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Gastherausgeber:

Stefan Brandenburg¹

Lewis Chuang²

Martin Baumann³

¹Technische Universität Berlin

²Technische Universität Chemnitz

³Universität Ulm

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Part I

General Information

Welcome

We are happy to welcome you all to the Third German Human Factors Summer School 2021. The German Summer School for Human Factors is the successor of the Berlin Summer School of Human Factors which was initiated and organized from 2014-2018 by the Department of Psychology and Ergonomics, TU Berlin. The Summer School is an annual postgraduate event that is supported by the Section of Engineering Psychology of the German Psychological Society (DGPs).

The intention is to provide an interactive platform that promotes the transfer and communication of interdisciplinary skills relevant to Human Factors research. Successful postgraduate applicants (Ph.D., M.Sc., and candidates) have the opportunity to present their research interests and/or current projects for critical discussion. Prominent researchers are invited to teach advanced methods and communicate state-of-the-art research from their laboratories.

The 3rd German Summer School for Human Factors is hosted by Technische Universität Berlin from September 17th to 18th. We are looking forward to inspiring talks and discussions.

Target audience

The target audience is Ph.D. students working in Human Factors, irrespective of whether they have just started or almost finished their Ph.D. The objective of the Summer School of Human Factors is to offer a space for Ph.D. students to connect and help each other with the empirical parts and handling of other issues concerning the Ph.D. Also, the summer school will be attended by invited senior researchers and guests, further facilitating the discussions.

Venue

The summer school will take place in building MAR (Marchstraße 23, 10587 Berlin) on the Charlottenburg Campus of the Technische Universität Berlin. The MAR building can be reached by public transportation (www.bvg.de) via bus, S-Bahn or U-Bahn:

- bus 245 – stop: Marchbrücke
coming from Zoologischer Garten (approx. 8 minutes ride)
coming from Hauptbahnhof (approx. 25 minutes ride)
- S-Bahn (S) – stop: Tiergarten
all S-Bahn crossing the city from west to east or vice versa stop at Tiergarten (S3, S5, S7, S75)
from Tiergarten it's an approx. 12 minutes walk to the MAR building
- U-Bahn (U2) – stop: Ernst-Reuter-Platz
from Ernst-Reuter-Platz it's an approx. 6 minutes walk to the MAR building

When buying a ticket from a ticket machine, it always has to be validated. Validation points are inside busses but not inside trains. Please remember that you have to validate the ticket before entering the train at the platform. A single ticket will allow you to use all public transportation for two hours but only when traveling in one direction. A ticket for the whole day is valid from the moment it is validated to the next day, 3 a.m.

Accommodation

Berlin is a city of long distances. Therefore, we recommend booking a room nearby the venue. Also, check the connectivity between the venue and your preferred accommodation. Connectivity can be checked with either Google Maps or on the website of the Berlin public transportation system (bvg.de/en). We provide some suggestions for accommodation on our website.

Information for presenters

Each focus group will be scheduled for 5 + 45 minutes:

- Prior to the focus group (5 minutes), the presenters are kindly asked to give a sneak preview of their focus group (max. 40 seconds without slides).

- During the focus group (45 minutes), the contributor has the opportunity to initialize and lead a discussion about his/her current project. On this account, contributors can give a short introduction to their current project (max. 10 minutes) and use the rest of the time for an intense discussion with the audience. The room will be equipped with a laptop, a projector, a flip chart, etc..

We think the easiest way to conduct your session is that the audience will first listen to your short introductory talk (5-10 mins.). You can use the flip chart and/or some other form of presentation for your session. For the discussion, we provide notes, pens, etc. facilitating the creative process. We want to establish a convenient atmosphere for the speaker and a lively exchange of ideas later on.

Questions?

If you want to get in touch with the organizers to discuss some ideas or upcoming questions, please get in touch via email:

- stefan.brandenburg@tu-berlin.de

Program

Friday, 17.09.2021

09:00 – 09:30 **Welcome TU Berlin & FG-Ing.-Psy.**

Maren Heibges and Martin Baumann

speed dating of the participants

Presentation – Discussion

Chair: Martin Baumann

09:30 – 10:20 Andreas Schrank

10:25 – 11:15 Alina Rörig

11:15 – 12:05 Lena Kölmel & Lina Kluy

12:05 – 13:00 Lunch break

13:05 – 13:55 Veronica Hoth

14:00 – 14:50 Antonia Markus

14:55 – 15:45 Nicklas v. Kalkreuth

15:45 – 16:00 Coffee break

16:05 – 16:55 Laura Prislán

17:00 – 17:50 Felix Grün

17:55 – 18:45 Christoph Rürger

18:45 – 19:00 **End of the Day Summary (talking ball)**

19:00 – ... **Dinner**

Saturday, 18.09.2021

09:00 – 09:10 Welcome day two

09:15 – 10:00 Questionable Research Practices in Human Factors research
Martin Baumann, Stefan Brandenburg

Presentations – Discussions

Chair: Martin Baumann

10:15 – 11:25 Francesca Zermiani

11:30 – 12:20 Tim Schrills

12:30 – 13:20 Katharina Jungnickel

13:20 – 13:40 **End of the Summer School Summary**

13:40 – 14:30 **Lunch Break and taking farewell**

Presentation topics

Andreas Schrank	DLR Braunschweig	Enhancing the Teleoperator's Situation Awareness by Human-Centered HMI Design
Alina Rörig	TU Berlin	Ethnographic approaches to ethically challenging counseling issues in the care of mutation carriers at increased risk for breast and ovarian cancer
Lena Kölmel & Lina Kluy	KIT Karlsruhe	The role of external agents and different goal criteria in the context of task allocation in human-robot collaboration
Veronica Hoth	TU Berlin	UX Design Ethics for e-Health Applications
Antonia Markus	RWTH Aachen	Designing Human-AI Interfaces to support customer services
Katharina Jungnickel	TU Berlin	Development of a modular questionnaire for assessing Customer Experience
Laura Prislan	Robert Bosch GmbH & University of Stuttgart	How to foster sustainable behavior in consumer technology
Felix Grün	TU Berlin	How physicians nonverbally affect the Doctor-Patient-Relationship in telemedicine settings
Christoph Rieger	Charité Berlin	The triad of ergonomics, technology and domain expertise – can we lower the practical barriers for cooperation in academic research?
Nicklas v. Kalkreuth	TU Berlin	In apps we trust
Tim Schrills	Universität Lübeck	Do Users Understand AI as Good as They Think? Experiencing Information Processing Awareness in Intelligent Medical Systems
Francesca Zermiani	Universität Stuttgart	Is a wandering mind always a distracted mind? Identifying the costs and benefits of mind wandering in learning contexts.
Christoph Rueger	Charité Berlin	The triad of ergonomics, technology and domain expertise – practical barriers.

