreams, we should provide the participants with tools which are focused primarily on what people make in addition to what they say and do. To serve the above-mentioned purpose we designed and applied a participatory prototyping toolkit as part of our method.

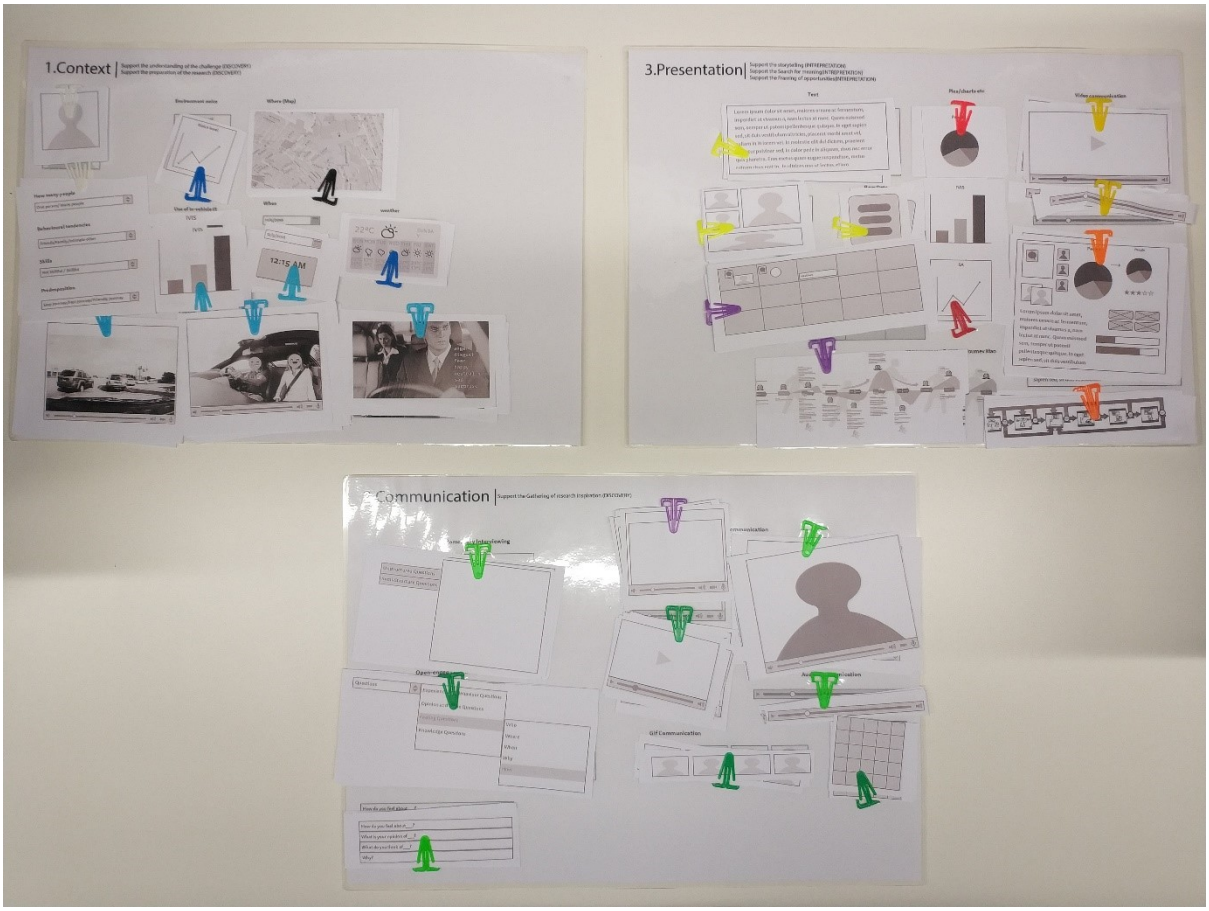

Figure 1. The paper cards represent technologies or affordances previously used to help in identifying the context of the vehicle, support the remote communication, and presentation. We base the selection and design of our cards on previous work on remote communication, automotive domain deficiencies and UX Design process guidelines

We base our new prototyping toolkit on the Design Thinking (DT) model for designing new artifacts. The tool kit consisted of low fidelity representations of A) the processes. Three basic screen-wireframes representing the three steps of the process used to support the need for discovery and interpretation) and B) the available components including communication technologies and interactions. The previous two low fidelity components served as stimuli material for a co-design workshop. Using the toolkit was not only successful in giving us valuable insight into the needs of the designers, but it also allowed us to co-design prototypes and to inform our iterative design of a remote participatory design system.

The first part of the toolkit consisted of cards of low fidelity paper illustrations of components that derived from the guidelines of previous work. The cards served both as stimuli for discussion about the design and application of the system in context; the acceptance of the technologies used; the system's architecture and interactivity; (what the users say and do) and as a tool for prototyping (what the users make). Similar tools presented by Sanders's make tools[] are a common practice for practitioners including the 'interface toolkit' by Frog design. Components include, Car Passengers (1 or many); Behavioral tendencies; Relation (friends, family, Intimate other); Emotion, Skills; Physical and temporal Context; Where (map); When (time and date); Weather (sunny- rainy etc.);Temperature; Noise (Very Loud- Not loud at all) System Context; Percentage of use of IVIS; Video/Audio/text/Emoticons/Gifs; Charts/pies; Snapshots Infographic; storyboard; Costumer journey etc.

