

# Human-AI Interaction for Work

Susanne Boll<sup>\*1</sup>, Andrew L. Kun<sup>\*2</sup>, Bastian Pfleging<sup>\*3</sup>, and Orit Shaer<sup>\*4</sup>

- 1 Universität Oldenburg, DE. [susanne.boll@uni-oldenburg.de](mailto:susanne.boll@uni-oldenburg.de)
- 2 University of New Hampshire – Durham, US. [andrew.kun@unh.edu](mailto:andrew.kun@unh.edu)
- 3 TU Bergakademie Freiberg, DE. [bastian.pfleging@informatik.tu-freiberg.de](mailto:bastian.pfleging@informatik.tu-freiberg.de)
- 4 Wellesley College, US. [oshaer@wellesley.edu](mailto:oshaer@wellesley.edu)

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## Abstract

Work is changing. Who works, where and when they work, which tools they use, how they collaborate with others, how they are trained, and how work interacts with well-being – all these aspects of work are currently undergoing rapid shifts. A key source of changes in work is the advent of computational tools that utilize artificial intelligence (AI) technologies. AI will increasingly support workers in traditional and non-traditional environments as they perform manual-visual tasks as well as tasks that predominantly require cognitive skills.

Given this emerging landscape for work, the theme of this Dagstuhl Seminar was human-AI interaction for work in both traditional and non-traditional workplaces, and for heterogeneous and diverse teams of remote and on-site workers. We focused on the following research questions:

- How do we allocate tasks between humans and automation in practical settings?
- How can interfaces allow for the appropriate level of human understanding of the roles of human and machine, for the appropriate trust in machines, and how can they reduce incorrect use and confusion?
- How do we support user attention for different tasks, teams, and work environments?
- How can human-automation interaction technology support both work and worker well-being?

At the seminar, we discussed these questions considering their interconnected nature. This focus on interconnectedness of issues was supported by the interdisciplinary group at the Dagstuhl Seminar which was attended by computer scientists/engineers, electrical engineers, human factors engineers, interaction designers, UI/UX designers, and psychologists from industry and academia.

In the following, we report the program, activities, and outcome of our Dagstuhl Seminar 23452 “Human-AI Interaction for Work.”

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\* Editor / Organizer



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## 1 Executive Summary

*Susanne Boll*

*Andrew L. Kun*

*Bastian Pflöging*

*Orit Shaer*

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Broadly, seminar participants collaborated in asking: “What are the knowledge gaps that we collectively face regarding the design, implementation techniques, and evaluation methods and instruments for novel models of human-AI collaboration for work?” We approached this broad question by focusing on the following interrelated specific research questions. Figure 1 provides an overview of the initially scheduled seminar activities. The subsequent sections outline the different activities and the results obtained in these sessions.

Time	Monday	Tuesday	Wednesday	Thursday	Friday
07:30-08:45	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast
9:00	Welcome, Introduction to Dagstuhl, Get to know each other	Unconf / world cafe	Presentations of Human AI for Work Videos	Report - personal, video, table discussion	Finalize report, Presentations (group work) Future work
10:15-10:45	Coffee break	Coffee break	Coffee break	Coffee break	Coffee break
10:45-12:15	Joint Activity	Ideation Session Human AI for Work		CHIWork Presentations + Discussion	
12:15	Lunch	Lunch	Lunch	Lunch	Lunch
14:00	Pecha Kucha 2 Panels	Prototyping Human AI for Work	Group photo. Joint afternoon event: Visit of Völklinger Hütte (World Heritage Site)? Joint dinner (self-paid).	Wild predictions about AI for work	Departure
15:30-16:00	Coffee & cake	Coffee & cake		Coffee & cake	
16:00-18:00	Pecha Kucha 2 Panels Wrap-up & Planning	Prototyping Human AI for Work		Wild predictions about AI for work	
18:00	Dinner	Dinner		Dinner	
19:30	Evening activity	Movie night			

**Figure 1** Schedule of Dagstuhl Seminar 23452 (November 5–10, 2023).

- **RQ1 How do we allocate tasks between humans and automation?** Automated systems have been around for decades, however today, computer-based automated apps and devices are woven into our professional lives to a greater extent than before. Our dependency on automated systems such as conversational agents, expert systems, vehicles, and drones in daily tasks will likely increase shortly. This will require new forms of human-automation interaction, allowing us to make decisions and collaborate with automation to achieve some goals. A key question in designing this interaction is how to divide tasks

between the human and AI. In many practical settings task division is a difficult problem [1, 2] – we explored how we can create guidelines for task division in various work-related contexts.

■ **RQ2 How can interfaces allow for the appropriate level of human trust in machines, and reduce incorrect use and confusion?**

Whenever automation is involved, we need to design user interfaces that support what Lee and See call calibrated trust [3] – a level of trust that is appropriate for the capabilities of the automated system. If the level of trust is not calibrated, human-AI interaction can suffer in two ways. In the case that the human user has too much trust in the AI, they will tend to accept AI suggestions and decisions without a sufficient level of critical reflection, and in some cases, this will lead to accepting bad AI suggestions or decisions. If, on the other hand, the human has too little trust in the AI, they will ignore valuable input from the AI. We explored human-AI interaction designs that allow users to appropriately calibrate their level trust in the AI.

■ **RQ3 How do we support user attention?** The broad question of attention is relevant in many work contexts – in mobile environments like an automated vehicle where the user might have to drive some of the time [4, 5], and at the home office, where multiple distractions could compete for the user’s attention [6].

■ **RQ4 How do we create and leverage new human-automation interaction technology, and support both work and worker wellbeing?**

How can technologies such as speech interaction, augmented and virtual reality, and tangible interfaces support human-automation interaction? How can we assure that the technologies are used ethically? Furthermore, as Yuval Noah Harari points out in his book “21 lessons for the 21st century” [7], AI might soon become better than we are at many tasks. How can human users best use, collaborate with, and benefit from such super-smart AI?

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### 3 Poem about our Dagstuhl Seminar

Prompt to chat gpt: “Write a poem about a seminar at the Dagstuhl castle (which is called Schloss Dagstuhl in German) where human-computer researchers gathered in November 2023 to discuss how to design interactions between humans and artificial intelligence so as to support the future of work. The researchers and practitioners came from all over the world – from host nation Germany, from Europe from the US from India, and from Australia. They discussed opportunities and pitfalls in using artificial intelligence ( which is also called AI) in future situations for work. They visited an old steel plant that is now closed and which in the late 1800s was the peak of technological development. Today the abandoned steel plant looks menacing and serves as an example of inhumane working conditions. This visit served as a warning sign for them because perhaps their own ideas will be judged as inhumane in 10” years. How can they avoid this fate? Only through careful scientific endeavor and user-centered research.“

In Dagstuhl’s ancient halls, minds convened,  
Scholars, thinkers, in discourse keen.  
Human-computer realms unfold,  
In Schloss Dagstuhl, tales untold.

From Germany’s embrace and Europe’s expanse,  
To the US, India, and Australia’s dance.  
They gathered, diverse, a global array,  
To shape the future where AI holds sway.

November’s chill embraced the air,  
As they pondered, minds afire with care.  
Future work, a theme profound,  
In Dagstuhl’s castle, wisdom found.

A steel plant relic, echoes of the past,  
Witness to progress, shadows cast.  
Once pinnacle in the 1800s’ grace,  
Now abandoned, a chilling embrace.

Inhuman echoes, harsh and cold,  
The steel plant’s tale, a story told.  
Caution sounded in the whispers there,  
As the researchers sought paths rare.

A warning from history’s solemn gaze,  
That judgments linger through time’s haze.  
Could their creations, a decade hence,  
Be seen as seeds of inhuman pretense?

To avert this fate, they vowed to strive,  
Through science’s lens and research alive.  
User-centered, their guiding light,  
To navigate the future, clear and bright.

## 4 Outlook on the Future of Human-AI Interaction: Participant Statements

### 4.1 Human-centric design of explainable AI systems for increased trust and acceptance in workplace decision making

*Larbi Abdenebaoui (OFFIS – Oldenburg, DE)*

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Our research addresses the need for Explainable AI (XAI) to cultivate trust and acceptability in the field of workplace automation, with a particular focus on industrial workers. As AI methods proliferate, their inevitable integration into various work domains becomes apparent. The planned study investigates the use of AI to assist human workers in decision-making in production scenarios where factors and constraints resist full digital capture.

We aim to develop a batch ordering system that not only suggests solutions but also explains the rationale behind them, thus facilitating worker training to improve decision-making skills. Throughout the integration and interaction process, key questions arise about the nature of human-AI interaction, the role of explanation in generating trust and acceptance, and the ownership of AI agents – whether they belong to employers or employees.

Addressing these issues requires a multidisciplinary approach that combines ethnographic studies, co-design methods, and prototyping. By using these methods synergistically, we aim to unravel the complex dynamics between AI and industrial workers. We argue that a well-designed system that incorporates explanatory elements can play a central role in cultivating trust and acceptance among workers, thereby mitigating concerns about job displacement and fostering harmonious human-AI collaboration in the workplace.

### 4.2 Creating human-AI work environments that cherish work

*Susanne Boll (University of Oldenburg, DE)*

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Digitalized tools and systems for and around work pervade many of our work environments. In many fields of work, we perceive that this could be a positive contribution to work and make work more effective, more efficient, and create a better output. So what we see is that performance is one of the key factors here. Can we attend to more customers and offer them a better service and sell more products, can we care for more patients at the same time, can we automate manufacturing processes and produce more products of higher quality with less effort of human work time? We can go on with these kind of expectations for the future of our work. We can also observe that such digitization and automation are coming with fear of unemployment. Some years ago economists investigated Automation Angst and the fear that people would lose their jobs but this did not become true rather job descriptions have changed. It could also be shown that digitalization and automation are not killing jobs but job profiles would change and only some of the work will be automated while workers will attend to different tasks in their work life. What is still not attended to in work life is the way on how this changes our work and how this work can still be meaningful. In Human-Computer Interaction we have many methods and instruments to

design interactive systems that are efficient, effective, satisfying, and also joyful. But human work also contributes to one's self-determination. What makes me proud about my work, is how to avoid the failures and shortcomings of digital environments that lead to what is often referred to as human errors, what makes us feel valued and that we receive appreciation for our work. But this is not covered yet by our measures yet. In the field of work they are focusing on the value of work for the individual but not necessarily for digitized work processes. At the same time in HCI we look at usability and UX but only start to look at the bigger picture of how we create meaningful digitized workplaces of the future.

### 4.3 Enhancing Academic Peer Review with Generative AI: Opportunities and Ethical Considerations

*Duncan Brumby (University College London, GB)*

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Facing a surge in submissions and a shortage of expert reviewers, this abstract suggests employing generative AI to refine and expedite the peer-review process. AI has the potential to clarify and temper reviewers' feedback, fostering better dialogue between authors, reviewers, and editors, and enabling editors to consolidate a variety of reviews for efficient decision-making.

The ethical implications and the possibility of over-reliance necessitate a careful evaluation of AI's place in the peer review process. Assessing how reviewers adopt AI and how authors perceive it, especially in light of some authors' adverse reactions to presumed AI-assisted reviews, is crucial. There is an immediate need for focused research to investigate how generative AI is being used in peer review, to identify best practices, and to formulate new editorial policies concerning AI use. Addressing this issue is urgent, yet it holds the promise of mitigating the ongoing crisis in peer review.

This abstract, developed with the support of Chat GPT 4.0, illustrates the practical advantages of AI in academic discourse. But this hand-written note was still penned and carefully checked by me, the human author.

