Report from Dagstuhl Seminar 21232

Human-Computer Interaction to Support Work and Wellbeing in Mobile Environments

Edited by

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Abstract

We are living in a world where ubiquitous computing devices are becoming parts of the fabric of our lives. At work and at school, devices such as calculators, tablet computers, mobile phones, and different electronic measurement devices, support our work and learning. Building on all of these technological advancements will be novel human-computer interaction techniques that will allow us to use the devices for work and play in a broad set of circumstances, from riding in automated vehicles, to exploring museums, to walking on the street, to playing with our kids on the beach. The central underlying question Dagstuhl seminar 21232 wanted to address is, "how will we interact with the ubiquitous devices of our near (and not-so-near) future?" To date, there are a number of interaction techniques that show significant promise, including speech, augmented reality, tangible objects, gesture, multitouch screens, as well as simple keyboards and non-touch displays. But, before we address technologies to use, we must first identify the economic and broad societal driving forces that will create the need for interaction with our ubiquitous computing devices. From the economic point of view worker well-being is one such driving force; another one is the need to improve the productivity of workers and firms; yet another is the need to provide access to continuous education to a changing workforce. From the broad perspective of our society, it is important for us to understand how ubiquitous technologies can support living a meaningful and fulfilling life, from childhood to adulthood.

In the following, we report the program, activities, and the outcomes of Dagstuhl Seminar 21232 "Human-Computer Interaction to Support Work and Wellbeing in Mobile Environments".

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1 Executive Summary

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Stephen Brewster (University of Glasgow, GB)
Andrew Kun (University of New Hampshire – Durham, US)
Orit Shaer (Wellesley College, US)

Agenda in a nutshell

The seminar was conducted online during the week of June 6-10, 2021. A particular difficulty in planning the agenda (see Fig. 1) arose due to the different time zones of the individual participants. It was especially important to us to offer at least some of the program items together to all participants (Opening and Group Work on Day 1, Summit and Closing on the last day). On the other days, we planned different activities in smaller (2-3 people) and larger (up to half of the participants) groups to better accommodate the participants based on their time zones.

Dagstuhl Seminar 21232 "Human-Computer Interaction to Support Work and Wellbeing in Mobile Environments"

					all	all	individual/small groups	individual/small groups	all
Europe (CEST, Germany)	US (EDT, e.g. Boston MA)	US (West, Seattle SA)	China/Hong Kong	Tokyo, Japan / Australia	Monday, June 7	Tuesday, June 8	Wednesday, June 9	Thursday, June 10	Friday, June 10
12:00:00 am	6:00:00 pm	3:00:00 pm	6:00:00 am	7:00:00 am					
1:00:00 am	7:00:00 pm	4:00:00 pm	7:00:00 am	8:00:00 am				Video discussions (pairs)	
2:00:00 am	8:00:00 pm	5:00:00 pm	8:00:00 am	9:00:00 am				Compilation of playlists (pairs)	
3:00:00 am	9:00:00 pm	6:00:00 pm	9:00:00 am	10:00:00 am					
4:00:00 am	10:00:00 pm	7:00:00 pm	10:00:00 am	11:00:00 am					
5:00:00 am	11:00:00 pm	8:00:00 pm	11:00:00 am	12:00:00 pm					
6:00:00 am	12:00:00 am	9:00:00 pm	12:00:00 pm	1:00:00 pm					
7:00:00 am	1:00:00 am	10:00:00 pm	1:00:00 pm	2:00:00 pm					
8:00:00 am	2:00:00 am	11:00:00 pm	2:00:00 pm	3:00:00 pm					
9:00:00 am	3:00:00 am	12:00:00 am	3:00:00 pm	4:00:00 pm		Workshop1 G1 (19)			
10:00:00 am	4:00:00 am	1:00:00 am	4:00:00 pm	5:00:00 pm		Workshop1 G1	Movie "Coded bias" +discussion (Miro)		
11:00:00 am	5:00:00 am	2:00:00 am	5:00:00 pm	6:00:00 pm		Workshop1 G1	Movie "Coded bias" +discussion (Miro)		
12:00:00 pm	**6:00:00 am**	**3:00:00 am**	**6:00:00 pm**	**7:00:00 pm**					
1:00:00 pm	7:00:00 am	4:00:00 am	7:00:00 pm	8:00:00 pm					
2:00:00 pm	8:00:00 am	5:00:00 am	8:00:00 pm	9:00:00 pm					
3:00:00 pm	9:00:00 am	6:00:00 am	9:00:00 pm	10:00:00 pm					
4:00:00 pm	10:00:00 am	7:00:00 am	10:00:00 pm	11:00:00 pm					
5:00:00 pm	11:00:00 am	8:00:00 am	11:00:00 pm	12:00:00 am	Opening & Introduction	Workshop2 G2 (US, 11)			Summit
6:00:00 pm	12:00:00 pm	9:00:00 am	12:00:00 am	1:00:00 am	Opening & Introduction	Workshop2 G2 (US)	Movie "Coded bias" +discussion (Miro)		Summit
7:00:00 pm	1:00:00 pm	10:00:00 am	1:00:00 am	2:00:00 am	Opening & Introduction	Workshop2 G2 (US)	Movie "Coded bias" +discussion (Miro)		Summit
8:00:00 pm	2:00:00 pm	11:00:00 am	2:00:00 am	3:00:00 am					
9:00:00 pm	3:00:00 pm	12:00:00 pm	3:00:00 am	4:00:00 am					
10:00:00 pm	4:00:00 pm	1:00:00 pm	4:00:00 am	5:00:00 am					
11:00:00 pm	5:00:00 pm	2:00:00 pm	5:00:00 am	6:00:00 am					

Figure 1 Compact overview of the agenda for the week including different geographical zones (for better planning with participants from all-over the world).

- Monday, June 6: The seminar was opened and its main goals introduced by the seminar co-organizers Stephen Brewster, Andrew Kun, Andreas Riener and Orit Shaer. The presented slides can be accessed here: `https://docs.google.com/presentation/d/15NtQy96wAS_dMHpdqTO-2TfZhbSGssWAn96RxHJizVA/edit#slide=id.gdd9402fdbb_0_8`. After a social "warm-up" activity, Pecha Kucha presentations of all participants followed. During the presentations, all participants were instructed to collect questions, ideas, thoughts, etc. on a Miro-board; The items were clustered by the organizers (in a short coffee break) and after that, a voting of topics to be picked-up/focusing on in the next days of the seminar (see Fig. 2) followed. This activity ended day 1.
- Tuesday, June 7: The second day of the seminar was dedicated to the "Work(shop) for the Future of Work and Mobility in Automated Vehicles". In this workshop, participants (see Fig. 3) worked together on user needs and how to fulfill them during shared or private automated mobility. The workshop was conducted twice – each with half of the