Part II

Abstracts

Enhancing the Teleoperator's Situation Awareness by Human-Centered HMI Design

Andreas Schrank

German Aerospace Center (DLR), Braunschweig

andreas.schrank@dlr.de

Teleoperation of vehicles has the potential to serve as an approach to reap off the benefits of automated driving already in the near future when fully automated vehicles (SAE level 5; SAE, 2018) will not yet be fully operable. In teleoperated driving, a human operator in a remote control center boosts passenger safety and service reliability by monitoring the vehicle and taking over control when disturbances occur that the vehicle automation's skills cannot cope with by itself. A user-centered human-machine interface (HMI) for the teleoperation of highly automated shuttles (SAE 4) by a public transport control center was generated to integrate the vehicle's automation and human remote operation. The HMI prototype was evaluated regarding its usability, situation awareness (SA; Endsley, 1995), acceptance, and perceived workload by transport control center professionals as an online interview study (Kettwich et al., 2021; Schrank et al., 2021). Even though results supported our HMI overall, especially regarding usability, acceptance, and workload, SA ratings did not differ significantly from the scale mean, suggesting a merely average degree of SA perceived by participants. SA was measured using the Situation Awareness Rating Technique Starting (SART), a subjective self-report measure.

Setting out from this particular result, the following questions arose: (1) Why did the current HMI not provide sufficient SA to the participants? What improvements need to be made in order to do so? Specifically, how did the remote setup as an online interview study influence factors such as involvement and immersion? (2) Is the SART questionnaire-based method suitable

to measure SA in this setting? If not, are there more suitable approaches to measure SA in teleoperated driving?

In order to answer the first cluster of questions, a systematic analysis of the first HMI prototype's evaluation was conducted. Both improvement suggestions from participants and additional approaches to enhance key outcome variables regarding the HMI were compiled. These include theoretical frameworks such as the Out-of-the-Loop concept in automated driving (Merat et al., 2019) as well as empirical findings on the interplay of teleoperator, environment, and operation interface characteristics on the teleoperator's SA (Linkov & Vanzura, 2021). This compilation will subsequently be used to refine the HMI and then re-validate it by conducting a second evaluation study, preferably on-site using a lab-based simulator teleoperation workstation with scenarios that typically occur in teleoperated driving. To address the second cluster of questions, methods to measure SA will be systematically reviewed with a focus on objective approaches, such as the query-based Situation Awareness Global Assessment Technique (SAGAT) (Endsley, 1987) that Endsley specifically suggested for measuring SA in teleoperation (Endsley, 1995). Subsequently, the SA measurement method that suits the requirements of teleoperated driving best will be selected to evaluate the refined HMI.

The objectives for the focus group at the German Human Factors Summer School derive from the two central questions stated above: (1) Soliciting advice for designing the second evaluation study at the simulator teleoperation workstation and (2) discussing the construct situation awareness, its usefulness in the context of my research, how to measure it and what other related constructs and approaches could be considered.

Acknowledgements This research project has received funding via the project *RealLab Hamburg*, section *Autonomous Driving* (RealLab Hamburg, 2020), from the German Federal Ministry of Transport and Digital Infrastructure.

References

- Endsley, M.R. (1995). Toward a Theory of Situation Awareness in Dynamic Systems. *Human Factors: The Journal of the Human Factors and Ergonomics Society* 37, pp. 32?64. <https://doi.org/10.1518/001872095779049543>

- Endsley, M.R. (1987). *SAGAT: A methodology for the measurement of situation awareness*. Northrop C, Hawthorne, CA
- Endsley, M.R. (1995). Measurement of Situation Awareness in Dynamic Systems. *Human Factors* 37, pp. 65-84.
- Kettwich, C., Schrank, A. & Oehl, M. (2021). Teleoperation of Highly Automated Vehicles in Public Transport: User-Centered Design of a Human-Machine Interface for Remote-Operation and Its Expert Usability Evaluation. *Multimodal Technologies and Interaction* 5, p. 26. <https://doi.org/10.3390/mti5050026>
- Linkov, V. & Vanzura, M. (2021). Situation Awareness Measurement in Remotely Controlled Cars. *Frontiers in Psychology*. 12:592930. <https://doi.org/10.3389/fpsyg.2021.592930>
- Merat, N., Seppelt, B. & Louw, T. (2019). The Out-of-the-Loop concept in automated driving: proposed definition, measures and implications. *Cognition, Technology and Work*. 21, pp. 87-98. <https://doi.org/10.1007/s10111-018-0525-8>
- RealLab Hamburg (2020). *Autonomes Fahren*. <https://reallab-hamburg.de/projekte/autonomes-fahren/>. Accessed 25 Mar 2021
- Schrank, A., Kettwich, C., Oehl, M. (2021). Developing and Evaluating a Human-Machine Interface for the Remote Operation of Automated Vehicles (SAE 4 and 5). In: Huckauf, A., Baumann, M., Ernst, M. Herbert, C. Kiefer, M, & Sauter, M. (ed). *Contributions to the 63rd Tagung Experimentell arbeitender Psychologen*. Pabst Science, Lengerich, p. 224.
- Society of Automotive Engineers (2018). *SAE J 3016-2018. Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles*.