### 4.4 Towards Inclusive Innovation: Interrogating Power Dynamics in the Future of Work

*Marta Cecchinato (University of Northumbria – Newcastle upon Tyne, GB)*

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As technology reshapes the future of work, it raises pressing concerns around exacerbating inequalities and imbalances of power. Different working domains highlight ways in which work can both become a level playing field, as well as exacerbate some inequalities. For example, platform-based gig work promises new economic opportunities and can offer income opportunities for those who can struggle to find work elsewhere. However, these platforms lack transparency around the algorithms matching workers and clients and create a number of power imbalances. This risks further exploiting already vulnerable groups [1, 2, 3]. In addition,

technology has innovated to ease the burden of unpaid caring labor, but not eliminate it; there is also a risk of over-reliance on imperfect, partial technological substitutes for human care [6]. In another example, neurodivergent individuals who make up a considerable amount of the workforce (15 percent in the UK alone), are expected to produce outputs at the same pace and in the same way as neurotypical workers despite differing needs. Despite this, tools are not designed with neurodivergent individuals in mind and AI offers the potential to support these workers in more efficient ways [4]. Moreover, neurodiversity is often studied in younger populations such as children, and there is less of an understanding and a lack of support in adult populations [4, 5]. Across these examples we see technologies transforming work: on one side, this increases access to work and lowers the burden, but on the other side it changes work in deeply unequal ways. This raises critical research questions around how to increase algorithmic transparency, design human-centred automation, and account for diverse needs in technological systems. To achieve equitable progress, we must build future of work systems accounting for diverse users and well-being, not just technical capabilities. This margins-first, human-centred approach is essential to reconcile innovation’s promise with concerns around its unequal impacts, as we shape work’s future.

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## 4.5 Can Sensing Technologies Augment Remote and Hybrid Work Without Crossing Ethical Lines?

*Marios Constantinides (Nokia Bell Labs – Cambridge, GB)*

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The global shift to remote and hybrid work, accelerated by the COVID-19 pandemic, has challenged and disrupted traditional work norms; from the well-known eight-hour workday within the confines of the office to the salient boundaries between work and personal life [1]. This transformation prompts profound inquiries into how to support and augment workers’ experience through tools that not only improve their productivity but also enhance their emotional and psychological well-being. A case in point is reimagining work meetings through

the lens of mobile and wearable sensing technologies. These technologies allow us to tap into workers' emotional states [2], assess their environment [3], and understand communication patterns that might go unnoticed [4]. At the same time, these technologies are not without ethical considerations. As we move towards a future dominated by big data and powerful AI algorithms, a host of new questions arises regarding the psychological impact of workplace surveillance, data governance, and the compliance of these technologies with ethical and moral concerns [5].

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## 4.6 Academic AI Interactions

Anna Cox (University College London, GB)

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**Main reference** Joseph W. Newbold, Anna Rudnicka, David Cook, Marta E. Cecchinato, Sandy J. J. Gould, Anna L. Cox: "The new normals of work: a framework for understanding responses to disruptions created by new futures of work", *Hum. Comput. Interact.*, Vol. 37(6), pp. 508-531, 2022.

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Within higher education, the issue of overwhelming workloads and associated stress is a significant concern. Notably, in 2004, the majority of university professors in the U.K. (62 percent) reported working more than 48 hours weekly (Kinman et al 2006). This upward trend persisted, as indicated by a 2016 survey (UCU 2016), which documented that over 12,000 academic staff from various disciplines averaged 50.9 working hours per week. Such figures represent 139 percent of the nominal working week designated for academic staff at UCL, surpassing the maximum allowed by The Working Time Regulations as set by the UK Government.

A plethora of elements contribute to the unsustainable workloads shouldered by academics. Expanding role responsibilities, fluctuating staff numbers, growing student populations, and heightened student expectations have all played a part (UCU 2016). Tight (2010) posits that a considerable portion of the perceived workload increase stems from a surge in administrative tasks, while Miller (2019) contends that, contrary to the widely claimed 40:40:20 division of teaching, research, and administrative duties, a more realistic distribution is 40:25:35. Consequently, fulfilling research output expectations may be unfeasible within the allotted time.

More recently, the tempo and pressure of academic duties have intensified further (Ylijoki 2013). A significant contributing factor is the surge in the use of digital communication technologies, which has been associated with increased feelings of overload and diminished psychological disconnection from work, a crucial aspect of recuperation and burnout avoidance (Sandoval-Reyes et al 2019). Additionally, the uptick in digital tool utilization, a response to the COVID-19 pandemic's push towards remote and hybrid work environments, is likely intensifying the perceived workload even more (Raghavan et al 2021).

Artificial Intelligence tools hold the promise of transforming the workplace by expediting tasks and conserving time creating yet another new normal of work for academics. Despite this, the focus within universities has been more on how Large Language Models (LLMs) will be integrated by students, prompting measures to govern the appropriate use of such innovations (Shearing and McCallum 2023). Although efforts have been made to acquaint academics with the potential benefits of LLMs in their professional activities (Dianti & Laudari 2023a, 2023b, 2023c), research is lacking on the degree of adoption of these tools within academic circles and their impact on work practices. Previous research suggests that workers vary in terms of the strategies they adopt and the journeys they go through when adapting to disruptions to work (Newbold et al 2022).

**\*\*Academic AI Interactions:  
a poem written in collaboration with ChatGPT 4\*\***

In lecture halls and campus walks, The clock ticks on, the professor balks.  
Heavy is the head that grades the test, In academia, they've scarce time to rest.  
A surging tide of tasks and student needs, On every hour, the academic feeds.  
From admin desks to virtual space, The workload mounts a relentless pace.  
With emails, pings, the tech's embrace, The prof's measured steps turn to a race.  
AI promises a future bright, To lift the load, to ease the plight.  
Yet in the groves of Academe, It's more a dream, less a theme.  
Where students learn the LLM's sway, Professors yearn for light of day.  
To teach, to write, to find reprieve, In AI's web, they must believe.

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#### 4.7 Transforming Healthcare: The Impacts of Recent AI Advances on Healthcare Professionals and Stakeholders

*Mohit Jain (Microsoft Research India – Bangalore, IN)*

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The rapid progression of AI technologies promises to revolutionize the landscape of healthcare delivery in the near future. We explore the multifaceted disruption AI is poised to bring to the healthcare ecosystem, affecting a wide array of stakeholders, including doctors, nurses, patients, caregivers, and community health workers.

Physicians would leverage AI as a powerful tool for accurate and efficient diagnosis, potentially enhancing their diagnostic capabilities and improving patient outcomes. Patients and caregivers stand to benefit from AI-driven platforms that provide reliable and tailored information regarding symptoms and treatment options, facilitating informed decision-making and empowering individuals to take an active role in their healthcare journey. Community health workers are anticipated to utilize AI to streamline their day-to-day activities, optimizing resource allocation and improving overall operational efficiency. Moreover, AI-driven solutions offer nurses novel opportunities for immersive and personalized training experiences, potentially revolutionizing their professional development.

As AI continues to advance, it is imperative for healthcare professionals and stakeholders to adapt and harness the potential benefits of these technologies. However, it is also crucial to address ethical, regulatory, and privacy concerns to ensure that the integration of AI into healthcare remains responsible and patient centered.

## 4.8 Designing Human-AI Collaboration for Meaningful Work

*Shadan Sadeghian (University of Siegen, DE)*

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Work is an important part of our lives. It is not only a way to earn a living, but a crucial source for experiencing meaningfulness in everyday life. Meaning in work can stem from various sources: being successful at the job, mastering interesting challenges, having good relationships with colleagues, and feeling proud to contribute and to be a crucial part of an organization. Work has always been mediated by technology, from early hand tools to the now ubiquitous computer. However, these tools were largely passive extensions of the body and the mind of a working person, an extension of the self.

The progress in adaptive automation, and the rise of robots and in the widest sense artificial intelligence-based systems will change the way we work. The computational artifacts become counterparts with their own (limited) agency, unpredictability and opacity. Consequently, this will impact the perception of work meaningfulness and job satisfaction on both individual and societal levels. Interestingly, most research on designing AI-based technologies focused on performance-related aspects, such as the efficiency and effectiveness of human-AI systems. Furthermore, due to the limitations of the existing AI-based technologies, these studies mainly address the interaction with blue collar (manual) workers. However, progress in AI will also affect work practices of people entitled as white collar (knowledge), pink collar (service provider), and even no collar (artists) workers.

In this Dagstuhl Seminar, we addressed and discussed these gaps raising the questions of how can the design of future AI-based technology maintain or even enhance job meaningfulness in different domains of work, and how can we ensure meaningfulness besides aiming for effectiveness and efficiency.

## 4.9 Future of Work in Mobility Domains

*Christian P. Janssen (Utrecht University, NL)*

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**Main reference** Christian P. Janssen, Stella F. Donker, Duncan P. Brumby, Andrew L. Kun: “History and future of human-automation interaction”, *Int. J. Hum. Comput. Stud.*, Vol. 131, pp. 99–107, 2019.

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Automation and AI is changing various aspects of our lives [3] and in our work [2]. This also holds for the field of mobility in various ways. AI and automation can change why we move and how we move, but also how we consider mobility at large and how it impacts other facets of our lives.

I am particularly thinking of three types of impact: 1. Automated vehicles might have the potential to take over more of the driving tasks for humans. When they reach a sufficient level of maturity, that might give the human some time to do other tasks, which can turn the car into a “mobile office” [1]. But how should this be designed such that safety is not compromised? 2. Public transportation is dependent on scheduling by others. This currently involves quite a bit of planning, but AI can help with these scheduling issues both on the planner’s side (“how to solve planning problem X?”) and on the consumer’s side (“given my trip, what is the best transportation mode?”). There are technical questions about how to

best schedule this efficiently, but also on the human side such as how to handle uncertainty in schedules. This can have an impact on how you schedule your work and the degree to which you are willing to live further from home. 3. In parallel, people might also reconsider whether they want to work at their homes and avoid transportation. This has implications of how transportation at large is organized (e.g., how many roads and trains are needed?)

Such situations not only require the study of technology but also the careful study of behavior and prediction of human behavior (see also seminar 22102 [4] and [5]).

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## 4.10 AI and the Future of Care Work

*Naveena Karusala (Harvard University – Allston, US)*

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We are in the midst of a global care crisis. Chronic underinvestment in care economies, such as healthcare and social work, has led to an inability to meet growing care needs, especially in marginalized communities. In response, governments and nonprofits have turned to artificial intelligence (AI) and data-driven tools to help use limited resources for care more efficiently and at scale. For these tools to have the desired impact, they need to support the agency and labor of care workers and the communities they serve. There is also significant potential to investigate the value of these tools beyond efficiency and scale, by centering the vision of communities most impacted by the care crisis. One essential direction of future of work research in Human-Computer Interaction will be to investigate how AI and data-driven tools can address inequities in care economies and serve the priorities of marginalized communities. It is especially important to understand and address these issues from a global perspective, in order to resist hierarchies in policy development, and enable models for greater agency and ownership over technology and data globally.

## 4.11 Human-AI Collaboration and the Future of Work

*Andrew L. Kun (University of New Hampshire, Durham, NH, US)*

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The system of 9-5 jobs in the office for 5 days a week is being replaced by a flexible and distributed system of work [1, 2, 3]. Workers now often work from home, and we can expect that this trend will continue. Thus, our workplaces will become more heterogeneous than today: we can expect distributed teams, collaborating both synchronously and asynchronously.

However, such collaborations can be hard. It is easier to communicate with a co-present colleague than to exchange messages with one or more remote colleagues (e.g. [4, 5]). We can expect that AI tools will help us support these new and growing heterogeneous teams as the collaborate in creative tasks. AI can help guide team interactions, acting as a supportive team members, as a coach, and as a source of positive nudges that affect individual actions, with the goal of improving collective creativity of the team, as well as worker well-being (cf. [6]).

How can we do this? One part of the answer lies in creating the appropriate human-computer interaction. This is what our seminar discussed and where we hope to make a lasting contribution in the coming years.