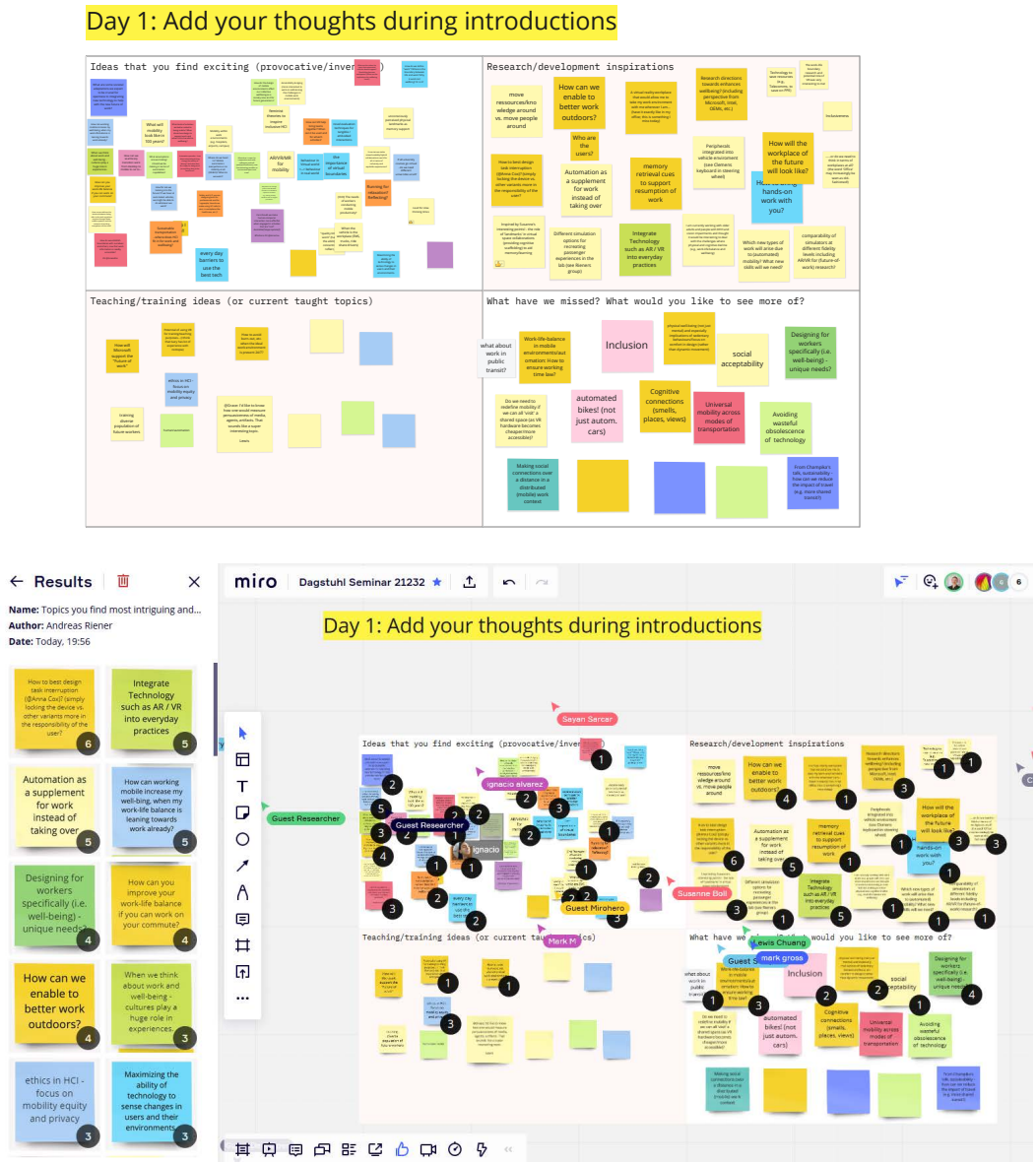

Figure 2 Group activities on day 1: Collecting of ideas, thoughts, questions from the individual presentations; Majority voting after clustering of collected items.

participants and lasted for about two hours including a short coffee break. In order to get all participants in the mood for the workshop and to allow them to reflect on the topic from their personal point of view, we invited everybody to complete a brief (10 min.) "pre-questionnaire" before the workshop (Link: `https://thimib.fra1.qualtrics.com/jfe/form/SV_03eUqLNatcDgzs2`). For details, see section 3.3. The results from both the questionnaire and the two workshops are currently analyzed and will be later submitted as conference paper or journal article (with recognition of the Dagstuhl seminar).

- Wednesday, June 8: On this day, in the Dagstuhl tradition to offer a social activity, we watched – again in two groups of each ca. 15 people – the documentary "Coded Bias" (`https://www.codedbias.com/`). While watching the video, participants were asked to record their thoughts (issues, concerns, suprises, technical problems/solutions,

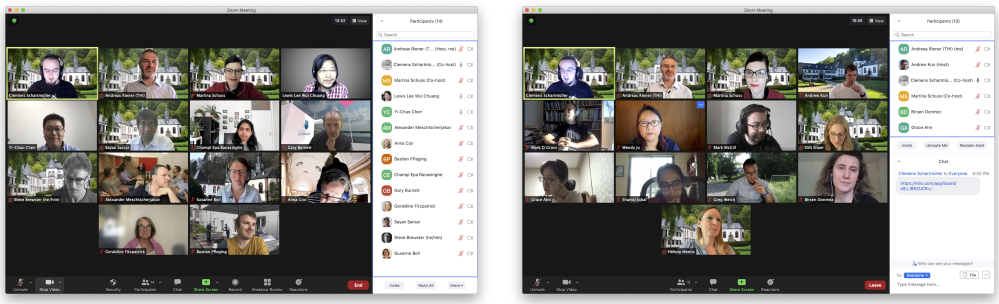

Figure 3 Introduction to the two workshops on day 2 including participants.

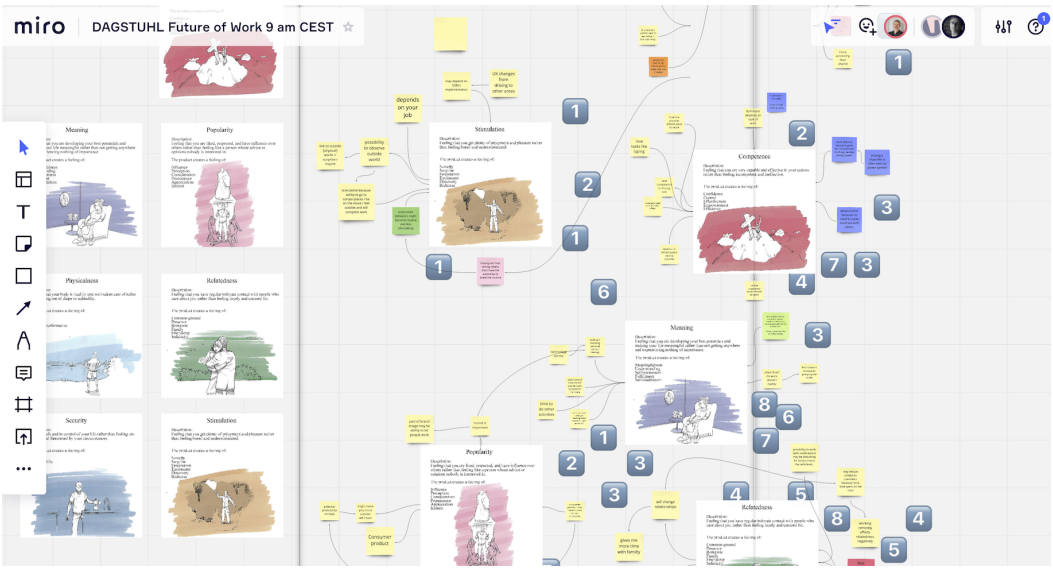

Figure 4 Intermediary results of the interactive workshop part on the Miro-board (group 2 workshop).

societal/policy related solutions) in a Miro-board, e.g., `https://miro.com/app/board/o9J_lCMqEEY=/` for group 1. After watching, we used 10 minutes for clustering the items followed by another 5 minutes for voting. The top voted items where than discussed in the large group and conclusions drawn for our work.

Coded Bias – group 1 results:

- 5 votes: "ensure the right to be forgotten" (removal/deletion of data)
- 4 votes: "AI algorithm uses historical information for the prediction – not everything has been seen before..."
- 3 votes: "Salery automatically based on office environment (stationary, in the car, on the go) -> lot of discussion
- 2 votes: "Transparency"
- 2 votes: "Use a diverse data set to train the AI"
- 2 votes: "Ways of opening the black box...?"

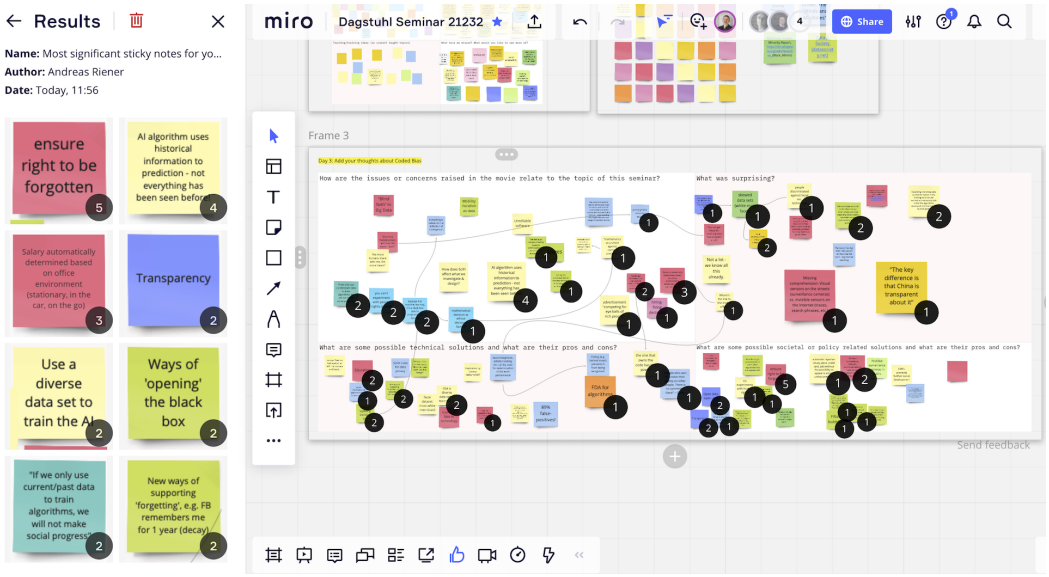

Figure 5 Post-its collected by the participants of group 1 and voting results.