Ethnographic approaches to ethically challenging counseling issues in the care of mutation carriers at increased risk for breast and ovarian cancer

Alina Rörig

Division of Ergonomics, Technische Universität Berlin

alina.roerig@tu-berlin.de

I would like to present my first drafts of my dissertation project, which focuses on issues of kinship and family planning for people with a family history of cancer. Familial cancer risks (e.g., due to genetic alterations such as BRCA12 mutations) are becoming increasingly important in gynecology: approximately 5-10% of all breast and 10-15% of all ovarian cancers arise due to congenital genetic mutations, regularly changing the panel of risk genes to be considered. Prospective, age-specific risk data are necessary to estimate risk reduction for every individual patient. Counseling on these individual risks is the core of genetic counseling for mutation carriers. In the field, there are, on the one hand, gynecologists in outpatient care, who play a central role in counseling patients with increased risk of disease due to family history. However, genetic counseling mostly takes place at specialized centers, which is why I would like to start here with an ethnographic research approach.

It is to be expected that counseling specialists will increasingly have ways to integrate topics such as the new possibilities of genetic testing, such as pre-implantation diagnostics, into their consulting practice. The consideration of these ethically controversially discussed medical possibilities in the counseling of mutation carriers, as well as the role of male mutation carriers in their individual family constellation could be the focus of the research questions to be developed.

Specifically, I would like to explore what shapes the daily lives of people living with genetic mutations. (How) does living with the mutations change

their perspectives on family, kinship, reproduction, and family planning? What questions arise and how can genetic counseling specialists be good counselors for these sensitive and private issues. On the other hand, I want to determine what the central challenges for the counseling physicians are and how patient-centered counseling can be improved both for the advice-seeking families and the professionals.

One of the dissertation's main achievement is to find ways to improve the counseling practice. For this purpose, an analysis of existing voids and potentially challenging situations will be conducted in a first study, in order to identify and implement possibilities for improving the consultation practice based on these results. Considerable implementation possibilities could be, for example, the creation of information material for independent decision-making by the patients or the development of tools that can be used by the physicians as support during the consultation. Depending on how physicians, patients or ethics experts assess the challenges in counseling practice, the development of a guide on family planning and kinship or the development of training formats could also be the focus of the subsequent research phases.

I would like to present my qualitative research design for the exploratory initial phase of the research and would in particular like to exchange views on the ethical challenges of the research project.

The role of external agents and different goal criteria in the context of task allocation in human-robot collaboration

Lena Kölmel & Lina Kluy

Karlsruher Institut für Technologie - Institut für Arbeitswissenschaft und Betriebsorganisation

lena.koelmel@kit.edu & lina.kluy@kit.edu

Technical advances make it increasingly possible to integrate self-learning systems (through artificial intelligence; AI) into people's everyday work. Collaborative robots are one example of those kind of systems in the context of production. With the introduction of human-robot collaboration (HRC), companies usually pursue two goals: On the one hand, economic advantages i.e. the improvement of productivity, and on the other hand, ergonomic advantages i.e. the reduction of strain and stress during work. Although an optimal task allocation between humans and robots is a crucial factor for the successful introduction of HRC, there have been few studies analyzing this process from a psychological point of view. On the one hand, the comparison of different allocation agents indicates that humans evaluate a task allocation performed by themselves most positively. On the other hand, it could also be shown that humans prefer to give up their decision authority to a technical system in studies with direct interaction.

The aim of this present study is to investigate the influence of the external allocation agent and the goal criterion on human perception of task allocation. Based on a partial hierarchical 2x2x2 between-subject-design, 199 people participated in an online experiment in which the influence of different allocation agents (human production manager vs. self-learning system) and the goal criterion (economic efficiency vs. human-centeredness) on the perception of the allocation process (i.e. satisfaction, trust, behavioral acceptance and emotion) was investigated. A third factor condition (joint presentation vs. separate presentation) was included to analyze whether the possibility to choose between

external agents is a relevant factor. For this purpose, a scenario of a HRC task allocation with interdependent work steps was presented to the participants. The results suggest an interaction effect between allocation agent and goal criterion, especially with respect to decision satisfaction. Moreover, the acceptance of the allocation is influenced by global attitudes towards technology and robots.

This study is the starting point of two PhD projects located in the field of work-related human-AI-interaction. Hence, the focus group will discuss research opportunities regarding human-centered artificial intelligence and human-AI interaction in the field of work. In the analysis of the study results, it became visible that - if people can choose between a self-learning system and a human production manager as external allocation agents - AI is often perceived as influenced by humans or *human-made* rather than as an independent entity with agency on its own. This finding is related to algorithm literacy and algorithm aversion/appreciation. These topics question and place new demands on research on human-AI interaction. Therefore, the discussion will provide impulses for approaching such experimental setups within AI studies with lay people and implications for future studies.

UX Design for Data Privacy Protection

Veronica Hoth

Technische Universität Berlin

veronica.hoth@tu-berlin.de

The General Data Protection Regulation (GDPR) aims to protect users' privacy setting regulations for internet providers to process users' data in a transparent manner (Art. 5, 13, 25 of GDPR, 2018). It mandates that storing technically data on a user's computer can only be done if the user is provided with information about how this data is used, and the user is given the possibility of denying this storage operation or changing his or her decision retrospectively. One technical method of storing user data while browsing the internet are cookies. Cookies are small data blocks that are saved on the user's device and send back to the provider to share information about the users' activity on the specific web site.

Consent dialogues or cookie banners pop up every time a user opens a new website to ask the users for permission to place cookies on the users' device to allow them to track their online behavior, store their data and pass it on to others, for example advertising companies. These cookie banners interrupt the user-flow and are perceived as annoying, which results in a *privacy fatigue* or *cookie banner fatigue* (Choi, n.d.) and a negatively perceived user experience.