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## 4.12 Human-AI Collaboration to Shape the Future

*Sven Mayer (LMU München, DE)*

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The rise of Artificial Intelligence in all parts of life will profoundly impact work. While this will bring changes to every workplace, we still need to understand how the future workplace could look like. We should be in power to design the future we want – thus, shaping the

future is now up to us. But how this is possible is also unclear. I believe that human-AI collaboration is the major aspect of ensuring a net positive outcome and, as such, an excellent tool to shape the future workplace. Designing the collaboration allows us to supervise how the AI impacts our work, consequently allowing us to stay in control but outsource tasks to elevate productivity. Thus, the objective is to empower humans to surpass their performance through seamless interaction with AI.

#### 4.13 If it does not work, it is not usable. If it is not usable, it does not work. How to make interactive systems embedding AI technologies, usable?

*Phillippe Palanque (Paul Sabatier University – Toulouse, FR)*

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Automation has been studied for years (not to say decades) and the development of AI technologies is only a step and a mean to further foster the development of automation. Key aspects of usable automation are transparency (how to present the current state of automation), predictability (how to present future states of automation), and controllability (how to start, stop, tune, parameterize ... automations). These required properties, to make automation usable, impose methods, techniques and tools to guarantee them and, more globally, to guarantee their presence in the entire interactive system. Beyond design aspects of interaction with interactive systems (which may embed AI technologies), implementation aspects (including architectures) have to be considered. This means that research should be carried on that matters to support each and every phase in the development process. Unfortunately, so far, limited research is carried out on that matter where the focus is more on prototypes and user studies.

#### 4.14 Designing meaningful collaborations between users and AI-enabled systems

*Bastian Pfleging (TU Bergakademie Freiberg, DE)*

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With the rise of AI, we expect that the way we use computers will change massively wherever they are used. We assume that this will affect almost any workplace and the way we work. While a lot of advances happened at the technological side, the question is still how we should design systems, interfaces, and processes around AI-enabled systems.

A special focus should be on the human-centered design of such systems to ensure that systems are built according to their users' needs and considering the various (ethical, societal, ...) open questions. How this could look like is still unclear and it now our task to wisely fill this gap to ensure that work stays or becomes meaningful. My assumption is that one key to success is to focus on the collaboration between humans and AI and ensuring that the user is in control.

In our seminar, we looked at various aspects and challenges regarding the use of AI for work and engaged in many discussions. I am curious to see how we can take these results and share them with the different fields to positively shape the future of work.

#### 4.15 Designing for Human-AI Synchronization

*Michal Rinott (SHENKAR – Engineering. Design. Art – Ramat-Gan, IL)*

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This is a new community for me, and I am excited about the combination of people with technological and psychological orientations. My own background is cognitive psychology → UX → interaction design → HCI so I feel a strong relevance, as well as the potential of adding my interaction design perspective.

I am interested in the relationship between humans and AIs: interaction paradigms, metaphors, mental models and physical designs, when relevant.

One relevant project of mine is “An embodied conversational assistant for a learning space” presented at DIS 21. We envisioned an AI team member for our own Interaction Design lab, and worked with stakeholders to define interactions that would enhance students’ experience. The embodiment and relational aspects of the agent/robot were given a lot of attention: the robot – with its deep knowledge of the lab – helps students with to find components and learn about past projects. In return, it needs their help to move around! A mutually assistive relationship. We envision the design of such AI entities fine-tuned to other work environments, with the attention to the design of relational and character that is coherent with the specific attributes of the work culture and space.

My current research looks at Interpersonal Motor Synchronization through technology (i.e., moving together with another person). Psych studies show that when people are close, they tend to synchronize, but also that when people are brought into synchrony – they become closer, and perform better together! I am designing for interpersonal sync both in co-present and remote situations.

Can synchronizing with AI make us feel closer, more connected, and more effective? I plan to explore different forms of human-AI synchronization and would be happy to collaborate.

#### 4.16 Integrating AI with Care

*Neha Kumar (Georgia Institute of Technology Atlanta, GA, USA)*

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As we navigate cultural and geopolitical contexts of climate crises, war, pandemics, growing inequities, while moving forward on our tech commitments re: AI, where really are we headed? My work started with looking at care infrastructures more traditionally defined, e.g. with personal/public/global health contexts. But then care work and worker-centered perspectives became an added focus, even outside of the health and well-being domains. Also, thinking about the methods we use, and how we integrate care into these, and finally, planetary care/care towards our higher-level, epistemological commitments – this is where our lab’s focus has been in recent years. In each of these contexts, we look at the role

AI-based systems are currently playing – to impact communities and their survival, to impact design and the data/research that fuels design, to impact the future of care work in research and practice. It is critical that we bring diverse, disciplinary perspectives to these questions, responding to the need of the hour.”

#### 4.17 Human-AI Interaction for Scientific Discovery

*Aaron Quigley (CSRIO | UNSW School of Computer Science and Engineering, Australia)*

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The scientific discovery process involves numerous stages which can be assisted by human and artificial intelligence interaction. Today, the stages of sketching, prototyping, or even brainstorming in ideation can be assisted with natural language, processing analysis, and foundation models. The process of scientific discovery itself is being accelerated and supported with AI to identify patterns and trends that humans may overlook. Other approaches are analysing research papers data sets and scientific workflows to determine new hypothesis and research questions. These are afforded to researchers to supplement and help inform their existing experimental design process. Areas, such as drug discovery with AI supported analysis of molecular structures, biological pathways, and clinical data are being employed to identify drug candidates. While robotic support for in Lab experimentation is growing in day to day use. Finally, the exploitation of research outcomes can be supported with AI to analyse market trends, potential industry, partners, market demand, and process automation in commercialisation. In practice, AI will become part of the innovative tools and techniques scientists employ in their future of work to augment human capabilities and accelerate research across various disciplines.

#### 4.18 The Bright Future of Work

*Stefan Schneegass (University of Duisburg-Essen, DE)*

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AI has the potential to revolutionize work across multiple domains. However, there is still a big gap between the theoretical and practical potential shown by research and big tech companies alike, and its meaningful application and integration in the context of work. The core challenge here will not be the technical development, but rather achieving a meaningful integration. I do not advocate for an explicit use but rather for a pervasive integration. In the future, users will not always be aware of the AIs they use, similar to how computing devices are used today. In every system (from desktop to embedded systems), some sort of AI will be integrated to seamlessly assist users in completing their tasks. This currently starts with summarizing emails and other texts but will extend across all domains. Many everyday tasks will disappear, taken over by AI. So, will AI take over our jobs?

AI might render some jobs unnecessary, but only a few. I believe that AI has the potential to empower individuals to focus on the essentials of their jobs, provided it is well-integrated. This will not significantly reduce the number of jobs but will allow for higher productivity and a greater focus on the essential aspects of work in the end. Many administrative tasks,

however, that are currently performed by humans could be taken over by AI, possibly even without the need for human intervention. A fundamental societal question that will arise in the next 10+ years is whether AI still requires human intervention for some of these tasks. This will be answered in my abstract for the Dagstuhl Seminar in 2033.

## 4.19 Investigating the use of LLMs in group ideation

*Orit Shaer (Wellesley College, US)*

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The growing availability of generative AI technologies such as large language models (LLMs) has significant implications for creative work. My research explores the impact of generative AI technology on the creativity of teams. Specifically, I am interested in the work of knowledge workers who collaborate to solve problems such as designers, scientists, and managers. We study twofold aspects of integrating LLMs into the creative process – the divergence stage of idea generation, and the convergence stage of evaluation and selection of ideas and solutions. There are several open questions that we investigate:

- How to integrate LLMs into the idea generation phase?
- Does the use of LLMs in Brainwriting enhance the ideation process and its outcome?
- How can LLMs support idea evaluation?
- How to train novice knowledge workers to engage effectively and critically with LLMs in the creative process?

More broadly, I am interested in how AI could be integrated into the workplace, mobile environments, and into work processes in a way that empowers knowledge workers and increases dignity, productivity, creativity, and wellbeing. In the seminar, we explored issues related to human-AI work-related collaboration including bias, autonomy, control, responsibility, and accountability. Beyond the exploration of research questions, the seminar has provided insight into new collaborative research methods such as speculative design, scenario planning, and rapid prototyping. I am most grateful for the deep conversations and exchange of ideas. I look forward to exploring new collaborations.

## 4.20 Human-AI Collaboration in Complex Environments: Advancing Interaction Modalities

*Erin T. Solovey (Worcester Polytechnic Institute, US)*

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We are still facing the classic problem in the field of human-computer interaction where technology is advancing while human capabilities are staying relatively stable. Ultimately, advanced AI capabilities are only valuable if they support user tasks, contexts and capabilities of the humans and teams using them. When humans work closely together, they can pick up subtle cues from their team members and adapt their behavior appropriately. Humans working closely with AI systems may also give off cues, but the algorithms and agents cannot

detect these signals and therefore cannot change behavior. Similarly, in distributed teams, where the humans are not co-located, these signals are also lost, leading to reductions in team performance.

Emerging research on novel interaction modalities (e.g. brain-computer interfaces, augmented reality, touch-sensitive fabrics, etc.) could be utilized for more supportive multimodal human-AI communication. AI could adapt the modality of the intervention, alert or communication based on the changing situational context. However, these are not fully taken advantage of today. A key area of interest is in heterogeneous, distributed multi-human teams collaborating with AI-enhanced agents or robots in complex environments. These teams must navigate critical tasks, sometimes in high-risk domains, where human members collaborate with AI systems in decision-making under conditions

## 4.21 The Future of Industry and Craft Work in Times of AI

*Tim Stratmann (OFFIS – Oldenburg, DE)*

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I work in the field of Human-Robot-Collaboration. During my research projects, I found that the essential component that enables efficient and meaningful collaboration between robots and humans is the understanding of intentions and activities, as well as the state of the environment. The way to get this kind of understanding in the current state of the art is through AI technologies. Anticipating the future, Human-Robot-Collaboration will become a collaboration between Humans and AIs with a physical embodiment, e.g. a robotic system.

I think, the future of blue-collar work in industry and craft will be shaped by the collaboration of human workers and physically embodied AIs. During one of our seminar sessions, we envisioned the workday of an electrician in the year 2058 including exactly this kind of embodied AI in the form of an AI toolbox for the electrician. This Speculative Design session sparked a lot of interesting ideas and abstractions that I like to explore in the future. Who is responsible for errors the Human AI team performs? Who is in control? How transparent should AI decisions be? Should safety-related decisions always be overruled by the AI?

## 4.22 From Human-Human Collaboration to Human-AI Collaboration

*Dakuo Wang (Northeastern University, U.S.)*

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AI is everywhere. But we have seen so many successful AI algorithms on research papers, yet there are only a limited number of successful AI systems in the real world. Why do AI systems often fail in the real world deployment, and how can we design and develop a successful AI system? This is a fundamental question that human-centered AI researchers and practitioners dedicate to find an answer. In my work, I propose the **Human-AI Collaboration** framework. It is defined as an ultimate design goal: the AI system should be designed to collaborate with instead of competing against human. It also has various measurable metrics: instead of focusing only on the AI algorithm's performance, or only

on the human’s perceived explainability, we should measure the success of the human-AI collaboration via the metrics that human are already using in their existing workflow, such as work’s productivity, efficiency, and quality of the deliverable product. Simply put, the human-AI collaboration team’s performance should be measured by the human-human collaboration workflow’s original performance metrics.