Coded Bias – group 2 results:

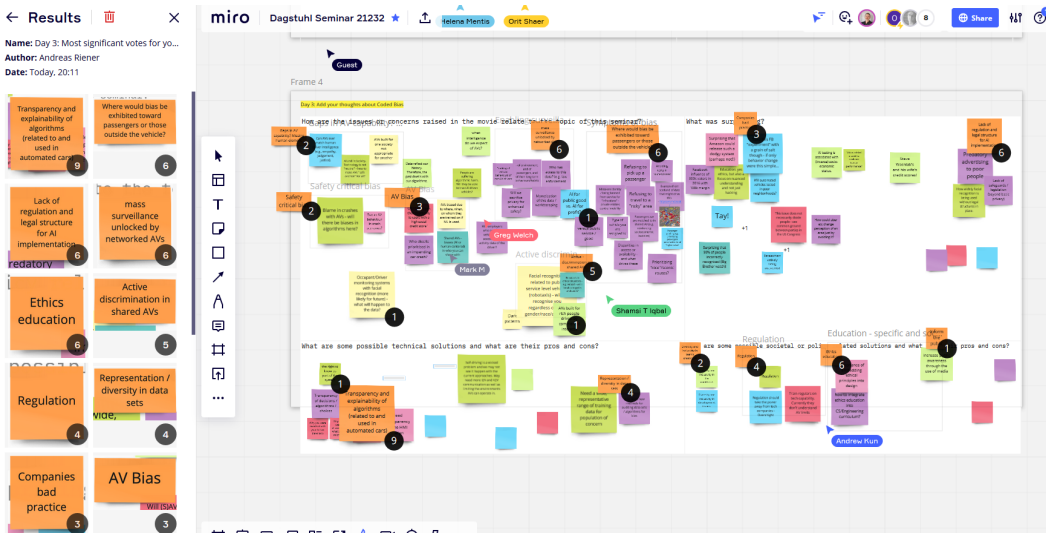

Figure 6 Post-its collected by the participants of group 2 and results of the voting on most relevant elements identified during watching "Coded Bias".

- 9 votes: "Transparency and explainability of algorithms (related to and used in automated cars)"
- 6 votes: "Where would bias be exhibited toward passengers or those outside the vehicle?"
- 6 votes: "Lack of regulation and legal structure for AI implementation"
- 6 votes: "mass surveillance unlocked by networked AVs"
- 6 votes: "Ethics education"

- Thursday, June 9: On the second last day of the seminar, all seminar participants met in small groups (2 to 3 people, see Fig. 7) to discuss one of the topics identified as most important (and to make a video of the discussion) or to jointly create a Youtube playlist of most-impactful videos in a dedicated topical area related to the seminar. The results were collected by the co-organizers of the seminar and distributed among the participants. Examples of bilateral interviews can be found in Sections 4.1 or 4.2, among others, and an example of a playlist is shown in Section 4.3.

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Participant 1	Affiliation	Participant 2	Affiliation
Chen, Yi-Chao	Shanghai Jiao Tong University	Fitzpatrick, Geraldine	TU Wien
Riener, Andreas	TH Ingolstadt	Burnett, Gary	University of Nottingham
Schartmüller, Clemens	TH Ingolstadt	Ranasinghe, Champika Manel Epa	University of Twente – Enschede
Shaer, Orit	Wellesley College	Lee, John D.	University of Wisconsin – Madison
Boffi, Laura	University of Ferrara	Brewster, Stephen	University of Glasgow
Ahn, Sun Joo	University of Georgia – Athens	Welch, Gregory F.	University of Central Florida – Orlando
Alvarez, Ignacio J.	Intel – Hillsboro	Gross, Mark D.	University of Colorado – Boulder
Boll, Susanne	Universität Oldenburg	McGill, Mark	University of Glasgow
Brumby, Duncan	University College London	Pfleging, Bastian	TU Eindhoven
Meschtscherjakov, Alexander	Universität Salzburg	Cox, Anna	University College London
Chuang, Lewis	IfADo – Dortmund	Lindley, Siân	Microsoft Research – Cambridge
Mentis, Helena M.	University of Maryland – Baltimore County	Ju, Wendy	Cornell Tech – New York
Kun, Andrew	University of New Hampshire – Durham		Sayan Sarkar, Tsukuba University
Donmez, Birsen	University of Toronto	Iqbal, Shamsi Tamara	Microsoft Research – Redmond

Figure 7 Couples who either had a curated conversation or created a Youtube playlist on Thursday bilaterally (<= 5 minutes each).

- Friday, June 10: The last day of the seminar has ended with a summit (Fig. 8). The first half of this activity was devoted to two panels with distinguished panelists. Panelists started the conversations with brief statements, which were then followed by moderated discussions with the group. For the second half of this activity all participants were sent into breakout rooms in Zoom and worked in smaller groups on a Miro-board (`https://miro.com/app/board/o9J_l_-usxU=`) on problems discussed during the panels. After the group work, all met again in the main Zoom room and each group presented the results of the group activity (Fig. 9).

Figure 8 The highlight of the seminar: A summit with contributions from seminar participants and keynote speeches from invited experts (including Neha Kumar, ACM SIGCHI President).

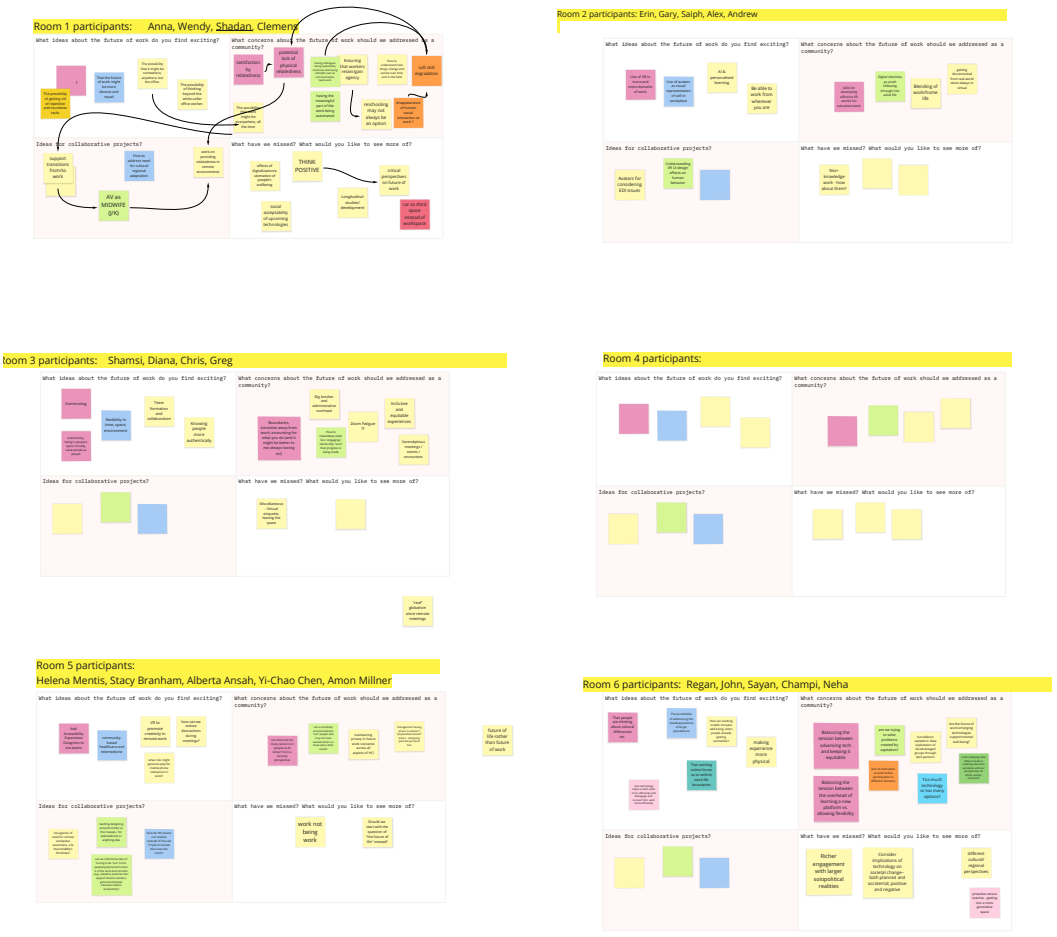

Figure 9 Overview of the results of the six groups in Miro.

2 Table of Contents

3 Overview of Talks

3.1 My Personal Research Outlook

Sun Joo Ahn (University of Georgia – Athens, US)

The future of work is anticipated to be a tight integration of workers and machines in both virtual and augmented versions of reality. Physical and geographical distance will become less relevant as workers learn to adapt to digital platforms that provide shared virtual spaces for social interaction and communication. Research on how these developments may transform the future of work has typically focused on worker efficiency but worker wellbeing needs to take into consideration the social relationships that support workers' resilience (e.g., family interactions [1]) and the context in which work takes place (e.g., working from home [2]). Users will begin to form relationships with artificial agents that drive and represent autonomous vehicles [3], and these relationships will impact how users interact with the vehicles. Future work in this area must consider individual, social, and environmental variables of the human-computer interactions that take place in the future of work, moving above and beyond the current focus on worker efficiency.