User Interface (UI) and User Experiences (UX) Designers apply design nudges on cookie banners, such as dark or whitelight patterns to steer the users into giving or denying consent without having to read the consent notice and to diminish the interruption caused by the cookie banner during the interaction with the website. These cookie banners are questionable because they do not actually inform the users, hence are not following Article 5, 13 and 25 of the GDPR that mandates that data processing should be transparent to the data subject (users and consumer) and aims to create trust to allow the digital economy to develop (Recital 7, Radley-Gardner et al., 2016).

Digital Health Systems

The GDPR principle of transparent information regarding the processing of personal data is challenging for digital health (DH) systems. It mandates that the information about the data processing should be *easily accessible and easy to understand* and that users should be informed about the "personal data concerning them that are collected, used, consulted or otherwise processed and to what extent the personal data are or will be processed" (Recital 39).

Methodology

To follow the Human Centered Design (HCD) approach, user centered design methods will be used to analyze the problems that exist with data privacy consent notices such as cookie banners by conducting user research, interviews and usability tests. The aim is to find out, how visual design can create new solutions to inform transparently about data privacy to increase trust.

- Can visual design improve data privacy interactions and increase trust in digital (health) systems?
- Do design nudges - such as dark or light patterns - used in cookie banners have an influence on the perceived trust in data privacy and technology?

Based on the Evidence Based Design Method (EBD), the outcome of the research will be used to design new UI and UX solutions i.e. guidelines or principles to create a transparent communication about data privacy in digital health web-applications that increase trust in digital health systems.

Research Design

Study 1

The aim of this study was to show whether the number of dark patterns and the white patterns used in cookie banners have an influence on the perceived trustworthiness of website providers. Since the quality of the user interface can affect user confidence, the UX was also reviewed (Roy et al., 2001). For this quantitative study we conducted an online survey with 56 participants combining an interaction with cookie banners and a survey, where participants were asked to evaluate the structure and the content of the cookie banner they were

randomly shown. Through the between subject design each group of participants had to interact with different cookie banners that apply different design nudges such as white/light pattern that motivate users to deny consent of data tracking and different levels of dark pattern, that persuade users into giving consent to data tracking. They had to interact with one of four different types of cookie banners and asked to answer two questionnaires about their experience. The meCUE-questionnaire (Modular evaluation of key Components of User Experience; Minge & Riedel, 2013) to evaluate the user experience and the SCOUT-questionnaire (Scale of Online Users' Trust) to evaluate their online trust.

The research question of the first study of this doctoral dissertation aims to answers the following main hypothesis:

- A) The more dark patterns are used, the lower is the perceived trustworthiness and the UX.
- B) White patterns lead to an increase in the perceived trustworthiness and the UX.

Results of the Study

The outcome of this study showed, that either dark or white pattern have an influence on the perceived trustworthiness of the website.

Study 2 - Qualitative Study

To find out, whether the context of the cookie banners can have an influence on the perceived trust in websites, I want to place three different types of cookie banners with white pattern, dark pattern and no design nudges in their real context of digital health websites. If the context increases the influence in the perceived trust, then the cookie banner is probably not having an influence on trust in web sites.

The advantage of the qualitative survey is, that I will be able to ask the participants questions about their perception of the interaction with the banner. *Cookie banner fatigue* and *data privacy fatigue* (Choi, n.d.) is a phenomenon that has raised since the GDPR was launched in 2018, so I would like to find out, what kind of privacy consent notice or privacy interaction elements participants would prefer during the interaction with the website.

For the experiment, participants will not know, that their perception of the cookie banner is being tested. They will be asked to interact with digital health web sites using think aloud to accompany the observation and to know what they think while they interact with the cookie banner, that will appear after the website opens. Afterwards, they will be interviewed about UX, trust, their attitude towards data privacy and data consent notices. Therefore I want to ask the following questions among others:

- What do users want to know about their data privacy rights?
- When do users want to be informed about their data privacy rights?
- What kind of data are they willing to share for what purpose?
- Have the participants seen or thought about user friendlier privacy consent interactions?
- Do participants feel the need to gain control over their data?
- Do they feel that control over their data would give them more trust in in digital health systems?

Study 3

Based on the results I aim to develop a design solution for trustworthy informed consent banners for digital health systems. A prototype of the design solution will be developed and tested again, following the HCD approach. Hopefully, this solution will be evaluated with a positive UX, communicate data privacy transparently and make users trust more in digital health systems.

Designing Human-AI Interfaces to support in customer services

Antonia Markus

RWTH Aachen

A.Markus@wzl.rwth-aachen.de

Advances of Artificial Intelligence (AI) are enabling developers to integrate a variety of AI capabilities into user-facing systems. For example, AI-systems can execute the analysis of big data sets that are too complex for the human information processing. Collaborating with each other the AI can augment the data processing capabilities and support humans in making databased decisions. Using AI in the customer service could be an answer to the increasing expectations of rapid response rates by the customers. However, successful human-AI collaboration requires that the offered support by the AI is comprehensible for the human. Key to address this requirement is the design of the human-AI interface, which strongly influences how the user perceives and assesses the AI-system. Although design guidelines for user interfaces had been discussed over decades, the transfer to human-AI interfaces remains an obstacle (Amershi, 2019). This stems from the fact that there is a great variability of AI design and use cases. Because the AI constantly adapts to the given feedback from the user, challenges for the designer of the interface arise. This can cause unpredictable interactions produced by the AI in real-world use. Yang et al. (2020) describe two challenges of human-AI interaction: the uncertainty surrounding the AI's capabilities and AI's output complexity. Especially, traditional human-centered design methods can reach their limits under these circumstances. Their focus of keeping the design artefacts and prototypes simple allows the user to participate in several design iterations, but can possibly not address the requirements of AI-systems due to the unpredictability and complexity of the outcomes. Consequently, the participatory approach, which is characterized by a strong involvement of the end user, cannot exploit its full potential when the end users or even the designers are not able to understand the AI.

The objective of this study is to compare different user interface design methods in the setting of human-AI interfaces. For this purpose, human-AI interfaces for three different real-world use cases are going to be designed. We will examine if the methods of a human-centered design process lead to improved performance outcomes despite the higher complexity of AI-systems.