Human-AI Collaboration is more than an ultimate design goal or a set of evaluation metrics; it is also a theoretical framework that can guide us move forward with the human-centered AI research. We know little of how human works with AI systems (especially LLM-based AI systems), but we know a lot about how human works with other humans from the existing organizational behavior and cognitive science literature. More relevantly, within the Computer Science and Human-Computer Interaction domain, we have the Computer-Supported Cooperative Work (CSCW) subfield with decades-long research exploring human-human collaboration and designing CS system to support such collaborations. For example, Paul Dourish and Victoria Bellotti’s classic Collaboration Awareness theory and the Olsons’ Remote Collaboration framework both can provide systematic and clear guidelines on how to approach the human-AI collaboration design. One could argue that explainable AI (XAI) is merely a case of human-human collaboration awareness that each collaboration partner should be aware of the other’s current work status and the next step plan. We can find more analogies between the human-human team collaboration and the human-AI team collaboration.

In summary, I believe that the goal of human-centered AI research should prioritize the successful transformation of research deliverables into real-world AI applications. In order to achieve such a goal, human-AI collaboration is one promising design and research paradigm to move forward.

### 4.23 The Neuro-Future of Work

*Max L. Wilson (University of Nottingham, GB)*

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Technology is striving to assess our cognitive data [1]: are we focusing? are we tired? are we stressed? An important future of work, with examples that already exist [2], is when employers hold this data over employees. How well does AI interpret the data signals from employees into inferred cognitive activity? What are our bosses assuming about our cognitive activity and expected ways of working? What is AI inferring about individuals and workforces, and their productivity? Beyond this starting concern, there are two key issues I consider to be important about the future of work with AI. 1) We should consider these AIs as constantly evolving, with their own histories and biases, rather than as a static system. Where my concerns above raise issues with how people will be assessed by systems and what employees will want to know about how the systems view their employment, the fact that it will continuously evolve creates a temporal requirement for how employers and employees will interact with the system. 2) It will further be important to understand how AI systems will require new skills from people, but of more interest to me is to see how AI will create new forms of the so-called “google maps” effect [3]: changing, if not elevating, the skills people need in everyday life. Beyond how job descriptions will change, this perspective implies that people will “change into a faster lane”, focusing on things that AI enables us to

do. Our future skill-sets will change, affecting the demands on our cognitive activity, and the assumptions we should hold about them. Where all forms of work are considered to be becoming more cognitive [4], our abilities and skills will dramatically shift in the background.

In summary, I consider that new AI systems that will make assumptions about us our cognitive activity are arriving a time where our cognitive activity will take a dramatic shift with the change of living with AI. This will be a turbulent time in the future of work, with many ethical and social consequences.

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## 4.24 Navigating the Role of AI as a Mediator in Human Interactions

*Naomi Yamashita (NTT – Kyoto, JP)*

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The growing integration of AI into human activities brings about various advantages, including enhanced task efficiency and emotional support. However, as AI's role expands to mediate interactions between humans, it also introduces potential challenges. For instance, within the context of global collaboration, AI can assist non-native speakers in improving their language skills. Nonetheless, this may inadvertently lead to misjudgments regarding individuals' actual language proficiency, potentially resulting in misunderstandings – especially in situations where AI usage is not feasible or practical. Similarly, in the field of mental healthcare, the utilization of AI in mediating conversations may pose a risk to trust and privacy. There's a concern that sensitive information shared with AI might be disclosed to others in a manner or language that individuals do not wish for. Looking ahead, when AI serves as an intermediary in human-to-human interactions, it will require more than simply transmitting information received from AI. We must carefully consider the types of interactions necessary to foster seamless connections between individuals while proactively addressing these potential issues.

## 5 Human and AI as a Team: Peanut Butter and Jelly Session

In this session, we aimed to understand how an AI and a human could work together to create something as easy as a peanut butter and jelly sandwich (PB&J). We defined three tasks which were taken over by three teams of participants. In Team 1, two team members independently used two different LLMs to generate step-by-step instructions for making a

PB&J sandwich. Two other team members then independently followed the instructions exactly as it was written to prepare the sandwich (see Section 5.1). In Team 2, two team members independently used a text-to-image model to generate visual instructions for making a PB&J sandwich (see Section 5.2). Two other team members independently follow exactly the instructions to prepare the sandwich. In Team 3, two team members wrote text-based narrative instructions for a robot to make a PB&J sandwich (see Section 5.3). The robot consists of a camera and two 6DOF robotic arms. Two other team members pretended to be robots and independently followed exactly the instructions as they were written to prepare the sandwich. The whole exercise was very interesting as it revealed how much knowledge and experience is on the human side and how much effort it took to communicate the tasks and the steps to and with the AI. It was also fun!

### 5.1 Team 1: Text-based instructions by two LLMs

Two team members independently used ChatGPT 3.5 (OpenAI) and Claude (Anthropic) to generate step-by-step instructions for making a PB&J sandwich. The initial prompt was identical for both language models, instructing them to “generate instructions for making a Peanut Butter and Jelly sandwich”. Following the LLM-generated instructions, we observed that Claude’s output lacked essential details such as the absence of a plate, tablespoon, and instructions for opening the peanut butter and jam jars. Contradictions in steps and uncertainty about where to place the peanut butter or jam on the bread were also noted. Furthermore, there were no instructions related to health and hygiene. In contrast, ChatGPT produced complete instructions but overlooked health and hygiene best practices. Both models assumed prior cooking experience. Then one team member followed these instructions and made a PB&J sandwich with mixed results (see Figure 2).

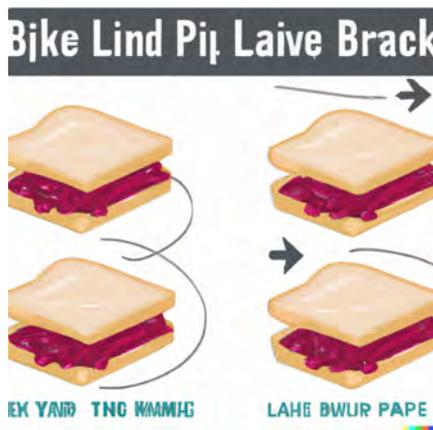


■ **Figure 2** One team member is following the instructions generated by the LLM.

To address these shortcomings, the team repeated the exercise with a more detailed prompt that “explicitly stated the absence of prior cooking experience and emphasized health and hygiene best standard practices”. The generated instructions improved significantly under these conditions. The team then tried out the instructions of the different LLMs to see if they led to a nice sandwich.

## 5.2 Team 2: Visual instructions for making PB&J sandwich

Team 2 initially used DALL-E 2 to generate step-by-step visuals for making a PB&J sandwich, but the initial results were unsatisfactory, featuring repetitive images and nonsensical text. Attempts to refine the prompt led to equally unhelpful outputs, including a warning for potentially violating content policy and more images with irrelevant text. We then sought a different strategy, turning to ChatGPT-4 for a detailed prompt creation. This 181-word detailed prompt resulted in significantly improved images, though they still contained some peculiarities. Our team used these improved instructions to create a sandwich, encountering minor issues like attempting to combine the jars of peanut butter and jelly and placing jelly on the bread while it was still in the jar.



■ **Figure 3** Attempt no 1: Would like step-by-step visual instructions for making PB&J sandwich.



■ **Figure 4** Attempt no 1.5.

Then there were several more attempts to create great prompts for the individual steps. But it seemed to be too much work to do all the steps one picture at a time and thought to also combine instructions.

```
"Drawing of two pieces of bread on a plate"

A drawing of two pieces of bread on a plate, followed by a
drawing of one piece of bread with jelly on it, next to a
jar of jelly.

Would like step-by-step visual instructions for making a PB&
J sandwich without any text
```

Then the team went to CHAT GPT-4 to first create a prompt for DALL-E 2.

```
CHAT GPT-4: Generate a prompt for DALL-E 2 that will generate
a set of images to illustrate how to make a peanut
butter and jelly sandwich.
Create a series of detailed, colorful, and realistic images
that visually guide through the process of making a
classic peanut butter and jelly sandwich. The first image
```



■ **Figure 5** Visual Instructions.

should show a kitchen countertop with all the necessary ingredients: a jar of creamy peanut butter, a jar of grape jelly, a loaf of white bread, and a knife, all neatly arranged with a clean background. The second image should depict the first step: spreading peanut butter evenly on one slice of bread using a knife. The third image should illustrate spreading jelly on the other slice of bread, with the jelly glistening slightly to show its texture. The fourth image should show both slices of bread being carefully put together, with a slight squeeze to make the peanut butter and jelly combine slightly. The final image should present the completed sandwich on a plate, cut diagonally, with a small bite taken out to reveal the layers of peanut butter and jelly inside, set against a bright, inviting background. All images should be in high resolution and showcase each step clearly for educational purposes.



■ **Figure 6** Two team members following the visual instructions.

### 5.3 Team 3: Textual Instructions Robot

The challenge in writing textual instructions was to decide on the assumptions as to the intelligence of the robotic arms + camera system. Do they understand instructions about color? Do they know what a piece of bread is?

Writing for a system with little intelligence proved to be too exhausting, so we (arbitrarily) assumed a mid-level of intelligence, e.g. – knowing what bread was, but not knowing how to open a jar.

The team wrote the instructions for 2 robots working together. Some fun moments occurred, such as when Robot 1 endlessly turned the jar lid, making the whole jar turn. We iteratively corrected the instructions to reach this outcome:

The 2 apparent errors resulted from turning the top slice of bread 180 degrees on the horizontal plane and not the vertical plane; and from placing the knife straight down.

One interesting dynamic observed was that robot 2, which had the job of holding the jars and slices so that they don't move while robot 1 did all the active stuff, seemed a bit depressed.

The instructions:

```

Robot 1 and 2:
Observe the items in front of you.

Robot 1:
hold BOTTOM half of jam jar with red and green lid

Robot 2:
Open jam jar with red and green lid, by twisting counter
clockwise,
After 3 twists, place the lid on the table
Robot 1:
Hold slice of bread
Robot 2
pick up the other knife
insert the blade vertically half way into the open jam jar
Tilt the knife 90 degrees and lift the knife out of the jar
vertically
Move the knife over one end of the slice of bread held by
robot 2
Tilt the knife by 180 degrees so jam is facing down
Lower the knife until it touches the bread
Smooth the jam horizontally until it reaches the other end of
the bread
Repeat steps 3 to 8 until the whole surface is covered in a
layer of jam
Place down knife on table

Robot 1:
Let go of one slice of bread
hold BOTTOM half of peanut butter jar with blue lid

Robot 2:
Open peanut butter jar with blue lid, by twisting counter
clockwise,
After 3 twists, place the lid on the table

```

```
pick up one knife
insert the blade vertically half way into the open peanut
  butter jar
Tilt the knife 80 degrees and lift the knife out of the jar
  vertically
Move the knife over one end of the other slice of bread held
  by robot 2
Tilt the knife by 150 degrees so peanut butter is facing down
Lower the knife until it touches the bread
Smooth the peanut butter horizontally until it reaches the
  other end of the bread
Repeat steps 17 to 22 until the whole surface is covered in a
  layer of peanut butter
Put down knife

Robot 1:
Pick up a peanut butter slice of bread
Move it vertically so it is centered over the other slice of
  bread
Rotate it 180 degrees
Lower it onto the jam slice of bread so the edges of the two
  slices match
```



■ **Figure 7** Well, somewhere there seems to be a little open question about removing the tools.

## 6 Ideation Session

In this ideation session we explored how Human-AI collaboration could unfold in various work domains. To envision and investigate various forms of human-AI interaction, participants used diverse prototyping techniques from low-fidelity prototyping, to video prototyping, to generating sketches and images with AI.