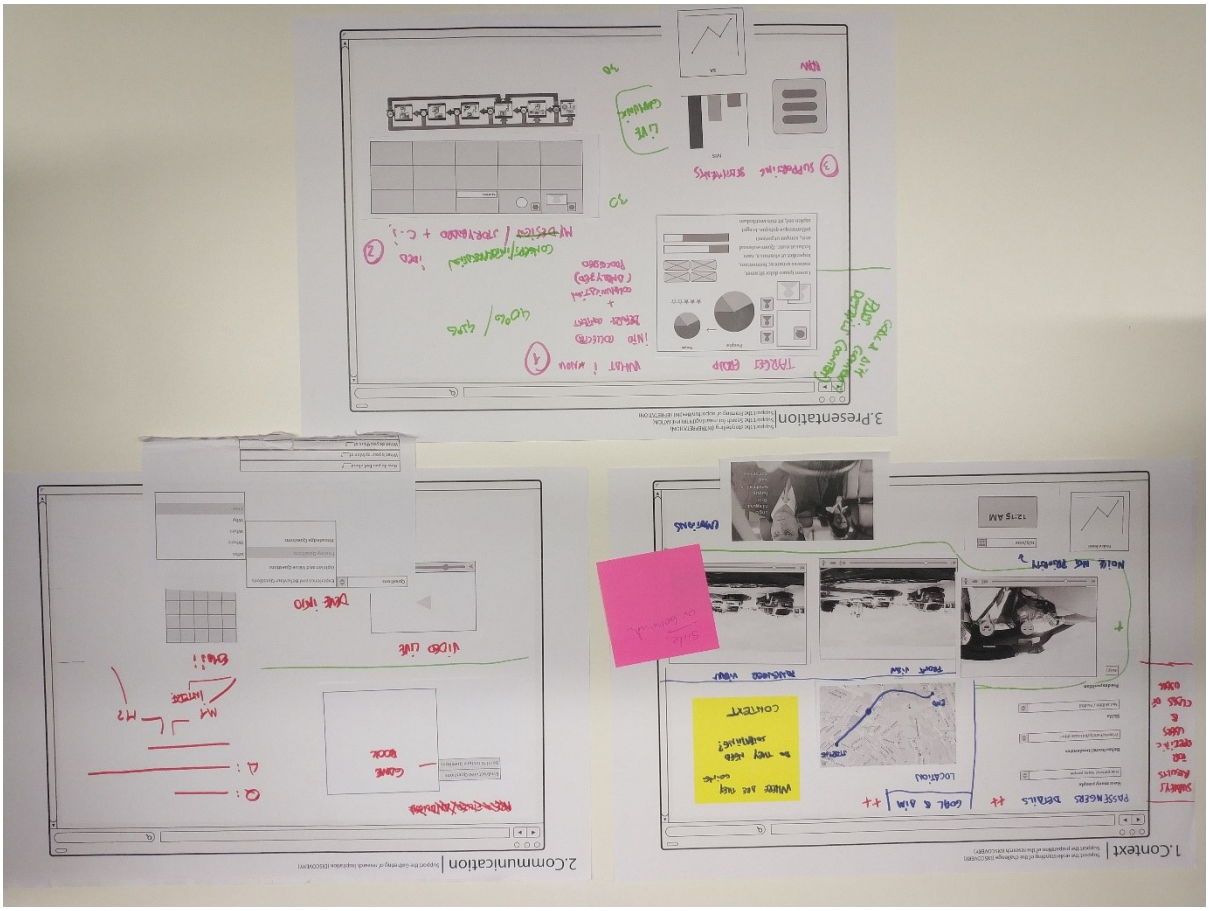

Figure 2. Here we see a P6 participant's basic-screens paper prototypes of the interaction. The three basic-screens represent the early stages of the DT process. UX researchers/designers individually co-designed their versions based on their needs.

Based on the IDEO's design thinking methodology the second part of the toolkit is serving the early stages of the designing for new experiences process. Three A3 size papers served as the space for low-fidelity prototyping of the basic-screens and interactivity for the proposed system. We designed the basic-screens as an empty web page with only a title and precise information of the DT processes. The technique that we recommended for the prototyping is to fill the basic-screens with information, notes and the cards that we provided.

3.2. Participants

Iversen et. Al. [44] argue for a value-led participatory design approach. They see a co-design process, at its core, as a negotiation of values that all participants bring to the table or which emerge from a collaborative experience. It is not only which values, but also whose (participants) values drive the design process. There are two main reasons why we are choosing the values of user experience designers who are not directly involved in the automotive domain. The participants were all holders of a driving license and were aware of the driving experience and the driving context.

Firstly, the fact that the automotive industry is more traditional regarding the methods and tools used to design and evaluate interactions in comparison to other domains. Hence, to achieve a state of the art result and claim the innovative outcome of this process, we were led to such a decision. Since the system itself aims to provide support not only to expert users such as automotive UX designers but also to general UX designers our decision fits our purpose.

We recruited 12 UX professionals aged 18-34. The sample consists of 8 UX designers/researchers working in academia and 4 in industry. A snowball sample emerged from 7 initial participants. All participants have expertise in design and high familiarity with new technologies. The workshops were individually assessed. Thus, we recruited UX designers that have a driving license, to secure the holistic nature of our design, and to make sure that we did not exclude other stakeholders' values such as the drivers' values from the design result. Each study participant received a reward/token, a box of chocolates, as a commonly used good practice for their time and effort.

3.3. Participatory prototyping Procedure

"Prototyping is a venerable system development methodology that involves construction and test of prototypes of systems, often for purposes of clarifying vague requirements and often in collaboration with the prospective users."[45] To identify the values of the designers that need to be fulfilled we use the prototyping workshops where we collect rich data on what the participants say, do and make and translate them into design goals. Participatory design limitations including recruitment limitations; time and location sensitivity; dictated that we actively involve participants in individual sessions as previously mentioned. Furthermore, Individual sessions are used because the system we are designing is relatively new therefore under-constrained. Using group sessions would have part of the insights undercut. In contrast, the result in comparison to the group sessions is more detailed and personalized due to the time spent with only one individual at a time.

In each session, the participants co-designed a low-fidelity prototype of the front-end interactions of the system using the components that were previously provided to them. Co-design is a common practice in participatory design where designers/researchers work together to envision future environments of use in different contexts[35]. To conduct the paper prototyping along with the cards of the components we provided sticky notes, marker, pencils and glue for the participants to construct their three basic screen-wireframes. We encouraged them to use whatever means they felt was most natural to them and in many cases, we constructed meaning collaboratively.

The sessions were conducted similarly to a group session with one researcher as a moderator who is also involved in the discussion and the co-creation of meaning and content without leading or biasing participants. When the moderator is one of the artifact designers, they should be cautious not to introduce any personal bias in the presentation of the artifact. We avoided bias over a prototype design since we provided the participants with the basic platform and raw materials that were then used to obtain their prototypes. Nonetheless, in this case, the researcher might need to make a higher effort.

An introductory video of a physically present designer interviewing a driver while they are driving in a real-time driving situation was displayed before the workshop starts. The reason was to inform UX designers of the current field methods used in Automotive Design and Research and to empathize with the automotive deficiencies mentioned above. Every session lasted 50-60 min, with approximately 15 min for each of the three tasks that the participants were assigned. We were mainly concerned about capturing the 'how' and 'why' that the participants would like to be supported in the discovery and interpretation phase in the early stages of the remote automotive UX design. Observation and Semi-structured interviewing took place beside other complementary methods such as co-designing the artifact. Observation, without following a specific observation scheme was mainly a tool to capture the 'do' and 'make' data other than what they say. Notes of critical points were taken to support the findings and video/audio recordings of the sessions for later analysis. At the end of the participants' tasks we used a semi-structured interview to ask participants to identify:

- The contextual data that would support them in designing for people's driving experience in an autonomous vehicle; Designing for the 'driving experience' in an autonomous vehicle we mean understanding and designing for secondary activities and interactive experiences in an autonomous vehicle including infotainment, productivity, gaming or other digital services.