References

- Amershi, S., Weld, D., Vorvoreanu, M., Fournery, A., Nushi, B., Collisson, P., ... & Horvitz, E. (2019). Guidelines for human-AI interaction. In *Proceedings of the 2019 ACM SIG CHI conference on human factors in computing systems*. pp. 1-13.
- Yang, Q., Steinfeld, A., Rosé, C., & Zimmerman, J. (2020). Re-examining whether, why, and how human-AI interaction is uniquely difficult to design. In *Proceedings of the 2020 ACM SIG CHI conference on human factors in computing systems*. pp. 1-13.

In apps we trust

Niklas von Kalckreuth

Technische Universität Berlin

nka@mms.tu-berlin.de

eHealth applications have long since gained a foothold in digital life and the number of application areas, apps and users is steadily increasing. In addition to apps for recording health and body data to track your own physical performance (healthy lifestyle maintenance apps), all health insurance companies already offer apps for managing the insurance relationship and for participating in their respective bonus programs. With the introduction of the electronic health record (EHR), even more sensitive data is now being stored on the health insurance companies' servers. With the increase in data leaks and hacker attacks, there are inherent risks to digital progress. To accept risks and use the technology, trust in the app and the provider is essential.

Previous research has already shown that trust as a motivator has a significant influence on the intention to use eHealth apps. The data also showed that the higher the frequency of use, the higher the trust in health insurance apps. The increase in trust from never, occasionally, one app regularly to several apps regularly was very or strongly significant. On the one hand, this could be due to the attitude towards data protection of individuals, which significantly influences trust in the provider. For example, individuals who are skeptical about data privacy would generally not use a health insurance app, as there is little trust. On the other hand, when interacting with the app, trust could be generated by various factors in the UX. This would increase trust through regular use and through experience. However, it would be unclear which subjective and objective factors influence the perceived trustworthiness of an app.

While the relevance of trust for interaction was confirmed in the first study of the PhD project, this interaction study aims to show which factors in the UX influence the perceived trustworthiness. The first part of the interaction is a simulated website of a Corona rapid test provider. The participants should book a test appointment on this, stating personal data (name, date of birth,

telephone number, e-mail address, ID number). Half of the participants will work on the directly simulated website, while the other half will be confronted with the website without security cues (no *lock* in the browser bar, expired website certificate). This manipulation is intended to investigate to what extent the absence of security cues influences the perception of trustworthiness cues. In the second part, the participants interact with an EHR app and are supposed to carry out various tasks. Subsequently, in the interview part, the participants are asked about factors in the UX that were perceived as particularly trustworthy. The answers are to be evaluated by means of a content analysis and the factors are to be categorized. Furthermore, the influence of the security cue manipulation on the factors mentioned is to be examined quantitatively.

Follow-up studies are to evaluate the extent to which the factors found are weighted for the perceived trustworthiness and how the user can be transparently informed about the actual trustworthiness.

How to foster sustainable behavior in consumer technology?

Laura Prislán

Robert Bosch GmbH & University of Stuttgart

laura.prislan@outlook.de

Sustainability is more and more seen as an important topic, not only in public but also in companies (Burritt, 2010), governments (Brugmann, 1996) and the stock markets (Yilmaz et al., 2020). Recent studies found a higher resilience for more sustainable companies in case of a severe stock market crisis (Yilmaz et al., 2020). Relevant literature focuses on three pillars of sustainability: social sustainability, economic sustainability, and environmental sustainability (Purvis et al., 2019). According to Clift (2007), three key issues arise in connection with emissions: first, they should be limited to avoid a major climate change. Second, the per capita allocation of emissions should be equal, and third, the techno-economic measures should be implemented to reduce emissions.

In my dissertation I will relate these pillars to user experience and nudging. There already exist examples in consumer technology which help saving energy and reduce emissions, e.g., the E-bike, LED-light or automated roller shutters. Nudging patterns could influence the decision making towards a more sustainable behavior (Thaler et al., 2008). Examples are the sound of the fridge when it is left open too long, or the kettle when it is ready.

On the one hand, identifying potential nudging strategies for consumer technologies could help to promote sustainable behavior. These strategies have the potential for low-cost implementation and are therefore suitable for series production and lower-paying customers. Furthermore, they could increase the awareness for sustainability in society. On the other hand, developing a tool that helps users to choose more sustainable products could foster sustainable behavior. An idea is to simplify the comparison of devices in terms of energy and resource consumption. It has also social perspective as the more sustainable option does not necessarily need to be the most expensive one. If it is the

most expensive option, one would have to think about the social implications (for example financial support for low-income households).

In the focus group, I will outline and discuss potential benefits and challenges of both directions. To give a good background first drafts of the experimental design will be presented. Further, I want to adjust the approaches above with input and choose the more promising one regarding the research question.

References

- Burritt, R.L. & Schaltegger, S. (2010). Sustainability accounting and reporting: fad or trend? *Accounting Auditing Accountability Journal* 23 (7). p. 829-846. DOI: 10.1108/09513571011080144.
- Brugmann, J. (1996). Planning for sustainability at the local government level. *Environmental Impact Assessment Review* 16 (4-6), p. 363-379. DOI: 10.1016/S0195-9255(97)81658-7.
- Clift, R. (2007). Climate change and energy policy: The importance of sustainability arguments. *Energy* 32 (4), p. 262-268. DOI: 10.1016/j.energy.2006.07.031.
- Purvis, B., Mao, Y. & Robinson, D. (2019). Three pillars of sustainability: in search of conceptual origins. *Sustainability Science* 14 (3), p. 681-695. DOI: 10.1007/s11625-018-0627-5.
- Thaler, R.H, & Sunstein, C.R. (2008). *Nudge: Improving Decisions about Health, Wealth, and Happiness*. New Haven, CT: Yale University Press.
- Yilmaz, M. K., Aksoy, M. & Tatoglu, E. (2020). Does the Stock Market Value Inclusion in a Sustainability Index? Evidence from Borsa Istanbul. *Sustainability* 12 (2), p. 483. DOI: 10.3390/su12020483.