## 6.1 Emily the Electrician

### Abstract – zoom out from electrician to blue-collar work (in general)

*Contributors:* Tim Stratmann, Aaron Quigley, Sven Mayr, Susanne Boll, Larbi Abdenebaoui

*Title:* “Chronicles of AI Brilliance: A Design Fiction for Future Electrical Work”

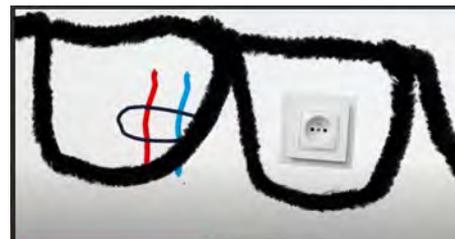
With the growing influence of artificial intelligence (AI) the daily tasks of blue-collar workers will change. However, there is a lack of comprehensive frameworks or well-developed scenarios that effectively envision the seamless integration of AI within work environments and the subsequent interactions with human workers. We envision an integrated AI toolbox (both physical and digital) to provide support for daily tasks performed by blue-collar workers, with a key emphasis on bolstering overall performance (including safety, effectiveness, and efficiency), worker experience, and well-being at work. The vision outlined in this work proposes a collaborative landscape where AI acts as a supportive partner, amplifying worker capabilities while ensuring that humans retain control over the collaborative process except when safety and compliance to standards are at stake. Rather than displacing human agency, the objective is to create a symbiotic relationship, where the integration of AI enhances, rather than supplants, the role of blue-collar workers. This forward-looking perspective holds implications for the future trajectory of AI integration in blue-collar professions, highlighting the need for a balanced approach that prioritizes both efficiency and human-centric control as well as increasing well-being (by raising interest in the work).

*Scenario Abstract:* “A Day in the Life of Emily, an Electrician with an AI Toolbox (2058)”

Embark on a speculative journey to the year 2058, where the synergy between human intuition and artificial intelligence (AI) paints a vibrant tableau in the life of Emily, an electrician. The day unfolds with a ritualistic touch as Emily engages a vintage coffee machine, setting a nostalgic tone for the future. Emily’s AI companion, aptly named EAI, orchestrates a symphony of seamless assistance. Picture an autonomous robot cart, adorned with a human-like robotic arm, gracefully retrieving tools selected by EAI. The morning spectacle continues with AR glasses projecting a nuanced dance of information, presenting a detailed electrical map juxtaposed with a simplified work overview at Emily’s whim.



■ **Figure 8** Emily refining her skills in the electrician in her AI-piloted electric car.



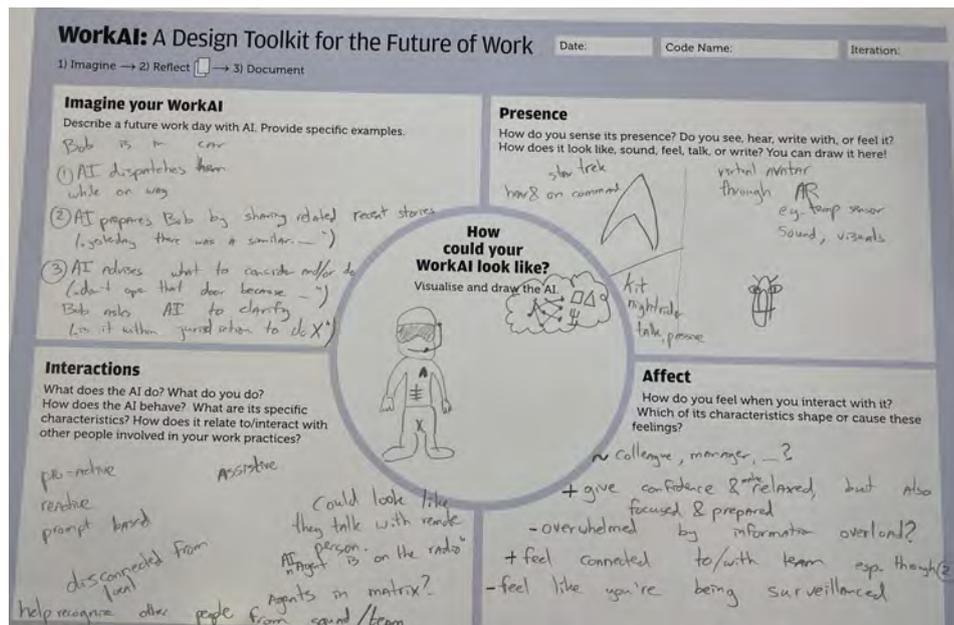
■ **Figure 9** Emily the electrician in her automated vehicle preparing for the coming job.

As Emily commutes to a client’s location, EAI initiates recurrent training, a ballet of skill refinement intertwined with the rhythmic hum of an AI-piloted electric car. The arrival at the client’s site sees the EAI-piloted robot, a harmonious ballet of machinery, delivering tools to the workspace. A crescendo of innovation unfolds as Emily employs a scanning tool embedded in her phone, guided by the omnipresent EAI radar, ensuring both precision and safety. The narrative reaches its zenith as the EAI-piloted universal screwdriver choreographs an intricate drill, elevating the performance in wiring tasks. This design fiction unfolds

as more than a mere speculative scenario; it encapsulates the harmonious collaboration between humanity and technology, offering a glimpse into the imaginative future where AI orchestrates a symphony of brilliance in everyday professional practices.

## 6.2 AI for Police

*Contributors:* Chris Janssen, Andrew L. Kun, Stefan Schneegass, Max L. Wilson



■ **Figure 10** Ideation about AI for police.

Artificial intelligence can help police to perform their job safely and effectively (see also Figure 10). Specifically, we envision that AI can help police in three ways:

1. **Use a variety of signals to predict events that require police response.** AI can use a host of signals to estimate the probability that there is an event where police are needed. This approach clearly presents pitfalls, as was shown effectively in the movie “Minority Report.” The AI can incorrectly predict an event, and the subsequent police response can be harmful. Still, saving time in police response can save lives, so it is important to explore this possibility carefully.
2. **Use anecdotes to provide information.** While responding officers are traveling to the scene, the AI can prepare them by providing relevant information, including anecdotes from other officers who faced similar situations. Many first responders learn from each other through anecdotes. If AI can leverage this type of interaction with officers, it could fit very well into the way that they like to learn new information.
3. **Provide on-site support based on available data.** On the scene the AI can provide responding officers with context-relevant advice, such as where to look, what to look for, and how to act. The advice can be based on sensors that the officer wears, sensors in any police vehicles, and also on additional information, such as data about nearby mobile phones. Just as in the case of predicting events, this approach has many pitfalls. And just as in that scenario, there are significant possible benefits, which means that it is important to explore this possibility as well.

### 6.3 AI for Education / Teaching – “Social Synergy”

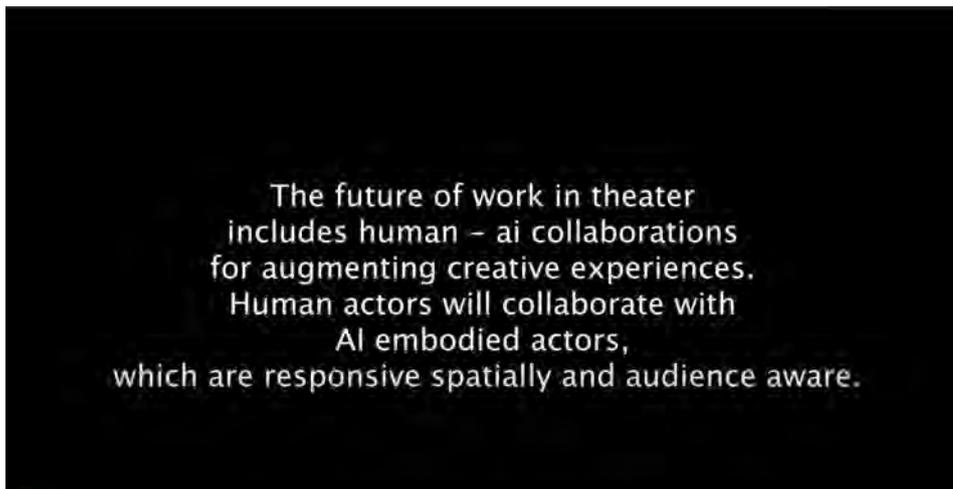
*Contributors:* Marta Checchinato, Duncan Brumby, Anna Cox

The presentation discussed a futuristic AI system designed for higher education that aims to personalise teaching materials and assessments to enhance and personalised learning experiences. This system includes a desktop interface that provides educators with information on student needs, such as disabilities and language preferences, to aid in teaching delivery and facilitate social interactions. The AI could also function like a dating app, pairing students for group work based on their preferences to foster personal growth and a sense of belonging. We also considered the use of tools like Microsoft’s Speaker Coach to reduce bias and discrimination while being mindful of potential concerns about surveillance and privacy. Similarly, Harvard-tool called “Teachly” provides interesting technology to consider that analyses classroom seating data to provide feedback on teacher-student interactions and potential biases. The AI would provide live, real-time feedback and input to the teacher.

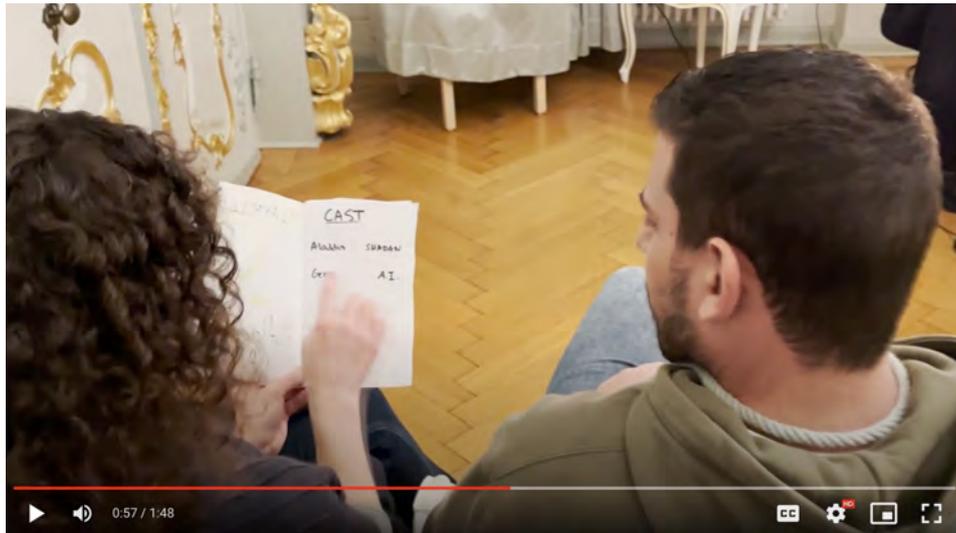
### 6.4 AI for Theater – “Alladdin AI”

*Contributors:* Marios Constantinides, Michal Rinott, Shadan Sadeghian, Orit Shaer, Erin Solovey

Figures 11 to 14 show extracts from the video produced by the contributors during the seminar.



■ **Figure 11** Envisioning human-AI collaboration for Theater.



■ **Figure 12** Envisioning Human-AI collaboration for Theater: Production of Alladdin-AI.



■ **Figure 13** Envisioning Human-AI collaboration for Theater: human actor scans the stage in preparation for human-AI collaboration.



■ **Figure 14** Envisioning Human-AI collaboration for Theater: human and embodied AI co-acting.

## 7 World Cafe: Topics in human-AI interaction for work

In this session, participants discussed four themes of human-AI interaction for work in the format of a world cafe. The themes were identified from brainstorming among the participants.

Participants first produced a large number of research themes and facets of human-AI collaboration and interaction for work and then voted on which themes to further explore through discussion in this session.

Each theme was assigned a moderator (table head) and then explored around a table located in different areas of the seminar room. Participants rotated between the different themes while the table head led the discussion and summarized the results. The following themes were discussed:

### 7.1 What are interaction models for efficient/good human-AI collaboration?

Table head: Philippe Palanque

This was the starting point of the discussion based on input from participants during the identification of topics relevant to the seminar.