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3.2 Cars with an Intent

Laura Boffi (University of Ferrara, IT)

Since its early phases, the development of automated vehicles has focused on functionality, safety and efficiency, overlooking the social implications that such technology would bring up in people's lives. "Cars with an Intent" is a design driven PhD research project which envisions how autonomous cars' behaviour and services can enable new car-to-human and human-to-human relationships. In particular, the research focuses on the "Co-Drive" concept, which is proposed as a new service for traveling and socializing by car between a driver of an automated vehicle and a remote passenger connected via virtual reality from home. I argue that the convergence of automated driving and telepresence technologies could provide a new social context for personal interactions to emerge, that are neither dependent on any earlier relationships nor based on age affinities. As remote passengers will likely be elderly

people and drivers younger ones, the aim of the research is to understand how the "Co-Drive" concept could support intergenerational encounters and relationships and reduce the sense of loneliness in senior adults. Moreover, I aim to understand how the "Co-Drive" service could enable an ageism-free approach towards senior adults through the use of digital and robotic embodiment for remote passengers. Prospective remote passengers can select a location from where to start their Co-Drive trip from among the many stops around the world which have been featured in the Co-Drive Atlas and place their avatar there to book their trip. A Co-Drive stop is the physical location where a Co- Drive trip can start from, blending the real and virtual into an extended reality experience for the driver as well as for the remote passenger. A driver passing nearby the stop where an avatar has been placed would spot such an avatar as an AR visualization on the car windshield. S/he and can decide to pull over, start engaging remotely with the person embodied in the avatar and eventually board her/him in the car as a remote passenger for a shared trip together. They could both converse "live" during the trip, while the remote passenger could also enjoy the view as if sitting on the passenger seat. At the moment I am experimenting with different immersive system for the remote passenger: from a computer display, to a big wall projection to a VR headset. The project has followed a participatory design process, engaging with real participants in their context since the very beginning. I have been designing my own early-stage XR prototyping methodology iand, beyond crafting lo-fi artefacts, I have been establishing collaboration with external partners which could provide me with "enough technology" to pilot the remote trips, such as Ericsson R&D Italy which developed the car-pod.

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3.3 Multimodal (and more physical) Interaction to Improve In-Car User Experience

Champika Ranasinghe (University of Twente – Enschede, NL)

Automated vehicles have the potential to provide increased mobility to a broader range of users such as elderly, children, people with physical limitations (e.g., visually impaired people, people with broken legs/ arms) or people with other types of limitations such as for example

people who are nervous of driving [1] [2]. On the other hand, driving becomes a secondary task and the drivers (and the passengers) can engage in various other tasks such as work, leisure or even sleep. This requires interacting with the vehicle at various levels such as for example to take the control of driving when mediation is necessary, making driving related decisions or for the purpose of other tasks the user is engaged in (such as online meeting of collogues using the car's infrastructure). This often involves two types of interaction: interaction for the purpose of the primary task (what the user is currently doing, for example playing a game) and the interaction for secondary tasks while the user is engaged in and her attention is on another primary task (such as for example, for receiving the status of the traffic ahead while the user is playing a game with the aid of car's infrastructure). Towards better facilitating these interactions, autonomous vehicles can benefit from multimodal interaction, the use of different (and often multiple) human sensory modalities. One the one hand, not much research has been done on how different human sensory modalities can be best used to facilitate in-car interaction. On the other hand, users of autonomous vehicles, use-situations, and what interaction requirements these users have remain largely unexplored. Except for speech and haptic based interaction, a little is known about using other modalities such as gestures, olfaction and sonification and how they can be used for different types of users and use situations. We aim to fill this gap by exploring how various types of sensory modalities can be used to enrich in-car interaction of various user groups and use situations.

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3.4 A Multi-level Approach to Understanding the Now and the Future of Work and Wellbeing

Anna Cox (University College London, GB)

The creators of digital technology promised that digital tools would increase our productivity and give us more autonomy over when and where we work. Instead, it often seems as though increased use of information technology has reduced worker productivity (the productivity paradox) and led to us working always and from everywhere (the autonomy paradox). One interesting question is, how to create digital information technologies that actually deliver on these early promises so as to support both our productivity and wellbeing.

In order to answer this question we need to understand the role that technology plays in shaping how we work at multiple levels. The micro or task level enables us to understand how technologies support us in doing a particular task. Examples include studies of which emails people prioritise answering and why [1], and how can we design interventions to help people keep their focus on their work and better self-regulate self-interruptions [2]. Investigations at the meso or job level involve explorations of the influence of technology on the shape of a job or the development of relationships between team members. Examples include studies

how people adapted to the switch to remote working brought on by the pandemic [3] and exploring how we can use videogames to create swift trust between remote teammates [4]. Explorations at the macro or life and wellbeing level enable us to focus on how technology influences the whole person, including outside of their work. Examples include studies of how people use technology to manage work life boundaries [5] and how we can use video games to support post-work recovery [6].

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3.5 Designing to Support People Working, Connecting and Living Well in Mobile Work Environments

Geraldine Fitzpatrick (TU Wien, AT)

Technology is making it increasingly easier to connect, interact and work independent of traditional office spaces – work is becoming more mobile, more distributed in space and time. With this mobility comes a number of challenges. One is around how to be effective at/in work, to maintain motivation and productivity without the structures and oversight of work places. This requires people to operate with a high degree of autonomy and self-efficacy. And it requires new forms of leadership to enable such autonomy, provide appropriate support and to build trust. A second challenge is how to build and maintain high quality social connections in the absence of contemporaneous co-location. This is both for relationship building and for effective collaboration, creativity and problem solving. Strong social emotional skills are required to build and maintain relationships online, to create empathic connections, and to communicate effectively, often having to take more proactive and explicit steps for communications and interactions that could happen much more implicitly and serendipitously when co-located. A third challenge is about how to navigate time and space and work and

all other aspects of life, often talked about in terms of blurring of boundaries. This can have both positive implications for increased flexibility and autonomy, mentioned above. It can also have negative implications for increasing stress and decreasing mental and physical health and well-being.

In our human-centred research, we explore roles for technology to support reflective work practices, e.g., [3], to develop emotional and social skills, e.g., [2], and to promote mental and physical health and well-being, e.g., [1].

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3.6 Is the Future of Work on the Move?

Christian P. Janssen (Utrecht University, NL)

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URL http://dx.doi.org/10.1016/j.ijhcs.2019.07.004

Automated technology is changing human lives rapidly [1], including in the automotive domain. As vehicles get equipped with more and more reliable automated technology [2], there might be occasional times where the human driver does not need to pay full attention to the road and can or wants to, temporarily, pay attention to other tasks and activities. Doing other activities during an automated drive is a desire for many humans [3]. However, there is a potential of being distracted for too long and missing critical events or failing to respond timely to an in-car alert.

In our previous work, we have proposed that it can be beneficial to think of such scenarios in terms of interruption management: how do people interleave their attention between driving and non-driving activities [4]? The general idea is that people might not always respond immediately to an alert, but respond more gradually, consistent with how they interleave their attention in other multitasking settings [5] and consistent with the idea that auditory alerts might not always be processed when people are distracted [6, 7]. We have started to test these ideas experimentally, and so far see that drivers might indeed follow interleaving patterns when they are interrupted by an alert during semi-automated driving conditions [8]. This work shows the value that theories [4] and models [5, 9, 10] of human behavior can have: they can predict human behavior and guide the design of future interfaces.

One open question is how human behavior changes over time. As humans get experience with new interfaces (e.g., novel in-car technology), and are exposed to different environments and settings (e.g., different levels or forms of automation), their behavior might be different

from what science might have predicted so far. Nonetheless, humans are humans, and theory about human behavior can guide and inform such insights. Another way that the future of work might be on the move more radically is whether humans will even travel as much by car as some did so far. Certainly, the recent pandemic has opened the eyes of many to the options of working from home. Again, thinking about such environments from an interruption perspective is beneficial, as theories of interruption have been proposed in both automotive [4] as well as office and home settings [5]. Although this might create some limitations (like being distracted by the home environment and pets and family members), there are also opportunities. For example, on a personal note, I was able to attend this Dagstuhl seminar remotely, despite having become a father recently. I am sure that my own future of work will change quite a bit over the next few years.

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3.7 The Future of Work and Wellbeing: From Automated Vehicles to Working at Home

Andrew Kun (University of New Hampshire – Durham, US)

Automated vehicles hold the promise of allowing us to use the time we spend on the road for productive endeavors, or for attending to our wellbeing. Thus, future commutes to work might include preparation for the workday. Similarly, trips from the office back home might allow us the time and place to shift out of work-mode and into home-life-mode. One interesting question is, how to create user interfaces that will allow us to take advantage of automated vehicles such as to support our productivity and wellbeing. We need to explore this question in light of the fact that automated vehicles are likely to be only partially automated for many years to come. This means that driving will be part of what we do on a trip in a vehicle, and user interface design will have to support driving safety [1]; however there will be extended periods of time (e.g. on a stretch of highway), where automation can take over, and we can focus on non-driving tasks. Periodically, automation will interrupt us in the non-driving task, and we will need to take back control of the vehicle [2].