How physicians nonverbally affect the Doctor-Patient-Relationship in telemedicine settings

Felix Grün

TU Berlin

felix.meier@tu-berlin.de

The doctor-patient-relationship has an influence on medical outcomes (Stewart, 1995). An important aspect of the doctor-patient-relationship is the nonverbal behavior of physicians (Lorié, 2017). Pandemic times may change how well nonverbal behavior can be perceived. Mimic expressions are hidden behind face masks and they are more difficult to be perceived in video chat consultations, which are recommended in the current pandemic (Coleman, 2020). Nonetheless, physicians influence the doctor-patient-relationship in online consultation by their nonverbal behavior (Pols, 2012). For my PhD project, I chose two aspects of telemedicine consultation. Firstly, I illuminate the influence of physicians' body postures on doctor-patient-relationship in online settings. Postures are part of nonverbal behavior (Forkin et al., 2019) and well perceivable in online settings (Kraft-Todd et al., 2017). First findings indicate, physicians are perceived differently depending on their assumed open or closed postures. Secondly, my research seeks to clarify the influence of the camera angle of the physicians' camera in telemedicine settings. Camera angles can affect the perception of postures (Baranowski & Hecht, 2018). The PhD project aims to explain, how doctor-patient-relationship, nonverbal behavior by the example of postures and the technical aspects of telemedicine by the example of camera angles are linked. In the summer school, I would be honored to present and discuss the findings and the framework of my PhD project.

References

- Baranowski, A. M., & Hecht, H. (2018). Effect of Camera Angle on Perception of Trust and Attractiveness. *Empirical Studies of the Arts*, 36(1). p. 90-100. <https://doi.org/10.1177/0276237417710762>
- Coleman, C. (2020). Health Literacy and Clear Communication Best Practices for Telemedicine. *HLRP: Health Literacy Research and Practice*, 4(4). p. 224-229. <https://doi.org/10.3928/24748307-20200924-01>
- Forkin, K. T., Dunn, L. K., Kaperak, C. J., Potter, J. F., Bechtel, A. J., Kleiman, A. M., Huffmyer, J. L., Collins, S. R., Lyons, G. R., Ma, J. Z., & Nemergut, E. C. (2019). Influence of Sex and Body Language on Patient Perceptions of Anesthesiologists. *Anesthesiology: The Journal of the American Society of Anesthesiologists*, 130(2). p. 314-321. <https://doi.org/10.1097/ALN.0000000000002527>
- Kraft-Todd, G. T., Reinero, D. A., Kelley, J. M., Heberlein, A. S., Baer, L., & Riess, H. (2017). Empathic nonverbal behavior increases ratings of both warmth and competence in a medical context. *PLOS ONE*, 12(5). <https://doi.org/10.1371/journal.pone.0177758>
- Lorié, Á. (2017). Culture and nonverbal expressions of empathy in clinical settings: A systematic review. *Patient Education and Counseling*, 15.
- Pols, J. (2012). *Care at a distance: On the closeness of technology*. Amsterdam University Press.
- Stewart, M. A. (1995). Effective Physician-Patient Communication and Health Outcomes: A Review. *Canadian Medical Association Journal*, 152. p. 1423-1433

The triad of ergonomics, technology and domain expertise – can we lower the practical barriers for cooperation in academic research?

Christoph Rieger

Charité Berlin

christoph.rieger@charite.de

Due to rapidly expanding knowledge bases, we see rising education and specialization requirements in many fields of (expert) work, such as medicine. At the same time, digital technologies become increasingly important, posing both the chance of supporting experts as well as the risk of further complicating their work. As a result, emerging technologies must be well suited and designed for their intended users and tasks if they are to be beneficial. Due to the developments mentioned above, though, it becomes increasingly difficult to understand and communicate processes and issues in expert domains - which is necessary for innovating, developing, and evaluating new technological solutions.

There are various methods for task and user analyses, as well as for evaluating the usability and effects of technology and software. Such methods have been created and refined both by academic fields like ergonomics and human factors, as well as commercial organizations. Though useful and effective, they require an additional skill set on top of the technical and domain expertise needed for developing new technology. Requiring expert knowledge in three distinct fields may be feasible for commercial organizations with corresponding product lifecycles and financial backing. However, it poses a large hurdle when researching experimental and specialized technologies in an academic context: Due to the structure and financial incentives in the (German) academic environment, research groups that include experts from all three fields

are unusual. As a result, it is often necessary for multiple organizations to cooperate which requires networking, good inter-organizational communication, shared interests and goals, as well as funding. These requirements can be major hurdles, especially for projects with non-commercial, more basic research questions and/or of smaller scope, which could benefit from low-threshold methods of cooperation.

For this focus group, I present my research project as an example for this issue, covering basic concepts and challenges of researching the impact of an emerging digital technology (augmented reality) in the operating room: As an engineer in a predominantly medical/surgical research group, it can be difficult to understand surgical processes, and to design experiments that adequately analyze the effects of new technology on these processes. In a previous project, it was very helpful to include experts in the field of human factors research to tackle these issues. However, I have struggled to establish such cooperation both on a longer term and for more spontaneous issues due to the hurdles mentioned above. Based on this personal example I aim to start the group discussion with the question: Are there practical ways to encourage and facilitate interdisciplinary academic research which requires expertise in human factors, technology, and domain knowledge?

Is a wandering mind always a distracted mind? Identifying the costs and benefits of mind wandering in learning contexts

Francesca Zermiani

University of Stuttgart

francesca.zermiani@ife.uni-stuttgart.de

Mind wandering is generally defined as an attentional shift from the primary task to internal task-unrelated or stimulus-independent thoughts, which has been shown to negatively influence students' learning performance (defined here as negative mind wandering). In the past decade, considerable scientific effort has led to the development of attention-aware learning technology, capable of detecting mind wandering from the learners' eye movements, facial expressions, EEG, electrodermal activity or heart rate, and delivering real-time interventions, such as content reiteration, attention redirection phrases and questions. Alongside this research direction, greater scientific attention has also been given to exploring the bridge between mind wandering and creative thinking. Emerging evidence exhibits a fundamental similarity between these conditions and a positive impact of mind wandering on creative idea generation (here referred to as positive mind wandering).