Peer-reviewed version available at Multimodal Technologies Interact. 2018, 2, 74; doi:10.3390/mti2040074

- The tools and techniques they would use for in-depth communication and information elicitation; Various tools and techniques are used in the past to support synchronous and asynchronous communication.
- The tools and techniques that would support them in communicating their results to other stakeholders; How to support them in presenting their rich findings.

Based on good interviewing practice we used complementary 'why' questions to shade light to short or unarticulated answers. We encouraged the participants to provide critical comments about their choices and designs. Furthermore, we prompted discussion by asking them to structure the information, the main groups of the content and add any other components that are not present in the stimuli material. As a result, we have captured rich data of what the participants say, do, and make, using a combination of observation, momentary qualitative interviewing and video records of the interaction. We also gathered the artifacts of each session and analyzed them to support the findings.

3.4. Analysis

After the participatory design sessions, we implemented an inductive approach to data coding and analysis. Respectively, we transcribed and coded the audio-visual data. Thematic maps helped us shorting the transcripts into related groups from which we later drew our themes. However, it is impossible to be purely inductive and completely ignore the semantic content of the data when we code for a particular theoretical construct. What is essential in this first part is that we prioritized the participants' meanings. We concluded on the user experience designer's values that need to be fulfilled when we design for such systems. These findings are presented as the needs of the UX designers under the automotive context and support the summative theoretical contribution which aims to evaluate such systems.

The prototypes created are the means that the participants use to express their multi-layered needs and the experiences they want to have when interacting with similar systems. Therefore, we can extract more in-depth information from the explanation of the created prototypes and even relate them to the previous data. Consequently, we go beyond the participants' meanings and the themes that derived from our analysis and suggest a pragmatic interpretation of the UX Goals of the UX Designers based on context mapping techniques which include the illustrations of the artifacts. Affinity diagrams[46] and context mapping techniques[29] are both techniques that analyze rich qualitative data. They both use coding of participants quotes or notes, and they are both trying to identify patterns or clusters of behavior or activity. They are both using big spaces as tables or walls to map, structure, and cluster the previously collected data and extract meaning. We achieved a holistic understanding using these techniques (see Figure 3) to triangulate the video and audio transcripts (what participants say and do) with the paper prototypes (what participants make) in the second part of the analysis.

Approaches for visual element analysis in isolation, including Zmet and Kansei, were previously explored[29] without leading to satisfying results. More information is found in the stories of the participants and their relationship with the visual elements, in our case the prototypes. The participants hidden or latent values that needed to be fulfilled based on our findings were later translated into seven UX goals. UX goals as previous researchers explain [47]support designers in developing products or systems. In this study, these findings support the formative practical contribution to the design and development of remote UX design systems in automotive. Nigel Bevan [48] also highlights how important is to establish criteria for UX/usability goals at an early stage of design and to use summative measures to evaluate whether designers achieve them during development.

4. Results

The process of developing and validating these artifacts identified numerous areas where future research is required. Using the knowledge gained from this study will provide insight into what researchers might look for and what they might see when studying remote UX design systems in automotive. The findings are structured and presented in themes. We examine the role of a set of

Figure 3. A glass wall was used to map all the information available, identify patterns, and cluster the critical issues concerning the prototypes. Ten needs and 7 UX goals emerged from this analysis.

Peer-reviewed version available at Multimodal Technologies Interact. 2018, 2, 74; doi:10.3390/mti2040074

values that we identified in this study and aim to the development of a remote participatory UX design system. The first theme examines the role of intrusiveness, emotions, and behavior. Followed by usability and information architecture and their impact on the effectiveness of our system. The third theme of the findings presents the value of quality of communication and the fourth designer's empathy about their end users. The last themes examine the role of context; and the preference of the participants in the communication medium of our system. Later we present a summary of the needs and how they relate to the UX goals that derived from our analysis.

4.1. Intrusiveness,Emotion and Behavior

The first theme that emerged was Intrusiveness. Even though some participants were more enthusiastic about the various supportive technologies that we provided as stimuli, the majority expressed a general mistrust of the effectiveness of using emotion recognition technologies to support design. The fact that, emotions could not rely only on facial recognition and the fact that emotions can be affected by different factors when users are in social settings leads designers to a mistrust of the technology. Additionally, even though the participants understand the possibilities of the technologies as mentioned above, ethical considerations such as privacy and safety were expressed as they see themselves as potential users. Thus, we mainly avoided face tracking and similar technologies.

P1: *" For safety purposes" "You can see children inside the car, and the passengers are not properly protected "*

P1: *"I am not really attracted by this kind of information. For the same concern. Privacy."*

P5:*"I am not sure what one sees in your face is what you feel, I think there is a discrepancy there. It is really difficult to understand emotions just from the facial expressions","my facial expression can be affected by so many factors."* On the contrary, the behavior of the users in the vehicle was more important for the designers than emotion recognition. The participants suggested an alternative, less intrusive methods such as observation, empathy building, and technologies such as video or audio monitoring.

P6: *"I would probably like to see him. If I was doing the interview remotely, I would like to see how he reacts to the questions that I ask and to different situations."*

P6: *"If you have a 360 view of everything around you can see the behavior."*

P7: *"You can design a car based on emotions, but you can also design a car based on demographics and behavioral (aspects). If someone is eco-friendly and likes nature, I could design for them but I cannot do the same with emotions."*

Participants offer evidence that other technologies are more useful for the needs towards designing for experiences. More specifically technologies like video or 360-degree view of the environment are suggested. A possible explanation for these results is that the context of the person interacting in the car is more important than the individual and can generate insights or inspirations for the design of the new automotive experiences. Even though the designers avoid monitoring facial expressions through technology, paradoxically they would like to see the users interacting with their environment and want to observe their reactions. That is possible because of the identification of cues such as frustration, confusion, or unexpected usage, which show a hidden or latent need as we mentioned previously in this paper. The fact that designers empathize at all times as being drivers themselves can explain this reaction. Therefore, ethical considerations of private information lead them to decisions of mistrust of specific communication mediums in comparison to the rationale of the media richness hypothesis[49].