Of course, in the coming years many workers might commute significantly less than in the past [3]. Yet, as user interface designers, we can notice parallels between the engagement in work tasks in a vehicle, and working from home. In both cases we work in an environment that possibly lacks all of the tools that are in the office or our lab. We are also interrupted unexpectedly in both environments – in the vehicle the interruption comes from the automation that needs us to take over control, while at home it might be the needs of a child. In both cases our co-workers are remote, and our communication with them has to happen in the context of distractions and interruptions. Thus, as we design interfaces for automated vehicles and for working from home, it will be fruitful to understand the similarities of the two domains.

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3.8 The Impact of XR-Headsets on Mobile Productivity

Mark McGill (University of Glasgow, GB)

Main reference Mark McGill, Aidan Kehoe, Euan Freeman, Stephen A. Brewster: "Expanding the Bounds of Seated Virtual Workspaces", ACM Trans. Comput. Hum. Interact., Vol. 27(3), pp. 13:1–13:40, 2020.
URL http://dx.doi.org/10.1145/3380959

As part of ERC ViAjeRo (`https://viajero-project.org/`), my research has focused on some of the key benefits and challenges offered by adopting XR headsets (augmented/virtual reality) in passenger contexts, offering new avenues for productivity and entertainment whilst potentially overcoming key impediments such as motion sickness. With respect to productivity, there are some notable benefits offered by transitioning from physical displays to virtual content and displays rendered by XR headsets. For example in terms of ergonomics we can dynamically manipulate the virtual content position for comfort and accessibility [1], making the most of our restricted capacity for movement in constrained spaces [2] like an economy plane seat [3].

However, we're also finding that a transition toward XR content in passenger contexts is posing unique challenges beyond the technical, for example in terms of social acceptability constraining how users see themselves adopting these technologies around other passengers. I believe that if we can resolve these key challenges in difficult mobility contexts, those solutions will also positively impact everyday productivity in many more contexts e.g. working from home, helping to adapt the home environment toward productivity just as we adapt the car or plane interior.

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3.9 Challenges in Mobile Offices in Automated Vehicles

Alexander Meschtscherjakov (Universität Salzburg, AT)

In the near future more and more Advanced Driving Assistance Systems (ADAS) will be integrated into modern vehicles and cars will be able to drive at different levels of automation. This relieves drivers from driving tasks allowing them to be involved in other activities – may it be work or leisure related. Especially for commuting this fact offers potentials to conduct work already while commuting to and from work. Depending on the type of work I see the following challenges to be addressed, to make mobile commuting work a success:

1. Allocation of driving related responsibilities between the automated vehicle and the driver needs to be defined and communicated
2. Automation mode must ensure a certain time frame of reliving drivers from any driving task related activities (e.g., monitoring the environment, take-over requests below a reasonable time span)
3. Providing infrastructure that allows mobile working while riding in a vehicle
4. Addressing aspects of motion sickness, re-routing, etc.

3.10 Resolving of Automation Level Issues and Operational Constraints to Enable Productive Work in AVs

Andreas Riener (TH Ingolstadt, DE)

Main reference Andreas Riener, Myounghoon Jeon, Ignacio Alvarez (eds).: "User Experience Design in the Era of Automated Driving", Springer Studies in Computational Intelligence, pp. 623, 2021
URL https://doi.org/10.1007/978-3-030-77726-5

Automated driving has undergone a major development boost in recent years, but the initial hype has also suffered some setbacks in the form of reality checks. While Level 3 automation was expected to hit the road by 2021 on a broad scale, we see today that this is no longer the case, mainly because of safety and legal issues [1]. In addition, recent accidents involving automated vehicles have fueled public fears, both on the side of policy makers and the general society. Legal and regulatory frameworks are subject to frequent changes and further vary from country to country. While there are many unanswered questions and uncertainties surrounding automated driving, broad user acceptance is considered a basic prerequisite for using these systems and thus also for bringing applications for productive work, among other things, into the vehicle. One particular issue discussed in this context is in which automation level effective working will be possible. There is broad consensus that this should be the case on levels 3 [2] or higher, because below that the driver is obliged to permanently monitor the vehicle. A common misconception is, however, that a specific car is a level 'X' automated vehicle – this is not correct! A specific vehicle might be equipped with several advanced driver assistance systems/driving automation systems implemented at different levels of automation. And for a specific function, its availability is further restricted by the constraints of the "Operational Design Domain" (ODD). ODD specifies the boundary conditions for a specific automation function, including environmental, geographical, time-of-day restrictions, and/or the requisite presence or absence of certain traffic or roadway characteristics for the intended automation functionality. For example, a (L3) highway assist might only operate on the (German) highway A9 from Munich to Berlin, under clear weather, dry road, visible lane markings, in the speed range 45 to 130km/h, and out of rush hour. Outside these boundary conditions, the system is not available (and may switch off automatically). The combination of assistance systems or automated driving functions on different levels in a variety of application scenarios (and restrictions) leads to ambiguity and high uncertainty and makes it almost impossible for the driver/passenger to find out whether an assistance or automated driving system is available in a certain situation, which one, and at which level of automation. Also, the availability might change rather quickly, based on the definition of the ODD. This example shows how difficult it is to implement efficient mobile working systems for the automated vehicle while ensuring that driving safety is not compromised by its use.

The consequence is either systems that have to adapt frequently and quickly to the current situation (level, ODD), which, depending on the context, has a negative impact on efficiency of work, or to wait with its introduction until at least level 4 is available on a large part of the commuter route. In our research group at Technische Hochschule Ingolstadt my PhD students and postdoctoral researchers explore together with me different opportunities to support the driver-passenger of an automated vehicle, for example, by implementing (personalizable, adaptive) interfaces to support mode awareness [3], develop and test prototypes for efficient and ergonomic office work in Level 3+ vehicles [4], build (mobile) driving simulators to test our interfaces with the general public, study the capability of augmented and/or virtual reality as an additional level of interaction [5], create (transparency) displays to communicate upcoming decisions/maneuvers from the vehicle to the passenger, investigate the potential that driver-automation cooperation has on road safety, to name a few.

I am looking forward to the seminar in Dagstuhl (although it is virtual this time) to discuss these challenges together, to identify/adapt solutions (possibly also from other domains) and to create a roadmap of research with all the participating experts.

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3.11 Human-Computer Interaction to Support Work and Wellbeing in Mobile Environments

Sayan Sarcar (University of Tsukuba – Ibaraki, JP)

Of late, as the ubiquitous computing field progresses, mobile and wearable devices have become mainstream computing resources to be operated anywhere and anytime. However, it has been an alarming fact that excessive use of mobile devices imposes a negative effect on the health and wellbeing of users. As Human-computer Interaction (HCI) researchers, our challenge is to design effective ways to use technology in a balanced way between work and wellbeing.

In this online Dagstuhl Seminar, HCI experts discussed possible research questions pertinent to this underexplored research area as follows.

- What are the manual, visual, auditory, and cognitive demands of tasks in mobile environments? Many present and future scenarios were discussed where such demands are prominent, such as a mobile office in the automated car environments, virtual environments such as AR, VR, MR, XR spaces for game playing, or doing office works. Also, the task spaces in such environments were explored with possible ways to make them less cognitively demanding.
- What are the aspects of mobile contexts that affect how people work and play in mobile environments? The workshop attendees also discussed several aspects: distraction caused by social media, less focus on the work users currently doing; scarcity of programs that can dynamically manipulate the work-life imbalances and encourage users to perform tasks to help balancing it.
- How do we support (safe) task switching?

Some potential strategies were discussed – such as how to incorporate programs to encourage short-term physical or mental exercising between two tasks to improve the focus, natural ways to switch the tasks.

How do we leverage advanced HCI technologies to support work and wellbeing activities in mobile environments? The discussion was focused around introducing immersive technologies (AR, VR, MR, XR) and design supportive interventions.

3.12 Productive and Safe UIs in Conditionally Automated Driving

Clemens Schartmüller (TH Ingolstadt, DE)

Main reference Clemens Schartmüller, Philipp Wintersberger, Anna-Katharina Frison, Andreas Riener: "Type-o-Steer: Reimagining the Steering Wheel for Productive Non-Driving Related Tasks in Conditionally Automated Vehicles", in Proc. of the 2019 IEEE Intelligent Vehicles Symposium, IV 2019, Paris, France, June 9-12, 2019, pp. 1699–1706, IEEE, 2019.
URL http://dx.doi.org/10.1109/IVS.2019.8814088

The COVID-19 pandemic has shown how technology enables knowledge workers to work literally everywhere. However, we have also seen how important personal contacts are to us as social human beings, also in the context of work. While traveling for personal contacts was previously often seen as a waste of time and resources, future automated vehicles may enable us to use this time productively. Furthermore, it may even allow retaining, e.g., the jobs of truck drivers. In a mobile office automated vehicle, they can do logistics planning between on- and offloading, where they would otherwise be rationalized away by driving automation.