Work in the field has so far mainly focused on automatic detection of mind wandering, while less attention has been given to computer-mediated teacher-learner interactions, although such interactions still constitute a crucial feature of today's learning. Detecting mind wandering from facial expressions has been shown to be easier for computers as opposed to human observers. Other modalities might therefore help to make mind wandering more visible to the human eye.

Results from studies involving eye tracking have shown the potential of gaze visualization in education. Sharing the students and teachers' real-time eye movements during learning would foster communication and coordination.

However, the impact of sharing the learners' gaze location with teachers is still understudied. Studies reported an increase in the teachers' ability to predict their students' level of cognitive understanding and states.

My aim is to investigate how we can discriminate between positive and negative mind wandering to provide students with tailored support to resume their task. In particular, it addresses the questions of how well humans can predict mind wandering from face and gaze visualizations and whether this technology might enhance the detection of the positive and negative conditions. My first study will therefore examine whether incorporating gaze and face information enables teachers to recognize mind wandering. We thus show participants' eye movements and facial expressions from a section of Huang et al. (2019)'s dataset, where participants were asked to view lecture videos on different topics. The dataset contains gaze data, facial video recordings, the elicitation videos, as well as ground-truth information regarding the episodes of mind wandering (see Huang et al., 2019 for further details). The participants will be presented with three experimental conditions: facial video, gaze, and both face and gaze, and they will be asked to indicate the beginning and end of a mind wandering episode. Pre- and post-survey will assess participants' demographic information and prior knowledge, user experience and observations while performing the task. Participants' prediction accuracy will then be compared to actual cases of mind wandering obtained by Huang et al. (2019). Further exploring human observers' performance serves as starting point for better understanding our capacity of recognizing attentional processes and for increasing the adaptability of the state-of-the-art attention-aware technology.

References

- Antrobus, J. S., Singer, J. L., & Greenberg, S. (1966). Studies in the stream of consciousness: experimental enhancement and suppression of spontaneous cognitive processes. *Perceptual Motor Skills* 23. p. 399-417.
- Baird, B., Smallwood, J., Mrazek, M.D., Kam, J.W., Franklin, M.S., & Schooler, J.W. (2012). Inspired by distraction: Mind wandering facilitates creative incubation. *Psychological Science* 23. p.1117-22.
- Baumgart, T. L., Klesel, M., Oschinsky, F. M., & Niehaves, B. (2020). Creativity loading - Please wait! Investigating the relationship between in-

- terruption, mind wandering and creativity. In *Proceedings of the Annual Hawaii International Conference on System Sciences (Vol. 2020-January, pp. 300-309)*. *IEEE Computer Society*. DOI: 10.24251/hicss.2020.038
- Bock, S., Dicke, P., & Thier, P. (2008). How precise is gaze following in humans? *Vision research* 48. pp. 946-57. DOI: 10.1016/j.visres.2008.01.011.
- Bosch, N., & D’Mello, S. (2019). Automatic Detection of Mind Wandering from Video in the Lab and in the Classroom. *IEEE Transactions on Affective Computing. PP(99)*. DOI: 10.1109/TAFFC.2019.2908837.
- Fox, K. C. R., & Beaty, R. E. (2019). Mind-wandering as creative thinking: neural, psychological, and theoretical considerations. *Current Opinion in Behavioral Sciences* 27. pp. 123-130. DOI: 10.1016/j.cobeha.2018.10.009
- Giambra, L. M. (1989). Task-unrelated-thought frequency as a function of age: a laboratory study. *Psychology Aging* 4. pp. 136-43.
- Huang, M. X., Li, J., Ngai, G., Va Leong, H., & Bulling, A. (2019). Moment-to-Moment Detection of Internal Thought during Video Viewing from Eye Vergence Behavior. *Proceedings of the 27th ACM International Conference on Multimedia. Association for Computing Machinery, New York, NY, USA*. pp. 2254-2262. DOI: 10.1145/3343031.3350573
- Hutt, S., Krasich, K., Brockmole, J., & D’Mello, S. (2021). Breaking out of the Lab: Mitigating Mind Wandering with Gaze-Based Attention-Aware Technology in Classrooms. *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*
- Mooneyham, B. W., & Schooler, J. W. (2013). The costs and benefits of mind-wandering: a review. *Canadian Journal of Experimental Psychology* 67. pp. 11-18
- Salvi, C. & Bowden, EM. (2016). Looking for creativity: Where do we look when we look for new ideas? *Frontiers in Psychology* 7. DOI: 10.3389/fpsyg.2016.00161
- Smallwood, J., & Schooler, JW. (2006). The restless mind. *Psychological Bulletin* 132. pp. 946-58
- Sung, G., Feng, T., & Schneider, B. (2021). Learners learn more and instructors track better with real-time gaze sharing. *Proceedings of ACM Human Computer Interaction. 5. CSCW1*. 134. pp. 1-23

Do Users Understand AI as Good as They Think? Experiencing Information Processing Awareness in Intelligent Medical Systems

Tim Schrills & Thomas Franke

University of Luebeck

schrills@imis.uni-luebeck.de & franke@imis.uni-luebeck.de

Through technological advancements in the field of machine learning (ML) and artificial intelligence (AI) automated information processing is becoming more and more relevant (Abdul et al., 2018). Such processes in medicine and health are not only complicated but often need a lot of experience and education. Therefore, systems that support the analysis of information - e.g. to make diagnosis - could be a huge achievement for professionals and private users.

The emerging research field of explainable AI (XAI) aims to enable users to understand decisions made by intelligent systems so they can reach an adequate level of trust and identify efficient cooperation patterns (Adadi et al., 2018). Verbene et al. (2012) found that after explanations were shown to users, trust ratings increased significantly. However, which explanations satisfy users can differ substantially based on e. g. correctness of mental models or experience (Hoffmann et al., 2019). Therefore, subjective experience of explanations may be substantial to understand how explanations influence trust. Additionally, while automation aims to reduce workload (Parasuraman et al., 2000), this reduction might be cancelled out when explanations require additional effort.