4.2. Usability and Information Architecture

Regarding the information architecture of the system, participants had various useful suggestions and ideas, and many usability qualities were highlighted as necessary by the participants. Although some of the participants wanted to include all the possible information they found on the system's toolkit, most of them highlighted the need for a minimalistic design approach. Thus, participants avoided redundant or complementary components regarding information content and architecture. Even though the hierarchy of information was generally not considered essential, participants used

Peer-reviewed version available at Multimodal Technologies Interact. 2018, 2, 74; doi:10.3390/mti2040074

patterns of content-architecture to group content and brought essential components in the front of the interaction, avoiding an utterly loose interaction with no hierarchical structure. Even though, sometimes the complementary information occupied most of the free space of the basic-screens, participants mainly followed the rule of bigger equals more critical, enlarging the more critical information.

P1: *"You want punctual information really direct, visual maybe audio I think is really effective."*

Moreover, they highlighted the need for a flexible design that adapts to their needs each time they interact with it. Immediateness is another quality that the participants stated as crucial for this type of interaction. The participants want the information to be immediately available to them. Finally, Information retrieval and ease of use were reportedly found crucial for our system, with the participants being concerned both on the 'hustle' of the interaction and the possibility of forgetting information and missing essential findings throughout the process.

P6: *"I don't think there should be any hierarchy in the position of the visual systems. If I am blue sky and I don't know what I am doing I would choose this hierarchy though."*

P1: *"With emoticons, you have a question and a list of emoticons that the driver can reply immediately."*

P5: *"Maybe what is very useful you can star it and it can get down to the 20 per cent. If you think it is important and you like it and not want to forget about it, why not?"*

The designers preferred flexibility in the way they are going to use their tools as part of the system. The need for exploration and experimentation is fundamental in the early stages of the design process, and that could be one explanation about their preferences. Another explanation is that they do not have a predetermined set of scenarios, but they depend on the observation to identify the behavioral patterns of the users. It seems possible that the designers need some initial time to grasp the interaction scenario, identify the preferred contextual information and then decide on what they want the system to support them on accordingly.

4.3. Quality

Participants expressed concerns about the quality of the communication being affected by trust. When the system supports them in communication with the driver/passenger, it is vital that the used technologies support a trustworthy communication interaction for both parties. They generally believe that when there is a lack of trust the goal of the designer is undermined. Accordingly, they proposed a more natural, transparent and socially present communication to mitigate the feelings of mistrust to them and the system by the passengers/drivers.

P7: *"If there is no point between you and the user, It is going to go downhill from there because you will never understand each other, that should be established. Building trust is the first thing. I want unstructured (interviewing) for the same reason."*

P8: *"Having an audio of me or of another person for self-presentation issues doesn't make much of a difference. If it wouldn't be my voice and it was somebody else's I don't want it to sound artificial. That is a very bad idea. I prefer a terrible natural voice than an artificial one."*

Participants are also concerned about the quality of communication affected by self-presentation issues. Their appearance can affect the level of engagement with a communication interaction that is going to take place. The same effect also works vice versa when people can be distracted by the image the designer communicates towards them and change their responses and behavior accordingly.

P5: *"I don't want to be good looking in case they are looking at my face, and start thinking about other stuff rather than design. We don't need to have the same interaction every day. We can have different types. We can see each other today. If I am not presentable. If I have an initial video it can work and then you can have another type of communication."*

P12: *"They cannot see the designer. Because the answer can change. If I see your facial expression, then my next answer is going to be different. For example, you are asking me how is research going and I am responding I didn't do my literature review and you are laughing. Your next question if you ask me how often do you see your supervisor, I might say every week. (very often)."*

Peer-reviewed version available at Multimodal Technologies Interact. 2018, 2, 74; doi:10.3390/mti2040074

Finally, the participants feel that a structured way of communication feels like a duty and a preferred semi-structured manner will give them more feedback. On the bases of instantaneous communication and face-threatening acts, they are also concerned that they may lack the skills to provide a high-quality communication and that they need to be supported by the system to achieve the levels of quality that are expected by this kind of qualitative conversations with people.

P9: *"People react in a way you react towards them. If you yell at someone they will probably yell back at you. The driver is going to see you sometimes. If he is going to make signs you can see him. Human beings respond to the way they are being treated. I would strongly lean on that the designer should be trained and experienced. "*

P11: *"Unstructured (communication) needs an experienced researcher."*

The results here are in agreement with those obtained by previous studies about the self-image of people using remote communication technologies. A possible explanation is that the participants are trying to protect themselves from an unexpected situation and at the same time to protect the validly of the insights gained by the interaction with the driver/passenger through the system. The fact that they do not want their presentation to affect the interaction shows again empathy for the people with whom they are going to be interacting.

Building trust and maintaining engagement is again expressed as a desire here by participants. The medium that can serve these needs of the designers is presumably the most useful as well. It worth highlighting here that the effectiveness of the medium in use is not a primary concern of the designers.

4.4. Empathic Design

The participants in many occasions empathized with the user and explained their decisions based on the experience that they would like the driver/passenger to have in this 2- way interaction. Their values and their company's values (when applied) lead them to a definition of the appropriate interaction. They are concerned with the perceived safety, comfort, naturalness, politeness and the feeling of being valued or any possible frustration that the drivers or passengers will experience during this interaction. The participants find it essential that the driver finds himself being in control and that the communication medium that they are going to be using is going to be appropriate for the situation.

P4: *"Create an environment where they feel safe because it is a radical change"*

P9: *"Structured feels like a duty. If someone is relaxed, he or she tells you more. A bridge between being polite and having all the information you need."*

P12: *"Unstructured questions allow a better user experience because people like their opinion to be heard."*

Participants highlighted the need for the naturalness of the communication, possibly prioritizing the sense of more informal and natural communication. Empathy is expressed here by many participants. A possible explanation is the one that one of the participant's claims, that is that the insights are going to be more in-depth if the person feels more relaxed. Another explanation is that they are already "walking in the driver's shoes" and feel that they would not like a cold closed and structured interaction.

4.5. Contextual Components

Participants generally expressed the need for contextual data that they can relate to, at the time, when the driving experience takes place. The place and the environment are also shaping the experiences of people and are equally important. Participants find the social context of the drivers to be of great importance to a deeper understanding of the situation. Finally, long-term patterns of behavior are thought to be of help to designers in identifying opportunities before they delve into the more in-depth understanding of the situation.