However, especially the first levels of automated driving will inherit safety-critical transitions of control from automated driving to manual driving. Accordingly, user interfaces are needed that enable safe working in such vehicles. We have quantitatively shown that merging knowledge from office ergonomics and human factors in automated driving can result in safe and productive in-vehicle user interfaces [1]. However, open questions include how novel technology like mixed reality can further foster safety and productivity without confusing the user [2] – do we need to deviate from the old interaction paradigms like WIMP wimp? – and, in the grand scheme of things, how will the ability to work on the go impact our daily routines, will there be a place left for "shutting down" or is a mobile office just another contributor to the "always-on" pressure?

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3.13 The Future of Work and Mobility in Automated Vehicles

Martina Schuß (TH Ingolstadt, DE)

Main reference Martina Schuß, Philipp Wintersberger, Andreas Riener: "Let's Share a Ride into the Future: A Qualitative Study Comparing Hypothetical Implementation Scenarios of Automated Vehicles", in Proc. of the 2021 CHI Conference on Human Factors in Computing Systems, CHI '21, Association for Computing Machinery, 2021.
URL http://dx.doi.org/10.1145/3411764.3445609

In the future automated vehicles (AVs) will permanently change our mobility. At the moment it is uncertain how these vehicles will be implemented and several scenarios including private car ownership, as well as scenarios that require sharing of rides and vehicles are possible. Most probably, shared automated vehicles (SAVs) where many rides are shared among people will be the most beneficial ones for society and environment, and they are my research focus. However, research in this area often focuses on the usability of HMI concepts rather than on user's emotions or daily life context, and includes unbalanced participant groups in terms of gender, age, and other social or psychological identities. In my research I am focusing on shared automated vehicles and I am taking a pluralistic viewpoint paying attention to groups of people that are many times are left out in the research and development of new technologies, such as people from different cultural backgrounds, senior citizens but also women and children [1].

During the Dagstuhl workshop "Workshop for the Future of Work and Mobility in Automated Vehicles" that was hosted on 8th June 2021 (see below for a more detailed summary), participants were vividly discussing the fulfillment of needs in SAVs in the context of work. Some of the most interesting findings were that autonomy and security were the least fulfilled needs in shared contexts and especially concerns due to co-passengers are unexpectedly complex and important. In the future, concepts are needed to account for a high feeling of autonomy and security in SAVs to make them the mobility of choice for as many people as possible.

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3.14 Existential Embodied Agents for Home and Mobile Environments

Gregory F. Welch (University of Central Florida – Orlando, US)

Main reference Kangsoo Kim, Luke Boelling, Steffen Haesler, Jeremy N. Bailenson, Gerd Bruder, Gregory F. Welch: "Does a Digital Assistant Need a Body? The Influence of Visual Embodiment and Social Behavior on the Perception of Intelligent Virtual Agents in AR", in Proc. of the IEEE International Symposium on Mixed and Augmented Reality, ISMAR 2018, Munich, Germany, October 16-20, 2018, pp. 105–114, IEEE, 2018.
URL http://dx.doi.org/10.1109/ISMAR.2018.00039

The future of work and wellbeing contextualized in mobile environments could actually be seen as yet another encroachment of work on life and wellbeing. Yet we (humans) are in control of the technology, and have the opportunity to make it work better for us for both work and wellbeing. Beyond direct interfaces to machines, autonomous agents have been increasing in acceptance and corresponding use. This is perhaps nowhere more eviden than with today's "smart speakers" from Amazon, Apple, and Google. While these devices are becoming more powerful, today's devices are inherently transactional, reactive, and relatively neutral with respect to influence. Beyond solely audio, embodied agents (agents with visual form) offer many more affordances in terms of their ability to communicate (adding nonverbal aspects) and their sense of existence. Whether in the home or in a mobile environment, such agents can provide autonomous intelligent behavior that is proactive, personalized, and adaptive to our needs and circumstances, while also providing a common "clean" interface to machines. Such agents can acton behalf of individuals and service providers, exerting influence aimed at short and long-term goals. Agents who are continuously existent, with an apparent independent virtual life, will be able to transform what is now a transactional relationship (e.g., "What time is it?") to a more relational one, with increased influence resulting from our perception of an existential companion.

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4 Working groups

4.1 Reporting on Bilateral Group Activity: Curated Conversation

Sun Joo Ahn (University of Georgia – Athens, US) and Gregory F. Welch (University of Central Florida – Orlando, US)

URL https://youtu.be/UmEuKcwaJWU

On Thursday, June 10, Grace Ahn and Greg Welch held a conversation on the utility and perils of historical data collected by autonomous vehicles, in which we discussed the dilemma of the utility of accumulated data for autonomous vehicles versus the dangers posed in control, ownership, and management of the collected data. Autonomous vehicles (and related

AI agents) cannot optimize their utility for users without collecting personal and behavioral data. Users may recognize that their direct interaction data with autonomous vehicles may be tracked and logged but may not be aware that other personal data may also be collected as the autonomous vehicle "gets to know" its user, such as medical data, purchase data, daily schedules, and social network data related to the users' friends and family. Users will want to maximize the convenience and utility of autonomous vehicles, but how can they protect third parties from gaining control over the collected data? Third parties, such as insurance companies and employers, may be able to make unwarranted inferences from the data collected on these users. This can be dangerous when people have a positivity bias toward data collected and processed by machines, considering these results to be more accurate and "correct" than humans.

One potential solution may be to allow users to grant temporary access to a very specific "lot" of data to increase the utility of specific goods and services, and then be able to revoke access as well as delete data that were temporarily provided. This voluntary provision of data may also assist in developing and training new autonomous platforms. Earlier research suggests that users are not necessarily against providing personal data, as long as there is utility to be gained. Users would appreciate more visibility and transparency in how they are better able to manage and control the personal data being collected, and this in turn, is likely to encourage data sharing. Collection of personal data is typically seen as an "evil" tactic to manipulate users, but many of the services and conveniences we benefit from would not be possible without collection of personal data. Therefore, we should recognize that data collection is a highly nuanced and contextual activity, its utility and value resting on the entities involved and for what reason the data are being collected.

Link to YouTube video of the conversation: `https://youtu.be/UmEuKcwaJWU`

4.2 Reporting on Team Breakout Activity: Curated Conversation

Mark McGill (University of Glasgow, GB), Laura Boffi (University of Ferrara, IT), and Susanne Boll (Universität Oldenburg, DE)

URL https://www.youtube.com/watch?v=lV3AyLzKtS0

On Thursday 10th June, our breakout group (Susanne Boll, Laura Boffi, Mark McGill) had a conversation around the future of work and autonomous vehicles. Based on prior group activities earlier in the week, we chose three topics noted to have the most significant impact:

- What kind of experiences we want to facilitate in autonomous vehicles – This considered the core aim of the workshop, to facilitate work in mobile environments. Our discussion reflected on existing use of travel time, and the possibility that by operationalizing travel, we might lose opportunities for reflection.
- Motion sickness and the fixation on visual experiences – Given the challenge of resolving motion sickness, the group approached this problem from the perspective of ruling out visually-led AV experiences, discussing the capacity of auditory presence / auditory virtual reality to facilitate passenger presence in other auditory environments, as a means to escape the journey.
- Algorithmic bias in shared AVs – Inspired by the group movie activity, we finally discussed sources of algorithmic bias as might be exhibited in rideshare platforms, and the potential societal impact that such bias might have given a transition from owned to shared transit,

and a developed reliance on this as the primary means of public transport. For example, consider structural bias in what areas AVs travel to or through, or how they collect passengers in different areas, or based on different socioeconomic profiles. Such bias' suggest that we might reinforce existing inequalities in shared AV services, or even develop new ones based on the profitability of servicing certain locations.

See the main reference of this abstract for a recording of this discussion.

4.3 Digital Assistants for Cars (Youtube-Playlist)

Andreas Riener (TH Ingolstadt, DE) and Gary Burnett (University of Nottingham, GB)

URL https://www.youtube.com/playlist?list=PLJi9U1fnyFjdPVbtYmDfmfdE4mPIrfh1l

Below, Gary and I (see Fig. 10) share a selection of videos showing different concepts for digital assistants/Intelligent Personal Assistants (IPAs), user-friendly vehicle interfaces in infotainment system, or interactive human-machine devices that react to the user's emotional state. On the one hand, this allows users to be more actively involved in these vehicles, and on the other hand, it also provides customers with the opportunity for better cooperation and effective collaboration with the systems. Some of the videos selected here show real digital assistants, some represent visions, some are jokes (but still informative). They differ in the way of representation (avatar, other form of visual embodiment, features of anthropomorphism in visualization, voice, natural language, etc.).