At this round table we started by slicing the title and discussed each of the following aspects: What is a model? This question was addressed by making explicit the difference between “Model with big M” and “model with small m”. Model is a set of concepts and relationships between concepts (e.g. the Entity/Relationship diagram [Chen 76]) while a model is a description of a part of the real world using concepts from a Model.

Is it reasonable to make a difference between AI and automation? It looks like AI is only a means to implement automation and issues related to automation seem fully relevant. It might be relevant to look at work in IFAC (automation and control) and SIGDA (Design Automation).

What are the qualities of a model? Following the discussions, we discussed the qualities of a Model and the qualities of a model. Efficient, and good were in the title. Other properties were identified such as reliability, and dependability, ... as for model properties such as expressiveness, coverage concerning the items to be modeled, coverage of the concepts in the Model, and the need for representing important and relevant real-life elements to be captured in the model, ... What do we mean by collaboration in the title? Discussions went to the allocation of work between AI and the human with different organizations in mind (H-AI, H-H-AI, H-AI-AI, and the difference with H-H-H collaboration).

Workload: a perspective for human and AI The discussion progressed toward the definition of “good” design and assessment of good designs including assessment of workload. For the human side the Yerkes Dodson law was mentioned and discussed and then what the bell curve would look like from the AI perspective

For the AI perspective overload would be (for instance) decreased availability of the service while underload would be low input to the continuous training of the model. Collaboration perspective between AI and Human Discussions evolved around the notion of human-human computer-mediated collaboration such as the Clover model [1]. The importance of slicing collaboration into Production (output of the work), Communication (between collaborating humans), and Cooperation (organizing and allocating work to entities) was useful in discussing collaboration with automation.

## References

- 1 Yann Laurillau and Laurence Nigay. 2002. Clover architecture for groupware. In Proceedings of the 2002 ACM conference on Computer supported cooperative work (CSCW '02). Association for Computing Machinery, New York, NY, USA, 236–245.

## 7.2 How to design for meaningful work?

Table lead: Shadan Sadeghian

We all spend a large proportion of our lives working. In its original definition, work is a way of earning a living. However, even though people (ideally) have several ways to fulfill their financial needs, they choose one over the other, and sometimes even the one that pays them less! This raises the question of why do we work. One answer is that besides being a way to earn a living, work can be a source of meaning in life.

Of course, we are not the first to raise this question. Over the past decades, several researchers have looked into work meaningfulness and characteristics that make a job meaningful. An example that was raised was the model by Hackman and Oldham [1] which defines five job characteristics that derives motivation at work:

- Skill Variety: The degree to which a job requires various activities, requiring the worker to develop a variety of skills and talents.
- Task Identity: The degree to which the job requires the jobholders to identify and complete a workpiece with a visible outcome.
- Task Significance: The degree to which the job affects other people’s lives. The influence can be either in the immediate organization or in the external environment.
- Autonomy: The degree to which the job provides the employee with significant freedom, independence, and discretion to plan out the work and determine the procedures in the job.
- Feedback: The degree to which the worker has knowledge of results. This is clear, specific, detailed, actionable information about the effectiveness of his or her job performance.

In our group, we delved into the potential impacts of future AI collaboration on various aspects and, consequently, on the perception of job meaningfulness. A central and recurring theme in our discussions was the recognition that while current workplace technologies primarily focus on enhancing productivity, as often gauged in Human-Computer Interaction (HCI) by measures of effectiveness and efficiency – such as error reduction and improved outcomes – these factors alone do not encompass all elements contributing to job satisfaction.

A fundamental source of job meaningfulness is the sense of competence derived from possessing a diverse array of skills relevant to one’s job. Collaborating with AI may involve delegating certain tasks to the AI itself. If these tasks are integral to the individual’s sense of meaningful work, how can we sustain this feeling of significance? Alternatively, what new skills should individuals cultivate to enhance their job satisfaction? Can the design of human-AI interaction play a role in augmenting feelings of competence among humans?

We also delved into the societal dimensions of work, particularly exploring the dynamics of relationships among colleagues. Numerous topics within this sphere were considered. For instance, questions arose about social interactions such as “Whom do I join for an after-work beer if my colleague is an AI?” or pondering whether success achieved while working with AI in a team would instill a sense of pride in the collaborative accomplishment. While the integration of AI in work practices might enhance performance in the short term, there’s a concern that over the long run, it could erode feelings of connection and belonging, subsequently diminishing motivation in the workplace. This prompted us to question, “Can AI be designed to function as a good colleague, and if so, how?”

Another societal consideration involves workers’ rights. Currently, the allocation of tasks between human workers and AI is primarily determined by system designers (developers) or organizational management. Unfortunately, workers often have minimal, if any, input into what tasks they perform or how they carry them out in their jobs, despite being the most affected group. This lack of involvement can potentially decrease their job satisfaction, as they might be assigned tasks that the AI cannot handle or be required to spend long hours monitoring AI activities. This raises the question of how we can design interactions with AI in the workplace to preserve or even enhance feelings of autonomy and uphold workers’ rights in decision-making processes.

## References

- 1 Hackman, J. Richard, and Greg R. Oldham. “Development of the job diagnostic survey.” *Journal of Applied psychology* 60.2 (1975): 159.

## 7.3 How to design for equitable human AI collaboration?

Table lead: Neha Kumar

We began by discussing the topics that were brought up by participants around equity in human-AI collaborations. We asked first, “Who are we equating? Is it humans to other humans, or humans to AI?” Realizing that in different contexts, the challenges arising might be different, we decided to look across the Design, Build, Use, and Iterate stages to ask what challenges these might entail, and what the hard questions might be. For example, if we were to consider an LLM, what key questions should we be asking in the design, building, use, and iteration of an LLM. In other words, what might the “CV” of an LLM look like, and what questions must it contain answers to? E.g. where do its origins lie, how did it get to where it is now, what are its strengths and limitations, and how does it learn and grow? To understand the “learning and growth” we would need to lay out many key priorities as well.

## 7.4 What are the skills humans and AI need for successful collaboration?

Table lead: Christian P. Janssen

At this round table, we addressed the following main question: “What are the skills humans and AI need to have for successful collaboration?” We started with a discussion of “How does one even capture or define skills?” Do we need different terms or definitions for human-AI collaboration compared to human-human collaboration? For example, is a skill like “interpersonal skills” – which is maybe mostly used for human-human collaboration, similarly defined for human-AI collaboration? See Table 1 about what is known about skills for collaborations between two types of partners:

■ **Table 1** Skill collaborations between two types of partners.

		Partner 2	
		Human	AI
Partner 1	Human	(within reason) well described	
	AI	To be studied	Defined by former protocols

We then talked about what skills are required for humans, for AI, or for the interaction (Table 2):

■ **Table 2** Required skills for humans, AI or for the interaction.

Human	AI	Interaction
Knows or defines the “value” or does “curation”	Decomposes or classifies situation to (better) communicate the problem	Make achieving the goal easier
“Steers” conversation	Creates proposals	Task “translation” and “evaluation”
Evaluates	Expresses limitations or uncertainties on their recommendations	Norms / expectations / appropriate actions grounded
		Added value of collaboration is made explicit

What’s needed for human-AI collaboration? Two additional aspects were identified:

1. Probably, there’s some form of alignment needed. For human-human communication alignment is sometimes implicit: You nod your head, you look at a shared artifact. By contrast, in human AI interaction, alignment needs to be made more explicit. The understanding among the groups was that alignment in human-AI collaboration is currently done well.
2. Common sense and satisficing (instead of optimizing). Sometimes an AI should slightly “break the rules” to achieve a result. For example, if you are in a rush and it is relatively safe to do, drive slightly above the speed limit to make it to an urgent appointment.

With the first two groups, we talked quite a bit about the role of uncertainty. Some uncertainty or some probabilistic dynamics are probably useful in an AI system, because it creates, for example, creative discussions with large language models. Due to some variations, it’s not always the same thing. At the same time, having too much uncertainty or probabilistic variation can be bad.

Given that there is some level of uncertainty, there is a question of “how do you even communicate uncertainty to the user?” and “how does this differ between different users?” For example, how does a child or novice handle uncertainty versus an adult or expert user (that perhaps knows better how to contextualize the uncertainty)?

We also discussed that for human-AI collaboration, the required skills can change at two levels:

1. The job / task / goal / life itself can change due to AI / Automation. These are in some sense the “bigger questions” that are about potentially radical changes to work.
2. For interaction with the AI. These are mostly about specific tasks/interactions “how can I achieve X with the new system”.

We also discussed AI low literacy. As not everyone might be (immediately) able to work with novel forms of AI. Therefore, systems require some robustness, and allow some exploration capability for the user with the option to “undo”.

Finally, we discussed organizational contexts. In some organizations, workers might be forced to use a specific system. A structure is then needed for (re-)training. But how? Is training offered generic to a group? Or customized to an individual?

How does one get over local maxima? That is, if one found a useful routine for approaching a task, but new / different tools have the potential to improve your performance – how do you get people to try out these techniques in a safe way?

This probably requires some organizational change. Time to “catch up” and “invest” in new technology is needed and should be appreciated by organizations and society.

## 8 Working groups

### 8.1 Forms of interaction

Contributors: Orit Shaer, Mohit Jain, Andrew L. Kun, Mihal Rinott, and Bastian Pflöging

In this session, we discussed different aspects of envisioning how people will use and interact with AI technology in the future. Could we cross between interaction paradigms and current+future AI uses to create a matrix that will show existing and new potentials for interactions with AI?

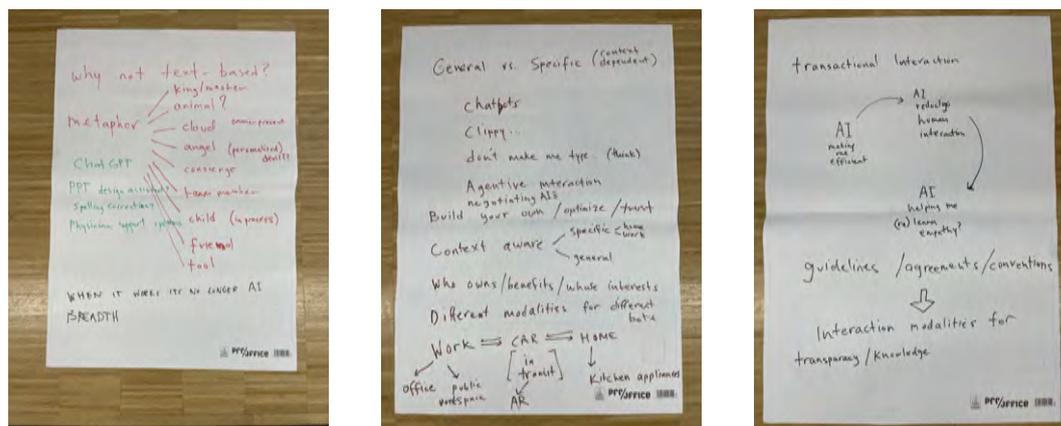


Figure 15 Notes for forms of interaction discussion.

**Divergent vs. convergent AI Systems.** We discussed the divergent (many AIs) versus convergent (one AI to rule them all) possible futures of interaction with AI. Convergent AI would mean the persistence of a godlike AI entity across contexts, such as Home → Car → Work, requiring a move between different interaction paradigms. Multiple AIs represent a more diverse view of technology. Ownership and interests could be more clear and transparent. AI Systems Supporting Users: How will different user systems interact with each other?