P5: *"You need to know if its rush hour in the morning and you have to get your kids to school or if it is a bit later in the day. "*

P8: *"It goes back to the personality depending on different things. With the personality, If you have your girlfriend in your car or someone you really care about, you might be driving a little bit more carefully, but then*

Peer-reviewed version available at Multimodal Technologies Interact. 2018, 2, 74; doi:10.3390/mti2040074

if you are with your first date you might want to impress her and drive more dangerously. And you might want to identify a pattern based on that."

P6: *"Otherwise how can we improve the commodities of this family here maybe you need data that are collected over a few months."*

The majority of participants agreed on longitudinal behavioral data and supporting rich contextual information as a source of inspiration for the design of new automotive experiences in autonomous cars. A possible explanation is that they want to design for long-lasting, meaningful experiences in comparison to momentary hedonic experiences[13].

4.6. Preferred communication medium

The primary communication medium was also a concern for the participants. A video is generally considered a vital medium towards the understanding of emotions and behavior. In like manner, the participants' Video technologies are suggested to capture behavioral patterns and to achieve more in-depth communication with the user. Video of the internal and the external environment can give a deeper understanding of how people experience driving.

P7: *"That is why I want the video. The reaction of how he is sitting, the reactions. The pattern that leads to a personality, because if someone is constantly doing something, it leads to a personality."*

P11: *"The external is important because we can see how he is reacting based on the environment. Sometimes he is feeling bored and sees the other way."*

Furthermore, some of the participants suggested a two-way video interaction to communicate transparency and build trust among them. However, there was one participant expressing concerns about the importance of the video on the driver's side basing his argument on the attention the video requires from the drivers. Many of the above qualities such as recognizing the feeling and the level of personal involvement in the communication are also expressed for only Audio as communication. Finally, they found text, gifs, and emoticons, exciting ways of communication but as an additional medium and not the primary due to the limitations in comparison to the Video as mentioned above or only Audio.

P2: *"I would use the voice because with the voice you can perceive the feelings as well." "So if you use emoticons or text other than your voice could be less personal, so harder to build trust."*

Building trust and maintaining engagement is again expressed as a desire here by participants. Additionally here we have participants adding characteristics of utility to their decisions choosing the most appropriate medium for convergence (better at engendering mutual understanding) [24].

5. Discussion

Our participants' goals are expressing their aim to fulfill specific needs. Our summative interpretation of these needs, based on empirical evidence drawn from our co-design workshops, informs relevant theory in Automotive design for experiences. Furthermore, we suggest a formative interpretation of our findings in the form of UX Goals as actionable insights. Each of these UX Goals relates to one or more user needs as presented below

5.1. UX NEEDS

Previous work(Eckoldt et al., 2013) supports the notion that meaning and positivity is related to the fulfillment of universal psychological needs (an experience becomes positive and meaningful if it fulfills a psychological need) and explores the potential of an experience-oriented approach to design for interactivity in and through cars. Identifying these needs, designing and evaluating gained the focus of automotive research measuring both momentary(Körber and Bengler, 2013) and long-term user experiences(Kujala et al., 2011). The analysis of our rich-data led us to identify the following needs of our participants.

Privacy: Privacy refers to the avoidance of intrusiveness by using a technological intervention that might have a negative impact on the sense of trust and which will consequently affect the quality

Peer-reviewed version available at Multimodal Technologies Interact. 2018, 2, 74; doi:10.3390/mti2040074

of the results of the system. For that want the system to inspire trust and positive effect acceptance of the interaction.

Efficiency: Immediateness is crucial for the communication result of the system. As a result, we want the system to interact with the user fast, on the spot.

Effectiveness: The majority of the participants are leaning towards a deep understanding of long-term behavioral patterns in contrast to data about the momentary emotional state of the participant. To support the designer's goals in empathizing with the user and in achieving a deeper understanding of the situation we want the system to be able to map the participant's feelings and behavioral patterns over time.

Engagement: A more personal and informal interaction. A communication which is going to provide us with more in-depth insights. We want the system to support the designer in achieving these levels of personal involvement when interacting.

Naturalness: An interaction that will feel natural to use. A technology that will be acceptable so as both parties can communicate instinctively. A naturalistic approach to the design of a system is the one that supports a natural user experience.

Ease of Use: The most convenient and hassle-free interaction. We want the system to feel comfortable.

Information retrieval: To be assisted in avoiding information loss due to memory lack. To be also assisted by the system to store and retrieve data on the spot during the use of the system.

Self-Image awareness: The system to support different levels of self-presentation. To support the designer in dealing with the situations of face-threatening acts in the communication.

Politeness: The system to support the designer to interact only when it matches the situation, 'at the right time' and in the right manner.

Flexibility: The system to dynamically adapt their needs based on the situation of use, supporting them with the right tools and interactivity.

5.1.1. Emotion recognition technologies

Previous studies in real-life driving (Dobbins and Fairclough, 2017) have reported that the area of lifelogging has emerged as an application that is designed to continuously measure personal data with the purpose of supporting recall and self-reflection. Respectively, emotions can be captured continuously and in an unobtrusive manner. In our study, the participants do not trust the effectiveness of using face tracking, emotion recognition technologies, and in general psychophysiological techniques[50], due to technical and ethical considerations including false positives and effectiveness, privacy and safety. Even though the majority of our participants agree with the notion that it is the long-term user experience that matters [12], they are not primarily interested in momentary emotions especially coming from physiological measures. Thus, participants perceive mediums including video and audio for long-term behavioral observation, empathy building, and possible communication, as more effective and less intrusive forms of interaction.

5.1.2. Unobtrusive long-term behavioural research

As we previously mention researchers in automotive(Dobbins and Fairclough, 2017) have established the need for unobtrusive research in automotive. Furthermore, in-situ methods such as the Experience Sampling Method and the Day Reconstruction Method are increasingly applied in longitudinal settings as Karapanos et al. highlights (Karapanos, Jain, and Hassenzahl, 2012), while retrospective techniques offer a cost-effective alternative to longitudinal studies. Our results are in agreement with the theoretical framework of unobtrusive behavioral research in automotive. They indicate that the participants' needs are to achieve a deeper understanding of the situation and map insights on feelings and long-term behavioral patterns, in other words, behavioral research which avoids intrusiveness by limiting their interaction with the driver/passenger.

Peer-reviewed version available at Multimodal Technologies Interact. 2018, 2, 74; doi:10.3390/mti2040074

The majority of our participants prefer a deeper understanding of the situation choosing holism versus reductionism and contextual data as previously defined by [51] to design for the new automotive experiences. Identifying the behavior of the users in the vehicle and their experience over time [52] was more critical for the designer's aims than identifying momentary emotions. An interesting finding is that UX designers are willing to design for experiences based on emotions as defined by [53] but not to draw inspiration by detected emotions since they perceive that they do not reflect on the overall experience.