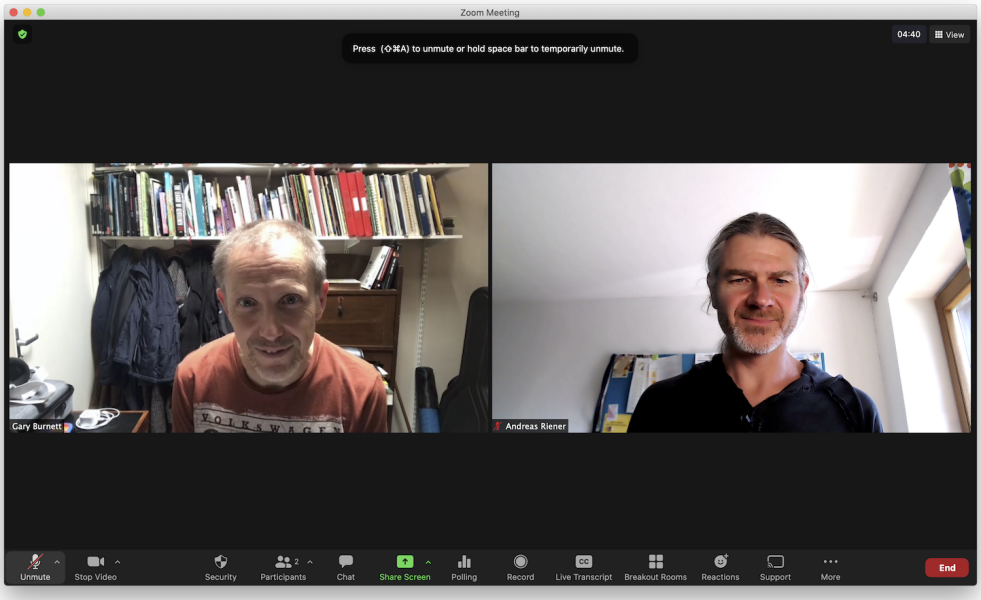

Figure 10 Gary Burnett and Andreas Riener during the Thursday group activity: Compiling a Youtube playlist.

4.3.1 Youtube playlist

The Youtube playlist with our selection can be watched here: `https://www.youtube.com/playlist?list=PLJi9U1fnyFjdPVbtYmDfmfdE4mPIrfh1l`.

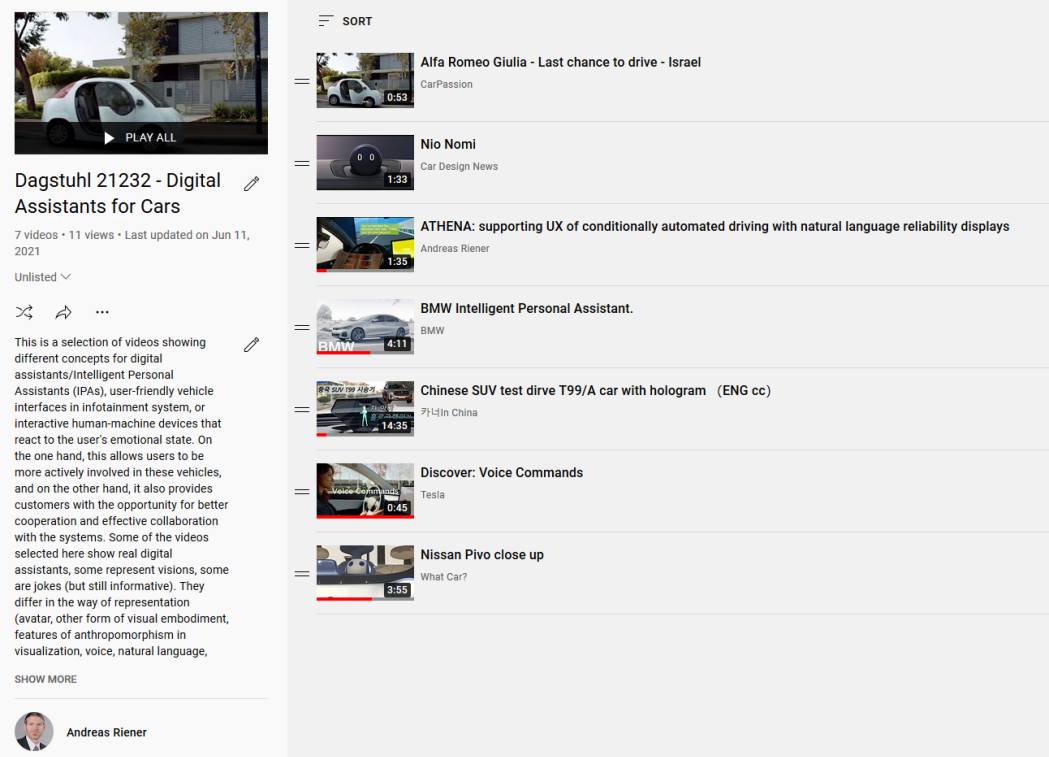

Figure 11 Youtube playlist with our selection of "must-seen" videos.

In summary, we can say that digital (or personal) assistants have great potential to support interaction, communication (incl. work) in the vehicle in the future.

4.3.2 Extended, full list of inspiring videos

- A joke advert but demonstrating many of the things you don't want to do with a digital assistant design in an automated car, `https://www.youtube.com/watch?v=UIzwQbOOBkY`
- Faw Bestune Chinese SUV with dancing hologram avatar on the dashboard (demonstrates many potential EDI issues), `https://www.youtube.com/watch?v=XQnvSKLLPC0`
- AIDA 1.0 – MIT SENSEable City Lab and Personal Robots Group with collaboration from Audi VW (video from 2014 but system created in 2009). A robot-like digital assistant, `https://www.youtube.com/watch?v=jCiTYytpMpQ`
- AIDA 2.0 – MIT SENSEable City Lab with collaboration from Audi VW (2011). They removed the robot-like presence, `https://www.youtube.com/watch?v=V9Qmg4TteMY`
- BMW's Intelligent Personal Assistant (not robotic/avatar based but it's what we currently can see/use), `https://youtu.be/C-gRJrDrICs`, `https://youtu.be/NP-ZzuKAD8k`
- Tesla's video on using voice commands to interact with their cars (I've never driven a Tesla, but it seems they take a "less communicative" approach unless you have a command/request for the car and most actions can be triggered using the screen or using speech), `https://youtu.be/oDruklAJFmA`

- Nissan's PIVO 2 (2007 concept car), https://www.youtube.com/watch?v=Lb1UYLhrFhw
- Penguin-like in0car robot by Pioneer, https://www.youtube.com/watch?v=GlSXHKJ6MDQ
- Another oldish concept by BYD that never made it to the roads, https://www.youtube.com/watch?v=BqncDH0mPlM

4.4 Reporting on Bilateral Group Activity: Curated Conversation about "Don't forget about physicality in HCI"

Clemens Schartmüller (TH Ingolstadt, DE)

Joint work of Clemens Schartmüller, Champika Manuel Epa Ranasinghe
URL https://youtu.be/zQ80SNHHDIY

In the day 4 bilateral activity, we, Champika Manuel Epa Ranasinghe and Clemens Schartmüller discussed how physicality is often overlooked in recent HCI research. The discussion was recorded on video, available here: https://youtu.be/zQ80SNHHDIY.

First, we discussed how physical interaction has the potential to improve the memorability of interactions, provide interactivity to disadvantaged groups like elderly and disabled people, as well as improve overall well-being. However, current mobile devices and also vehicles are trending toward touch displays, which not only results in a loss of the full haptic sensation of pressing a button but were also shown to be detrimental to driver safety. We then found that digital techniques and physical interfaces are easily combinable e.g., by combining RFID tags and tangibles. Coming back to work in automated vehicles, we discussed how slowing down with physical interfaces could be beneficial for users. Slowing down could support in being able to grasp the heavy information load presented in a mobile office (office tasks but also driving-related information) and thereby avoid users being just a passive recipient of information that misses half – after all, understanding, not only speed, is critical for effectiveness.

4.5 Reporting on the "Workshop for the Future of Work and Mobility in Automated Vehicles" Workshop

Clemens Schartmüller (TH Ingolstadt, DE), Andreas Riener (TH Ingolstadt, DE), and Martina Schuß (TH Ingolstadt, DE)

On Tuesday, June 8, the Dagstuhl seminar hosted a workshop entitled "Workshop for the Future of Work and Mobility in Automated Vehicles". Two researchers from Prof. Dr. Andreas Riener's HCI Group- Clemens Schartmüller and Martina Schuß- conducted the workshops during two different time slots. The workshop started with an introduction on automated driving in general and two forms of automated vehicles were presented to the workshop participants: private automated vehicles (PAVs) and shared automated vehicles (SAVs). Subsequently, the so-called user need cards [1-3] were presented to participants. These cards represent psychological needs that in situations or in the interaction with products can either be fulfilled or not fulfilled leading to either positive or negative user experiences. Thus,

these needs should be taken into account when designing interfaces in the context of AD and interfaces should be designed to enhance user's needs. The workshop participants were then split up into two breakout rooms and were brainstorming on whether the user needs were fulfilled, respectively not fulfilled, in the context of work. Thus, one breakout room was discussing on PAVs while the other participants were discussing on SAVs. After the first discussion round and a short coffee break, the groups were ideating on possible design solutions on the least fulfilled needs in the context of work in either PAVs or SAVs. The workshop closed with a plenary wrap-up round and goodbye.