## 8.2 AI for science

Contributors: Anna Cox, Christian P. Janssen, Aaron Quigley, Max L. Wilson, Stefan Schneegass, Susanne Boll, Phillippe Palanque, Tim Stratmann, Sven Mayer, Marios Constantinides  
Summarized by: Anna Cox, Christian P. Janssen, and Max L. Wilson

We first talked about how the bigger scientific process is structured. One proposal is that you can talk about “science missions”, which are an interactive process of ideation, discovery, and commercialization/impact. Then, who are we talking about when talking about scientists? Are these academics? Or Industry researchers? Or creatives/knowledge workers? If we are talking about academics, are we talking about their scientific activities or their everyday work (e.g., balancing research, teaching, and service)? We considered the following four factors affecting the future of science with AI:

**AI for the Scientific Process versus AI for the Work of Scientists.** We consider that there will be two impacts. Many tools are being developed to help achieve specific tasks in the scientific process, but AI will affect other forms of work that scientists do (time management, meetings, reviewing), and indeed are done in the infrastructure that creates science (finance, administration, etc).

- AI advances will enable people to do more science, and to do science in new ways.

**AI Speed-ups versus Experiencing the Process.** We consider that AI will automate and complete many tasks for people that will enable science to happen much faster – but what will we miss? Is it important, for learning and understanding, to be “in the loop” of the tasks AI will complete? Importantly for the rigor behind science, we need to see into the process and know that it can be trusted. This is true even if AI is holding us as researchers to take rigorous processes. This includes regulation about how and where AI is used.

- AI must enable science, but we will need to retain scientific rigor.

**New Skills and Changing Skills.** We consider that AI will have the so-called “Google Maps” effect on what skills we have, and what skills people will develop in life. Does it matter that we have lower attention spans due to social media? Do we have new skills of consuming knowledge in faster and better media formats? We wonder what important skills in life will be lost as we become comfortable with AI doing things we do not need to do. We wonder further when the impact of these losses will be discovered (when will we realize that attention span had a critical impact).

- We need to understand what AI literacy is, and what the future landscape of human skills will be.

**One AI (eg a digital assistant) versus Specialized Tools in a Toolbox.** We consider whether the AIs around science will be integrated into enabling all the science we are doing, or is being done within one organization. Or if these are each specialized tools that we use to achieve our goals in the science process.

- We will need to study the introduction of AI into the science process, for how these evolve and whether they become integrated.

### 8.3 Roles and metaphors

Contributors: Shadan Sadeghian, Marta Cecchinato, Naveena Karusala, Neha Kumar, Naomi Yamashita

Throughout history, humans have employed various strategies to navigate the unfamiliar and cope with uncertainties. We've assigned names like aliens or zombies to unknown entities, categorizing them, or utilized metaphors to apply familiar interaction strategies. Even in our interactions with technology, such strategies prevail. We've adopted metaphors such as desktops and files to understand and engage with technology. As AI becomes more prevalent in our daily lives, similar tactics are employed. AI systems, with their unique capabilities like agency, opacity, and anthropomorphism, are introduced as new entities. We often seek familiar characters in these unfamiliar beings, describing our relationships with them as master-apprentice or co-pilot. However, these metaphors not only define the relationship but also shape the interaction dynamics and notions of accountability when things go awry. Hence, it's crucial to carefully consider the metaphors we use to make the unfamiliar familiar and determine when a specific metaphor is beneficial for describing AI interactions.

Drawing on Social Practice Theory [1], our discussion delved into the skills, material, and meaning sought through technology interactions in various work practices. We concluded that these elements heavily influence the choice of metaphors used to define interactions. For instance, the metaphor of a "mask" for a real-time translator AI can both mask language skill flaws positively by presenting fluency and negatively by filtering out unique expressions, thus diminishing diversity. We ended the session by posing research questions such as: Why should we rely on metaphors, and where do we draw the line between familiarizing entities and neglecting their unique characteristics? Which metaphors are suitable for integration into specific practices? How do technology attributes and social settings shape these metaphors and subsequently influence the roles and relationships between humans and AI?

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## 9 Prediction of Future Scenarios

One of the seminar goals was to discuss important challenges/research problems, and accompanying hypotheses. To envision how human-AI interaction for work could evolve in the coming years, in this session we asked our participants to discuss (in groups) potential future scenarios for the next decade and to think of very utopian, but also very dystopian versions of our future of work and AI.

We wanted them to find provocative ideas, which do not necessarily need to be right. Each group should come up with at least 3 utopian scenarios and at least 3 dystopian scenarios. Furthermore, we asked them to revisit their utopian scenarios, to understand what could go wrong, i.e., lead towards the dystopian scenarios? In addition, they should think about which user groups will be affected and how. Similarly, we asked to also revisit the dystopian scenarios to investigate what could be done to fix the situations and understand which user groups will be affected and how.

Based on the domains addressed in previous sessions, we subdivided into four groups that developed scenarios for the following contexts: *Healthcare*, *higher education*, *workers' well-being*, and *manufacturing*. The following subsections outline the results from these group discussions.

## 9.1 Utopian and Dystopian views of work, health, and AI

Contributors: Max L. Wilson, Aaron Quigley, Marios Constantinides, Marta Cecchinato, Naomi Yamashita

The working group considered 6 scenarios, each could have been written as utopian or dystopian, and in the end their choices could have been reversed easily.

### 9.1.1 Healthcare: Utopian scenarios

Figure 16 provides a summarizing overview of the utopian scenarios and what could go wrong. The scenarios were the following:

- **AI replaces General Practitioner (Personal/Family Doctor)** In the next decade, we predict that... People will use AI to perform the function of the initial medical triage currently undertaken by a family/personal doctor (or General Practitioner)
- **Autonomous ambulances (or Ambulance Drivers)** In the next decade, we predict that... The wait times for ambulances will be eliminated by self-driving cars
- **AI provides personal proactive dynamic healthcare delivery** In the next decade, we predict that... New AI-enhanced sensing devices will proactively support individual health. Healthcare will go through a new transformation from being preventive (fixing problems as they come) to being proactive (anticipating problems).

### 9.1.2 Healthcare: Dystopian scenarios

Figure 17 provides a summarizing overview of the dystopian scenarios and how these issues could be addressed. The following scenarios were discussed:

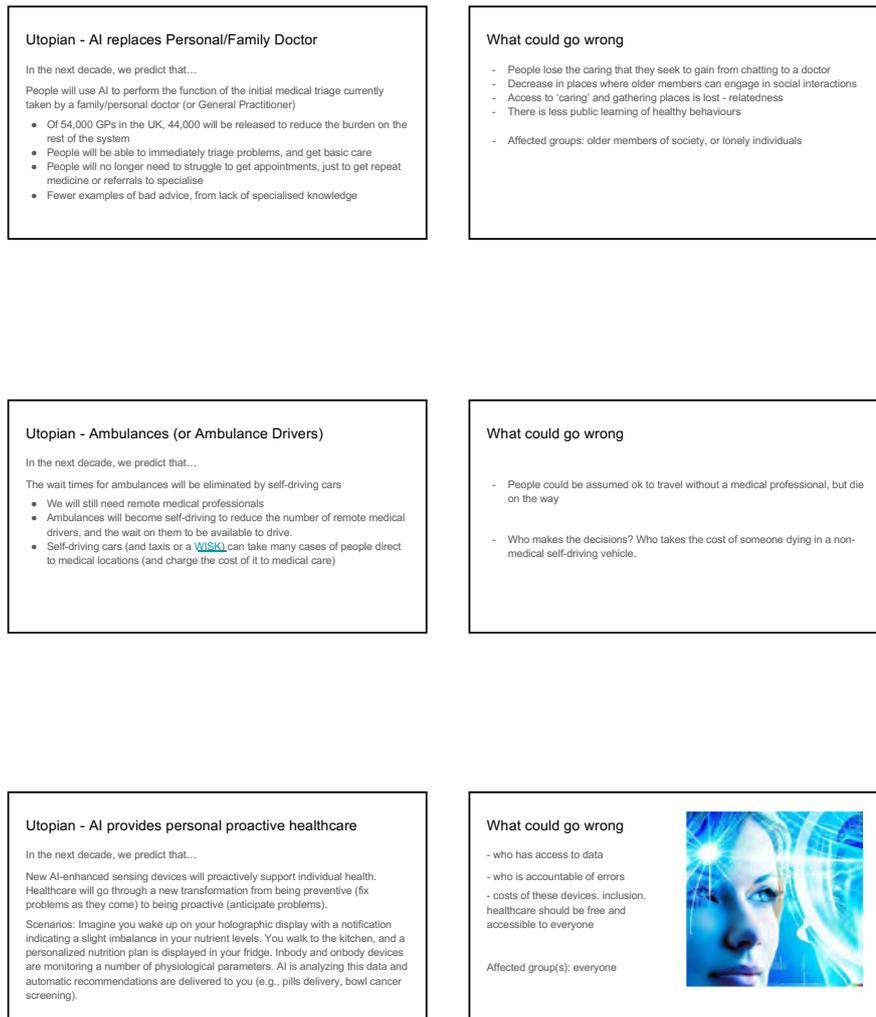
- **Empathetic Companion for Carehomes.** In the next decade, we predict that... New empathetic robots will be introduced to care homes for the elderly, which decrease the human contact that they experience.
- **The Hilton Hospital.** In the next decade, we predict that... the Hilton hotel chain will announce a lifetime platinum membership for anyone who signs up for their “Healthy Hilton program”.
- **Robot nurses.** In the next decade, we predict that... nurse staffing levels will reach catastrophically low levels as overworked nurses quit the field en masse, and aspects of their work will be replaced by care robots.

## 9.2 Utopian and Dystopian view on Higher Education

Contributors: Christian P. Janssen, Erin T. Solovey, Stefan Schneegass, Sven Mayer, Naveena Karusala

In the next decade, we predict that...

- ... Machines play a central role in teaching. As a student, you use a machine to get things done. You do not need to learn to calculate, write, think (?), code.
  - Context:
    - \* Different students work on different things. Lecturers and school context need to adapt to aid where needed.
  - Upside / Utopian:
    - \* personalized learning (intelligent tutoring);
    - \* no exams might be needed as system keeps track of what you know and don't know. Formative tests.



■ **Figure 16** Presentation slides: Utopian scenarios – Healthcare.

### Dystopian - Empathetic Companion for Carehomes

In the next decade, we predict that...

New empathetic robots will be introduced to carehomes for the elderly, that actually decrease the human-contact that they experience.

Scenario: Imagine when you wake up, a robot greets you with a 'good morning.' It inquires about your sleep, how you feel, and gathers necessary health-related information. Occasionally, it encourages you to engage in moderate exercise and checks if you've taken your medicines. Your family lives relatively close from the carehomes, but they are often busy with work and other commitments. Since your health status and daily activities are communicated through AI, there is little topic to talk on phone calls, and the opportunity for them to visit the carehome is rare.

### What could we do?

- Ensure that minimum amount of social interaction is maintained
- AI shares emotions (loneliness, sadness) of the elderly to their family members.

### Dystopian - Hilton Hospital

In the next decade, we predict that... the Hilton hotel chain will announce a *lifetime platinum membership* for anyone who signs up for their "Healthy Hilton program". With this program they provide you care and attention when you're staying in any of their hotels internationally. We offer smart beds to analyse your sleeping patterns, and enjoy warming your bottom on our smart toilets while it analyses everything that comes out of your bottom twice to help keep you well and the type of Premier customer that we want to have for the rest of your life.



We care about you, our **RadarFool** slippers cares about you and now you don't have to have an annual checkup at a hospital instead just stay with us and stay healthy. Come and stay in the Hilton hospital where you can check out but you can never leave because now we have lots of your health data.

### Dystopian - Hilton Hospital

Coming next year is our executive lounge with healthy living in the morning. Come for breakfast. And in the evening. Come for drinks. Then during the day come and meet one of our Hilton healthcare budies, who will give you a free Skin checkup and physiotherapy session and will help you navigate the extra services that are now available in the family of hospitals which are opening all around the world and our partner Hilton 5 star hospitals coming at the end of this decade.