5.1.3. Empathy and trust

Our participants agree that trust in communication is essential and that it is achieved when the communication is natural, informal, transparent and high in social presence. They also expressed that the lack of a specific set of skills will result in an impolite unnatural and ineffective communication, hence a non-trustworthy interaction. As previous researchers highlight [47] trust as an experiential issue has been included in earlier approaches, but rarely as the primary objective of the design process. Trust has been an essential factor in many e-commerce user studies. Another important finding was that self-presentation issues need to be addressed since our participants are concerned about their appearance and how that will affect a possible communication with the driver/passenger or distract from the task of design itself. In previous research [27] employees when teleconferencing, were more aware of others' status and reactions, thereby were more cautious of their self-image and behaviors. Our participants believe that their self-presentation is possible to affect the communication behavior and thus the driving experience itself. Even though we are designing for them, the participants empathize with the driver/passenger, and they are only supporting/proposing interventions that apply to all stakeholders of the system. Hence, the most compelling finding is that the participants believe that it is also crucial for the driver/passenger to find himself in control, valued, and interacting through the appropriate communication medium.

5.2. UX GOALS

A user experience goal (UX goal) is an actionable insight for the development of products, services or systems. It describes the intended momentary emotion or the emotional relationship/bond that a person has with the designed product/service/system (Lu and Roto, 2014). Lu et al. also highlight that these concrete UX goals may be most useful when various stakeholder groups need to agree on what to design when multidisciplinary product development and marketing process. Väätäjä et al. (Väätäjä et al., 2012) (2012), considers a good UX goal when it guides design towards a positive experience; helps in communicating objectives; and is measurable. As a result of our study, we came up with actionable insights to communicate how to achieve a positive experience when designing for remote UX design systems in automotive. These are UX goals as presented below, that can inform the design of goal-directed personas and scenarios and the development of high fidelity prototypes. Designers use scenarios and personas to realize their users and their users' goals and place them under context. "A scenario is a concise description of a user using a software-based product to achieve a goal" [54] where the goals stem from the persona description. The prototype system or systems are then build based on the user scenarios of use.

A list of the recommended UX goals when designing for relevant remote UX design systems in automotive:

1. Support the contextual understanding (Empathy, Effectiveness)
2. Reduce the intrusion of people's lives(Privacy)
3. Support long-term understanding of behavioral patterns (Effectiveness)
4. Operate even when the problem is ill-defined (Flexibility, Effectiveness)
5. Avoid redundant information at any interaction (Efficiency, Ease of Use, Flexibility)
6. Avoid anxiety about uncertainty (Privacy, Engagement, Naturalness, Self-Image awareness)
7. Feeling of intelligent interactivity (Efficiency, Ease of Use, Information retrieval)

Peer-reviewed version available at Multimodal Technologies Interact. 2018, 2, 74; doi:10.3390/mti2040074

We learn that these UX Goals, excluding the increased privacy concern and the support of long-term behavioral patterns, are not exceptionally different from what we see in other domains where remote systems are applied. That welcomes opportunities to apply state of the art practices and technologies from other domains for the implementation of the remote automotive UX system. We further recommend the design of compatible systems using the suggested UX Goals and the evaluation of them by automotive User experience researchers and designers which will shed light to automotive organization challenges for the adoption of such Research and Design Systems.

5.2.1. Remote design trust and privacy relevance in other domains

Characteristics such as clarity, naturalness, and communication etiquette to build trust and rapport in remote communication were previously investigated on telepresence systems' applications in organizations. Previous studies also have reported that a decrease in the degree of naturalness of a communication medium leads to increased cognitive effort; increased communication ambiguity; and decreased physiological arousal[49]. However, different types of technology require different forms of etiquette [55], and there are different kinds of etiquette for different settings [56]. Most norms, including rules of etiquette, are learned through experience in a community, just as Preece [56] emphasizes, children observe how adults and other children behave, absorb these norms, and learn their community etiquette at an early age. As a result, cultural characteristics are influencing the perceived politeness and naturalness of the remote interaction. In essence, politeness means 'phrasing things in such a way to take into consideration the feelings of the others' [25].

Previous work on trust in automated vehicles [57] has identified the need to calibrate and understand trust. Scholars have long debated trust issues in other domains as Metsctecherjakov et al. [58] stresses, and the findings of their studies could apply in the automotive domain. Studies in remote systems in organisations [59] suggest that the stage of the communication defines how trust is perceived and communicated: from the project starting-point to one week before the project mid-point, we identify that communication behaviours associated with trust are characterized by a combination of socially and task-oriented communications and the conveyance of enthusiasm. From the project mid-point to the project end, a sense of predictability in the interaction is generated by communication behaviors associated with trust.

Other researchers could further investigate the increased concern about privacy and safety though in automotive in comparison to other domains. Social situations in the car in comparison to a personal situation is a contextual metric that can alter the driving experience. For example when designers and a user need to collaborate in a daily basis that means that one of the two parts is intruding the personal space of the other by having face to face (FTF) communication or a computer-mediated communication (CMC) while being physically present in the first case or present but not physically in the second case. However, Anonymity is at the center of attention due to the general concern about privacy while using technology, it is more relevant in the absence of nonverbal cues which may lead to changes in the quality of the interaction including increased self-disclosure and intimacy on the same way that it provides more control over self-presentation [60]. Although the perceived social context of the in-vehicle situations may be the cause of that increased privacy concern, this was not thoroughly investigated as part of our research, and we would recommend further exploration on this direction.

6. Conclusion

In this study, we co-design a remote participatory automotive UX system. We increased active participation as a means for matching UX designer's needs with the affordances of remote UX design systems. To achieve that we conducted individual co-design workshops with UX designers and we identified their explicit, observable, tacit and latent needs based on empirical qualitative data. Needs including privacy, efficiency, effectiveness, engagement, naturalness, ease of use, information, retrieval, self-image awareness, politeness, flexibility were identified and explained concerning the prototype system. We triangulated our data with the artifacts that the participants provided us to translate these

needs into UX goals and concluded on a pragmatic interpretation of our findings. UX Goals that reflect that UX designers' needs including trust and empathy building; privacy and self-image awareness; and holistic and behavioral long-term understanding of the user and we suggest further exploration on goal-directed personas and scenarios of use to inform practitioners on how to develop relevant systems further.

Acknowledgments: The authors wish to thank Nick, Nicolas, Anna, and Maria for their help with recruiting. We are also very grateful to David for his comments on earlier drafts of the paper.