Below we briefly sum up which needs were the least fulfilled in the respective scenarios including AVs:

Fulfilled Not fulfilled PAVs Autonomy, popularity, security, Meaning, relatedness, physicalness **SAVs** Competence, meaning, relatedness Autonomy, popularity, security

Relatedness, physicalness, competence, meaning Security, relatedness, popularity, autonomy

References

1 Hassenzahl, M. & Diefenbach, S. (2012). Well-being, need fulfillment, and Experience Design. In Proceedings of the DIS 2012 Workshop on Designing Wellbeing. June 11-12, 2012, Newcastle, UK.

2 Hassenzahl, M. , Diefenbach, S. & Göritz, A. (2010). Needs, affect, and interactive products – Facets of user experience. Interacting with Computers, 22, 353-362.

3 Hassenzahl, M., Eckoldt, K., Diefenbach, S., Laschke, M. & Lenz, E. (2013). Designing moments of meaning and pleasure – Experience Design. International Journal of Design, 7 (3), 21-31.

5 Panel discussions

5.1 Report on "The Future of Creative Teams" panel

Andrew Kun (University of New Hampshire – Durham, US) and Orit Shaer (Wellesley College, US)

On Friday, June 11, the Dagstuhl seminar hosted a panel entitled "The future of creative teams." The panelists were two distinguished researchers, each of whom explores creative teamwork, and each of whom focuses on a different set of questions related to creativity and the future of (team) work.

The panel started with the two panelists each responding to the following question: "What is the future of creative teams through the lens of HCI?" After the panelists provided their responses, we proceeded with questions from the participants of the workshop, in which panelists elaborated on their main points. Below, we briefly introduce the two panelists and the central message they conveyed in the panel.

Panelists:

1. Mark Gross
   - Bio: Professor, University of Colorado, Boulder. Director of ATLAS Institutie. He is an expert on robotics, design, and tangible interaction.
   - Message: Creativity craves constraint. Diverse teams yield better outcomes. Focus on fun first.

2. Amon Millner
   - Bio: Associate Professor, Olin College. His research focuses on extending access to STEM empowerment.
   - Message: We must understand pre-existing and future social structures that surround how creative teams are formed, and influence (or even determine) the tools they use to carry out their work. How can we leverage all that we learned during the pandemic disruption to chart more equitable creative spaces and practices moving forward?

5.2 Report on the "Online Platforms and the Future of Work" panel

Andrew Kun (University of New Hampshire – Durham, US) and Orit Shaer (Wellesley College, US)

On Friday, June 11, the Dagstuhl seminar hosted a panel entitled "Online Platforms and the Future of Work." The panelists were three distinguished researchers, each of whom explores online platforms from the perspective of work, and each of whom focuses on a different set of questions related to these platforms.

The panel started with the three panelists each responding to the following question: "How will we, and/or how should we, use online platforms for the future of work?" After each of the three panelists provided their response, we proceeded with questions from the participants of the workshop, in which panelists elaborated on their main points. Below, we briefly introduce the three panelists and the central message they conveyed in the panel.

Panelists:

1. Jennifer Golbeck
   - Bio: Professor, University of Maryland, College Park. She is an expert in social networks, social media, privacy, and security on the web. She is also a content creator on various online platforms including Twitter and TikTok.
   - Message: Building an effective, engaged presence online – especially on social media – is a lot of work that's often dismissed. We need to value the content creation process more.
2. Neha Kumar
   - Bio: Associate Professor, Georgia Tech. Her research is at the intersection of human-centered computing and global development, and she works on technology design for/with communities that have historically been underserved.
   - Message: How do we ensure equality when workers use online platforms? Who are we leaving out and who are we keeping in, in the design of these online platforms?
3. Saiph Savage
   - Bio: Assistant Professor, Northeastern University. She is an expert on online labor platforms.
   - Message: We need auditing mechanisms to be able to understand what is happening inside online labor platforms. This is crucial to push for change (we need to understand problems that exist and also tways to put pressure on online labor platforms.)

6 Open problems

6.1 Summary and Next Steps

Andreas Riener (TH Ingolstadt, DE), Stephen Brewster (University of Glasgow, GB), Andrew Kun (University of New Hampshire – Durham, US), and Orit Shaer (Wellesley College, US)

With this Dagstuhl seminar, we set out to accomplish three goals. Here we review these goals and report on our progress towards accomplishing our original goals.

6.1.1 Overview of state-of-the-art technologies, methods, and models

The workshop was highly successful in providing both breadth and depth to attendees in reviewing the state-of-the-art in HCI for the future of work in mobile environments. Participants provided reports on their own work, and additionally five world-class experts from our community provided information on where technologies, methods and models are today.

6.1.2 List of challenges and hypotheses

Workshop participants identified several overarching challenges, as well as a long list of specific challenges. The overarching challenges centered around three issues. First, we focused on the algorithmic bias in how tools are designed for the future of work. These were underscored both from the discussions in our own meetings, and as we viewed the "Coded Bias" documentary. Second, we also focused on the global inequity in access to the knowledge and tools that will create and enable the future of work. Third, we discussed the lack of understanding how future work arrangements can help and hurt worker productivity, creativity, and very importantly, their wellbeing.

The list of specific problems included a host of problems in designing a broad swath of human-computer interfaces, not having information on how online platforms monitor, reward, and punish gig workers, and not having sufficient understanding of how the sudden change in work that was imposed by the COVID-19 pandemic affected workers, and what the long-term effects of this change will be.

We also worked towards formulating hypotheses to start the work of tackling the above challenges. Our work included both discussions about very specific problems, such as how to support a particular important activity (such as work in future automated vehicles), to how we can contribute to progress on overarching problems. The hypotheses that we discussed were focused on specific problems. One example is the suggestion of Saiph Savage that we need audit mechanisms for online platforms to effectively support gig workers. Another example is that, to support workers in future automated vehicles, we need to introduce user interfaces based on speech interaction, augmented reality, and tangible interfaces.

6.1.3 Roadmap(s) for research

Throughout this seminar we kept asking "which way do we move forward, together?" One avenue that we will pursue is to maintain the cohesiveness of the group that was assembled (virtually) for this Dagstuhl seminar by engagement in follow-on activities, such as the CHIWORK 2021-2022 symposium (www.chiwork.org). This symposium will feature weekly conversations on the topic of HCI and the future of work and wellbeing. We plan to continue our Dagstuhl conversations at this symposium.

We are also continuing to pursue international scientific collaboration that was supported and inspired by this Dagstuhl seminar. Along these lines, the two US-based organizers, Shaer and Kun, submitted a grant request to fund research experiences for US students to visit Germany. Two co-organizers (Riener and Kun) joined forces with a researcher from Japan and the head of the US-based research arm of the American Automobile Association (AAA) to propose another related Dagstuhl seminar. And Riener continues his collaboration with Shaer and Kun on exploring in-vehicle interfaces for work in automated vehicles – within this collaboration Kun is planning a visit to Riener's lab in the summer of 2022.

6.1.4 And one more goal – exploring best practices for remote, weeklong collaboration

This Dagstuhl seminar was conducted fully online, bringing about 30 researchers together to productively discuss the future of human-computer interaction for work in mobile environments, This was not an hour-long collaboration, or even a half-day workshop. Rather, this was a 5-day engagement with participants joining activities from all across the globe. This gave the organizers and participants an opportunity to think about best practices for organizing a key aspect of remote meetings. These meetings will likely affect our future of work deeply – work that will likely be global, collaborative and creative. Thus, we all thought about time zones (who should wake up when?), Zoom etiquette (who should talk, when, for how long?), collaboration tools (such as Miro, movie watch parties, and messaging apps), how to present information in online meetings (talks or conversations?), and how to write this report together (asynchronous vs. synchronous collaboration). We don't have the answers to all of the questions. And we know that some aspects of Dagstuhl cannot be replaced by virtual platforms (we really want to climb the hill to the castle ruins again, and we want to spend time chatting with colleagues in the music room). But this 5-day online seminar did what we have come to expect from in-person Dagstuhl seminars: it connected us to colleagues, it allowed us to come up with new ideas, and it taught us something unexpected (yes, we expect the unexpected from Dagstuhl). This unexpected things was that if we carefully organize them, we can have VERY productive, and even enjoyable, multi-day engagements online with a global group of collaborators. Thank you Dagstuhl for allowing us to learn this key lesson.

Remote Participants

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- Gary Burnett
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