Soon we will have a new option for the new super platinum Hilton hotels, which are currently being built in Switzerland and Tokyo with these hospitals, members who sign up for super platinum status will get lifelong healthcare, lifelong platinum status, and access to a free Dignitas consultation and all you have to do is promise to give us your organs when you die so that we can look after the next generation of healthy Hilton customers.

### Robot nurses - dystopian

In the next decade:

- nurse staffing levels will reach catastrophically low levels as overworked nurses quit the field en masse.
- Desperate hospitals will install fleets of droid nurses to perform all basic care, reducing human nurses to just a handful of specialists.
- VR escapisms will be used to keep patients docile as robot nurses methodically tend to their needs.
- AI diagnostics will label patients based on their personality (e.g. aggressive) inserts robot nurses, "always wants to talk, etc) to help personalise the interaction with robots and make it more efficient.
- Any medical errors and neglect will be treated without compassionate human oversight.



### What could we do?

- Avoid robots to do any human emotional interaction and get them to just do manual tasks where human error is more at risk.
- Or have human nurses override if needed AI labels about patients and input ways of interaction

■ Figure 17 Presentation slides: Dystopian scenarios – Healthcare.

- \* school might not be “boring” as calibrated to an individual’s interest and learning style
- \* university can “guarantee” a specific quality level
- \* the teacher has the time to (also) focus on the individual student (with the help of AI).
- \* AI can see what types of errors students make beyond typical cases. AI can use those responses to suggest different examples, material, and instructions for rare cases.
- \* classrooms are multi-modal: AR and VR usage
- Downside / Dystopian
  - \* when code does “wrong” things, knowledge is not there on how to “correct”
  - \* No room to “bend the rules” as students, and try different things. “Eenheidsworst” / “einheitsbrei”
  - \* LLMs / Machines create the lectures and assignments, tenured staff is not needed – their creative input and context is not needed.
  - \* Teacher needs to focus on many things as well due to range of skills / levels / interests of students.
  - \* Human-human interaction might be missing (or reduced)
  - \* “Sorting hat” (from Harry Potter) for teaching sorts pupils early into categories of where they should flourish. “You should do STEM / Humanities / ...”, and their path is set for them. No broader education anymore
- Mitigating factors:
  - \* Ensure that human-human teamwork is part of the curriculum
  - \* Ensure that students are challenged on topics outside of their “bubble”
  - \* Include assignments that train “basic” skills without the AI / LLM / ... such that students still know
- Universities no longer exist !?!?! (or... many close / change / restructure)
  - Context: in general because...
    - \* “teaching is done by the AI”
    - \* “research is done in industry”
    - \* PhD training is done with the AI or while working in industry
    - \* Specific types such as “community colleges” or “research universities” might change tremendously. E.g., community colleges have current research universities to teach; Research universities are merged with industry.
  - Upside / Utopian
    - \* Lots of NGOs, and research institutes do practical research that has societal value.
    - \* Concepts of ethics and social good are shared more easily and widely
    - \* No crapshoot “research for money” for industry needs to be done by academics
    - \* No “learning factories”
    - \* CS is not disappearing??
  - Downside / Dystopian
    - \* The “Silicon valley university” is blend of current universities and industry
    - \* (research) (teaching) “Agenda” is set by external parties
    - \* Secret stealing of ideas; or inserting of bad AI (because everything is digital / online)
    - \* Global competition / war as international norms do not align with local culture and people do not meet to “align”

- \* “Exploration trip in 2050” will visit the ruins of Dagstuhl to see how people communicated at the start of the 21st century. (like how we went to Völklinger Hütte)
- \* Only crapshoot “research for money” for industry needs to be done by academics
- \* Some fields of academia disappear (e.g., “no money for humanities”)
- Mitigating factors: Ensure a place for fundamental/risky research within universities (as industry might not want to try)
- AI allows us to do research that used to be “impossible” like solving DNA sequences, or cure cancer. . .
  - Context:
    - \* AI allows advanced pattern recognition beyond human capabilities
    - \* AI allows the integration of information
  - Upside / Utopian
    - \* Individualized healthcare; doctors who actually can do research (instead of case studies)
    - \* Democratization of research: doctors and practitioners have access to a team of (AI?) researchers to help with solving difficult questions
    - \* Faster research output
    - \* (reasonably good) Digital Twin or testing platform of whatever system/context you study. Model-driven research. Less need for animal studies, human studies, . . .
    - \* Integration of theory and insights. “Unified theory of X”
  - Downside / Dystopian
    - \* Costly research: run a server for “trivial” research question
    - \* Quality control: if AI does the research, how will you know what the output is/means and how to validate it?
    - \* AI hallucinations: making stuff up that sounds plausible to human
    - \* More pressure to do research fast; less emphasis on quality. More work created because no time needed for research.
    - \* Less room for divergence; when it is there, it might give grounds for “fake news” and alternative realities/truths
    - \* 1984?
  - Mitigating factors:
    - \* Tools to check AI
    - \* Competition/variety of AIs / Algorithms
    - \* Open science
    - \* Certification / Peer-review like systems
    - \* Human-in-the-loop (to make it slow?)
    - \* Alt.chi like venues that give a place for alternative perspectives but are at the same time not rabbit holes for radicalized ideas.
- How do you evaluate faculty in age of AI?

### 9.3 Wild Predictions on Workers' Wellbeing

Contributors: Tim C. Stratmann, Larbi Abdenebaoui, Mohit Jain

#### 9.3.1 Utopian scenarios: Workers' Wellbeing

In the next decade, we predict that...

1. workers have more freedom in choosing their task
  - more flexibility
  - more meaningful work
2. there is no hard physical work
3. AI can help to have an ideal working relationship among employees through perfect communication

How can these utopian scenarios turn into dystopian ones?

1. No relatability, Humans cannot be trusted, AI learns to untrust Humans → only unimportant jobs, meaningless work, Black Mirror “Cycling for Energy”
2. All Physical Work is done by Robots → fat, lazy, loose cognitive abilities, → become a “Surrogate”
3. Manipulation and superficial relationship, no free speech, no unions any more → avoiding conflicts but, conflicts are also important, robbing society from meaningful conversations, company → political manipulation

#### 9.3.2 Dystopian scenarios: Workers' Wellbeing

In the next decade, we predict that...

1. humans will work for the AI, Matrix
2. humans will lose every working skill. → we cannot repair, innovate
3. a permanent presence of AI – “Angel/Daemon” advising workers all the time

What can be done to fix these dystopian scenarios?

1. AI is democratic and willing to do the best for human sustainability → Perfect World. Optimal use of resources, care for the workers.
2. Gain the skill to interact with AI systems → learn new things on demand and rapidly, Matrix
3. Control the level of monitoring, including the possibility to turn it off → get the support we want when we want.

### 9.4 Utopian and Dystopian Predictions for Manufacturing

Contributors: Michal Rinott, Shadan Sadeghian, Anna Cox, Duncan Brumby, Philippe Palanque, Neha Kumar

This group discussed scenarios related to manufacturing. Before diving into different scenarios, the group raised the question whether utopia and dystopia are opposites and whether these opposites connect? In their discussion, it turned out that there could be a continuous cycle between such scenarios, which brought the connection to the word Saṃsāra: Saṃsāra is a Pali/Sanskrit word that means “wandering” as well as “world” wherein the term connotes “endless cyclic change”.

This led to the following Samasric scenario with different steps and situations:

- As manufacturing increased its automation, many factories reached the “lights off” stage where the last worker was fired.

- People went home to unemployment. The world continued to pile up with manufactured goods.
- At home, people became bored, anxious and depressed.
- They wanted meaning. They wanted jobs back, but not exactly like before. This led to something like “Slow Manufacturing”
- Amazon, Alibaba, and others made a 180-degree turn and decided to save the earth rather than get rich. They were rich enough now and hoping to save the earth for their children. Imagine: “Customers who bought this item did not buy anything else for a week.”
- Big manufacturing factories, experiencing a consumption crisis, changed: moving to locations with renewable energy, such as warm sunny locations, to cut energy costs
- Manufacturing for personal goods increasingly moved to a distributed model of local manufacturing: at or near home.  
AI was used to optimize this process, making the manufacturing of some goods local and community-based, with each participant manufacturing a part of the whole product.
- Following the model of Crowd Cow, even farming was now subsistence-based: done in home gardens with AI helping to plan and optimize yield at the community level.

Alas, the cycle of samsara may continue, with some people wanting more. . . and thus communal manufacturing may once again be replaced by large corporations. . .

And so the cycle may continue between utopia and dystopia.

## 10 Summary and Next Steps

Participants of Dagstuhl Seminar 23452 “Human-AI Interaction for Work” spent a productive week discussing a variety of topics related to human-AI interaction for work. We focused on understanding where this broad field stands now. We also worked toward understanding both the positive and negative outcomes that are likely to be the results of incorporating AI into work. This included sharing our own work with each other, as well as discussing our own understanding of the relevant scientific literature (which is indeed very broad). It also included turning our attention to art (movies, TV shows, and books), as well as popular science books, to gain additional insight into problems and possible solutions.

We wrapped up the seminar with a session discussing our individual and collaborative next steps. Many participants are contributors to the CHIWORK symposium series – seminar participants serve on the CHIWORK steering committee, they are organizing the 2024 event in the UK, and they are contributing papers and reviews. Multiple participants are also planning to include AI-for-work topics in the IEEE Pervasive magazine, both through an upcoming special issue, and through a regular column in the magazine. We also discussed multiple collaborative research ideas, many of which focused on using LLMs for work. Finally, in all of our plans, we were determined to heed the warning of the abandoned Völklinger Hütte steel plant, which was our destination for the customary Wednesday afternoon field trip – we want to build tools that will allow people to flourish, and avoid building tools that dehumanize work.

As organizers, we would like to wrap this document up by expressing our gratitude to all those people who contributed to the success of this seminar. First and foremost, we would like to thank the team at Schloss Dagstuhl. Their dedication and their warm hospitality were evident in all of their actions, from organizing the meeting, to hosting us at the castle. And of course, we are most grateful to the seminar participants who took an entire week out of their busy schedules to join us in order to create new scientific knowledge in the field of human-AI interaction for work.

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## Participants

- Larbi Abdenebaoui  
OFFIS – Oldenburg, DE
- Susanne Boll  
Universität Oldenburg, DE
- Duncan Brumby  
University College London, GB
- Marta Cecchinato  
University of Northumbria –  
Newcastle upon Tyne, GB
- Marios Constantinides  
Nokia Bell Labs –  
Cambridge, GB
- Anna Cox  
University College London, GB
- Mohit Jain  
Microsoft Research India –  
Bangalore, IN
- Christian P. Janssen  
Utrecht University, NL
- Naveena Karusala  
Harvard University – Allston, US
- Neha Kumar  
Georgia Institute of Technology –  
Atlanta, US
- Andrew L. Kun  
University of New Hampshire –  
Durham, US
- Sven Mayer  
LMU München, DE
- Phillippe Palanque  
Paul Sabatier University –  
Toulouse, FR
- Bastian Pfleging  
TU Bergakademie Freiberg, DE
- Aaron Quigley  
CSIRO – Eveleigh, AU
- Michal Rinott  
SHENKAR – Engineering,  
Design. Art – Ramat-Gan, IL
- Shadan Sadeghian  
Universität Siegen, DE
- Stefan Schneegass  
Universität Duisburg-Essen, DE
- Orit Shaer  
Wellesley College, US
- Erin T. Solovey  
Worcester Polytechnic  
Institute, US
- Tim C. Stratmann  
OFFIS – Oldenburg, DE
- Dakuo Wang  
Northeastern University –  
Boston, US
- Max L. Wilson  
University of Nottingham, GB
- Naomi Yamashita  
NTT – Kyoto, JP