Author Contributions: S.T. designed the process of the workshop, recruited the participants, designed the prototypes and facilitated the participatory design workshops. S.T. conducted the literature review for this study and both the thematic analysis and the glass wall analysis. M.P. proposed ideas and helped reviewing and editing the paper to its current form. (he is the supervisor of S.T.)

Conflicts of Interest: The authors declare no conflict of interest. The founding sponsors had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, and in the decision to publish the results.

1. Pfleging, B.; Rang, M.; Broy, N. Investigating user needs for non-driving-related activities during automated driving. Proceedings of the 15th International Conference on Mobile and Ubiquitous Multimedia - MUM '16; ACM Press: New York, New York, USA, 2016; pp. 91–99.
2. Pettersson, I.; Ju, W. Design Techniques for Exploring Automotive Interaction in the Drive towards Automation. *Proceedings of the 2017 Conference on Designing Interactive Systems* **2017**, pp. 147–160.
3. Meschtscherjakov, A.; Ju, W.; Tscheligi, M.; Szostak, D.; Krome, S.; Pfleging, B.; Ratan, R.; Politis, I.; Baltodano, S.; Miller, D.; Pfleging, B.; Baltodano, S.; Miller, D.; Ju, W.; Meschtscherjakov, A.; Tscheligi, M. HCI and Autonomous Vehicles: Contextual Experience Informs Design, 2016.
4. Tasoudis, S.; Perry, M. Mediated participatory design , for contextually aware in - vehicle experiences. AutomotiveUI'16 Adjunct Proceedings, 2016.
5. Alvarez, I.; Rumbel, L.; Adams, R. Skyline. Proceedings of the 7th International Conference on Automotive User Interfaces and Interactive Vehicular Applications - AutomotiveUI '15; ACM Press: New York, New York, USA, 2015; pp. 101–108.
6. Meschtscherjakov, A.; Wilfinger, D.; Osswald, S.; Perterer, N.; Tscheligi, M. Trip experience sampling. Proceedings of the 4th International Conference on Automotive User Interfaces and Interactive Vehicular Applications - AutomotiveUI '12; ACM Press: New York, New York, USA, 2012; p. 225.
7. Niforatos, E.; Karapanos, E. EmoSnaps: a mobile application for emotion recall from facial expressions. *Personal and Ubiquitous Computing* **2015**, *19*, 425–444.
8. Martelaro, N.; Ju, W. WoZ Way. Companion of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing - CSCW '17 Companion; ACM Press: New York, New York, USA, 2017; pp. 21–24.
9. MacIntyre, B.; Gandy, M.; Dow, S.; Bolter, J.D. DART. Proceedings of the 17th annual ACM symposium on User interface software and technology - UIST '04; ACM Press: New York, New York, USA, 2004; p. 197.
10. Carter, S.; Mankoff, J.; Heer, J. Momento. Proceedings of the SIGCHI conference on Human factors in computing systems - CHI '07; ACM Press: New York, New York, USA, 2007; p. 125.
11. Hassenzahl, M. Experience Design: Technology for All the Right Reasons. *Synthesis Lectures on Human-Centered Informatics* **2010**, *3*, 1–95.
12. Roto, V. User Experience from Product Creation Perspective. *Towards a UX Manifesto* **2007**, p. 37.
13. Mekler, E.D.; Hornbæk, K. Momentary Pleasure or Lasting Meaning? Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems - CHI '16; ACM Press: New York, New York, USA, 2016; pp. 4509–4520.
14. Rittel, H.W.J.; Webber, M.M. Dilemmas in a general theory of planning. *Policy Sciences* **1973**, *4*, 155–169.
15. Addis, M.; Holbrook, M.B. On the conceptual link between mass customisation and experiential consumption: an explosion of subjectivity. *Journal of Consumer Behaviour* **2001**, *1*, 50–66.
16. Hassenzahl, M.; Tractinsky, N. User experience - a research agenda. *Behaviour & Information Technology* **2006**, *25*, 91–97.

17. Sanders, E.B.N.; Stappers, P.J. Co-creation and the new landscapes of design. *CoDesign* **2008**, *4*, 5–18.
18. Whiteside, J.; Wixon, D. Improving human-computer interaction—a quest for cognitive science **1987**. pp. 353–365.
19. Schmidt, A.; Aidoo, K.; Takaluoma, A. Advanced interaction in context. *Handheld and ...* **1999**.
20. Csikszentmihalyi, M. *Flow and the Foundations of Positive Psychology*; Springer Netherlands: Dordrecht, 2014.
21. Standaert, W.; Muylle, S.; Basu, A. An empirical study of the effectiveness of telepresence as a business meeting mode. *Information Technology and Management* **2015**.
22. Derks, D.; Fischer, A.H.; Bos, A.E. The role of emotion in computer-mediated communication: A review. *Computers in Human Behavior* **2008**, *24*, 766–785.
23. Cahir, J.; Lloyd, J. 'People just don't care': practices of text messaging in the presence of others. *Media, Culture & Society* **2015**.
24. Rhoads, M. Face-to-Face and Computer-Mediated Communication: What Does Theory Tell Us and What Have We Learned so Far? *Journal of Planning Literature* **2010**, *25*, 111–122.
25. Morand, D.; Ocker, R. Politeness theory and computer-mediated communication: a sociolinguistic approach to analyzing relational messages. 36th Annual Hawaii International Conference on System Sciences, 2003. Proceedings of the. IEEE, 2003, p. 10 pp.
26. Miller, C.A. "Human-Computer Etiquette: Managing Expectations with Intentional Agents.". *Communications of the ACM* **2004**, *47*, 30.
27. Park, N.; Rhoads, M.; Hou, J.; Lee, K.M.; Lai, J.Y.; Ulhas, K.R. Understanding the acceptance of teleconferencing systems among employees: An extension of the technology acceptance model. *Computers in Human Behavior* **2014**, *39*, 118–127.
28. Meschtscherjakov, A.; Wilfinger, D.; Gridling, N.; Neureiter, K.; Tscheligi, M. Capture the car! Proceedings of the 3rd International Conference on Automotive User Interfaces and Interactive Vehicular Applications - AutomotiveUI '11; ACM Press: New York, New York, USA, 2011; p. 105.
29. Visser, F.S.; Stappers, P.J.; van der Lugt, R.; Sanders, E.B.N. Contextmapping: experiences from practice. *CoDesign* **2005**, *1*, 119–149.
30. Cycil, C.; Perry, M.; Laurier, E.; Taylor, A. 'Eyes free' in-car assistance. Proceedings of the 15th international conference on Human-computer interaction with mobile devices and services - MobileHCI '13; ACM Press: New York, New York, USA, 2013; p. 332.
31. JORDAN, B.; WASSON, C. Autonomous Vehicle Study Builds Bridges between Industry and Academia. *Ethnographic Praxis in Industry Conference Proceedings* **2015**, *2015*, 24–35.
32. Gellatly, A.W.; Hansen, C.; Highstrom, M.; Weiss, J.P. Journey: General Motors' Move to Incorporate Contextual Design Into Its Next Generation of Automotive HMI Designs. Proceedings of the 2nd International Conference on Automotive User Interfaces and Interactive Vehicular Applications - AutomotiveUI '10; ACM Press: New York, New York, USA, 2010; p. 156.
33. Bartl, M.; Jawecki, G.; Wiegandt, P. Co-Creation in New Product Development : Conceptual Framework and Application in the Automotive Industry **2010**. *9*.
34. Rizzo, F. 12. Co-design versus User Centred Design: Framing the differences. *Notes on Doctoral Research in Design. Contributions from the Politecnico di Milano: Contributions from the Politecnico di Milano* **2011**, p. 125.
35. Muller, M.J. Participatory design: the third space in HCI **2002**. pp. 1051–1068.
36. B-N Sanders, E.; Dandavate, U. Design for Experiencing: New Tools **1999**.
37. Sanders, E.B.N.; Stappers, P.J. Probes, toolkits and prototypes: three approaches to making in codesigning **2014**.
38. Tonetto, L.M.; Desmet, P.M. Why we love or hate our cars: A qualitative approach to the development of a quantitative user experience survey. *Applied Ergonomics* **2016**, *56*, 68–74.
39. Vines, J.; Clarke, R.; Wright, P.; McCarthy, J.; Olivier, P. Configuring participation. Proceedings of the SIGCHI Conference on Human Factors in Computing Systems - CHI '13. ACM Press, 2013, p. 429.
40. McCarthy, J.; Wright, P. Technology as experience. *interactions* **2004**, *11*, 42.
41. Sanders, E.B.N.; Brandt, E.; Binder, T. A framework for organizing the tools and techniques of participatory design. Proceedings of the 11th Biennial Participatory Design Conference on - PDC '10; ACM Press: New York, New York, USA, 2010; p. 195.

42. Sleeswijk Visser, F.; van der Lugt, R.; Stappers, P.J. Sharing User Experiences in the Product Innovation Process: Participatory Design Needs Participatory Communication. *Creativity and Innovation Management* **2007**, *16*, 35–45.
43. B-N Sanders SonicRim, E. From User-Centered to Participatory Design Approaches. *In Design and the Social Sciences. J.Frascara* **2002**.
44. Iversen, O.S.; Halskov, K.; Leong, T.W. Rekindling values in participatory design. Proceedings of the 11th Biennial Participatory Design Conference on - PDC '10; ACM Press: New York, New York, USA, 2010; p. 91.
45. Baskerville, R.; Pries-Heje, J.; Venable, J. Soft design science methodology. Proceedings of the 4th International Conference on Design Science Research in Information Systems and Technology - DESRIST '09; ACM Press: New York, New York, USA, 2009; p. 1.
46. Lucero, A. Using Affinity Diagrams to Evaluate Interactive Prototypes; Springer, Cham, 2015; pp. 231–248.
47. Kaasinen, E.; Roto, V.; Hakulinen, J.; Heimonen, T.; Jokinen, J.P.P.; Karvonen, H.; Keskinen, T.; Koskinen, H.; Lu, Y.; Saariluoma, P.; Tokkonen, H.; Turunen, M. Defining user experience goals to guide the design of industrial systems **2015**.
48. Bevan, N. Classifying and selecting UX and usability measures **2008**.
49. Kock, N. Media Richness or Media Naturalness? The Evolution of Our Biological Communication Apparatus and Its Influence on Our Behavior Toward E-Communication Tools. *IEEE Transactions on Professional Communication* **2005**, *48*, 117–130.
50. Mandryk, R.L.; Inkpen, K.M.; Calvert, T.W. Using psychophysiological techniques to measure user experience with entertainment technologies. *Behaviour & Information Technology* **2006**, *25*, 141–158.
51. Roto, V.; Väätäjä, H.; Jumisko-Pyykkö, S.; Väänänen-Vainio-Mattila, K. Best practices for capturing context in user experience studies in the wild. Proceedings of the 15th International Academic MindTrek Conference on Envisioning Future Media Environments - MindTrek '11; ACM Press: New York, New York, USA, 2011; p. 91.
52. Karapanos, E.; Zimmerman, J.; Forlizzi, J.; Martens, J.B. User experience over time. Proceedings of the 27th international conference on Human factors in computing systems - CHI 09; ACM Press: New York, New York, USA, 2009; p. 729.
53. Desmet, P.; Hekkert, P. Framework of Product Experience Human-Product Interaction. *58 International Journal of Design* **2007**, *1*, 57–66.
54. Hevner, A.R.; Chatterjee, S. *Design research in information systems : theory and practice*; Springer, 2010; p. 127.
55. George, J.F.; Carlson, J.R.; Valacich, J.S. Media selection as a strategic component of communication. *MIS Quarterly* **2013**, *37*, 1233–1252.
56. Preece, J. Etiquette online. *Communications of the ACM* **2004**, *47*, 56.
57. Mirnig, A.G.; Trösterer, S.; Meschtscherjakov, A.; Gärtner, M.; Tscheligi, M. Trust in Automated Vehicles. *i-com* **2018**, *17*, 79–90.
58. Meschtscherjakov, A.; Tscheligi, M.; Pfleging, B.; Sadeghian Borojeni, S.; Ju, W.; Palanque, P.; Riener, A.; Mutlu, B.; Kun, A.L. Interacting with Autonomous Vehicles. Extended Abstracts of the 2018 CHI Conference on Human Factors in Computing Systems - CHI '18; ACM Press: New York, New York, USA, 2018; pp. 1–8.
59. Rico, R.; Alcover, C.M.; Sanchez-Manzanares, M.; Gil, F. The joint relationships of communication behaviors and task interdependence on trust building and change in virtual project teams. *Social Science Information* **2009**, *48*, 229–255.
60. Shalom, J.G.; Israeli, H.; Markovitzky, O.; Lipsitz, J.D. Social anxiety and physiological arousal during computer mediated vs. face to face communication. *Computers in Human Behavior* **2015**, *44*, 202–208.