Besides trust, the Situation Awareness (SA) that users are able to develop when interacting with automation determines successful human-machine cooperation (Endsley, 1988). Similarly, Awareness of the information processing in e. g. medical diagnoses, may affects central interaction metrics like performance. As in Situation Awareness Theory (Endsley, 2015), the objective performance in perceiving, understanding and predicting information processing

can differ from subjective experience. Similar to Subjective Situation Awareness (c.f. Taylor, 2017) this distinction is important in medical diagnostic decisions; we describe the perceived SA in medical diagnosis as subjective information processing awareness (SIPA).

If, for example, a medical diagnosis system provides explanations (e. g. highlights areas in x-ray images) on a specific decision (e. g. pulmonary embolism) which are in fact not related to the diagnosis, users may assume to be well aware of the information processing. However, the performance in predicting the system's information processing would not match the users' self-believe.

In our current research, we manipulate types and amount of information an intelligent diagnostic system provides. There is a need for research regarding interactions which lead to high levels of SIPA without providing relevant information (see Eiband et al., 2019). To this end, we suppose experiments based on research on human reasoning with focus on observation-based deduction (c.f. Mehlhorn et al., 2011). In an example scenario, insulin requirements of diabetics are determined by an AI, which communicates to the users either a) only user-entered information such as food intake, b) system target values such as a specific tissue sugar, c) information learned by the system such as the ratio between ingested carbohydrates and insulin, or several of these types.

We aim to provide insight into the human-centered design of intelligent systems cooperating with human users. We focus on implications on how, when and how much information about an AI's information processing should be communicated. Our objective is to develop guidelines for designs, which 1) are able to achieve high levels of SIPA without inducing more workload, 2) allow for SIPA to influence performance and trust as well as 3) avoid a false rise in SIPA levels due to misleading explanations.

References

- Abdul, A., Vermeulen, J., Wang, D., Lim, B. Y., & Kankanhalli, M. (2018). Trends and Trajectories for Explainable, Accountable and Intelligible Systems: An HCI Research Agenda, in: *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*, ACM, Montreal QC Canada, pp. 1-18. DOI:10.1145/3173574.3174156.

- Adadi, A. & Berrada, M. (2018). Peeking Inside the Black-Box: A Survey on Explainable Artificial Intelligence (XAI). *IEEE Access* 6. pp. 52138-52160. DOI:10.1109/ACCESS.2018.2870052.
- Eiband, M., Buschek, D., Kremer, A. & Hussmann, H. (2019). The impact of placebo explanations on trust in intelligent systems, in: *Extended abstracts of the 2019 CHI conference on human factors in computing systems*, pp. 1-6.
- Endsley, M. (1988). Situation awareness global assessment technique (SAGAT), in: *Proceedings of the IEEE 1988 National Aerospace and Electronics Conference, IEEE*, Dayton, OH, USA. pp. 789-795. DOI:10.1109/NAECON.1988.195097.
- Endsley, M. R. (2015). Situation Awareness Misconceptions and Misunderstandings. *Journal of Cognitive Engineering and Decision Making* 9(1).pp. 4-32. DOI:10.1177/1555343415572631.
- Hoffman, R. R., Mueller, S. T., Klein, G., & Litman, J. (2019). Metrics for Explainable AI: Challenges and Prospects. *ArXiv: 1812.04608*. URL <http://arxiv.org/abs/1812.04608>
- Mehlhorn, K., Taatgen, N. A., Lebiere, C. & Krems, J. F. (2011). Memory activation and the availability of explanations in sequential diagnostic reasoning. *Journal of Experimental Psychology: Learning, Memory, and Cognition* 37(6). pp. 1391-1411. DOI:10.1037/a0023920.
- Parasuraman, R., Sheridan, T., & Wickens, C. (2000). A model for types and levels of human interaction with automation. *IEEE Transactions on Systems, Man, and Cybernetics - Part A: Systems and Humans* 30(3). pp. 286-297. DOI:10.1109/3468.844354.
- Taylor, R.M. (2017). Situational awareness rating technique (SART):The development of a tool for aircrew systems design. *Situational awareness*. Routledge, pp. 111-128.
- Verberne, F. M. F., Ham, J., & Midden, C. J. H. (2012). Trust in Smart Systems: Sharing Driving Goals and Giving Information to Increase Trustworthiness and Acceptability of Smart Systems in Cars. *Human Factors: The Journal of the Human Factors and Ergonomics Society* 54 (5). pp. 799-810. DOI:10.1177/0018720812443825.

Development of a modular questionnaire for assessing Customer Experience

Katharina F. C. Jungnickel

Technische Universität Berlin

k.jungnickel@tu-berlin.de

Volatile markets, global integration of value chain, shorter innovation cycles and Corona pandemic are a driver for the digitization of touchpoints for products and services. Customer experience is a multidimensional construct that includes the interaction between customers and companies along the entire consumer process. As online usage continues to grow, customer experience is an important factor to consider for companies. In order to satisfy the needs of end users regarding products, services and touchpoints, it is essential to design the user experience of the individual touchpoints in user-centric design along the customer journey.

The aim of this paper is to develop an instrument that explores customer experience exploratory from the perspective of customers and companies. Therefore, the presented explanatory approaches to customer experience with their characteristic dimensions are summarized as a list of requirements for the item pool. Here, touchpoints serve as an important element for the design of the item pool. Furthermore, existing measurement instruments are analyzed, which usually only indicate a specific context of use or which are not stable enough to apply to other contexts of use. Study 1a investigates the evaluation of digital products and services from the customer's perspective and Study 1b their evaluation from the company's perspective. The purpose of the focus group is to receive feedback on the various items in each touchpoint module. In study 2a and 2b possible gaps are covered by optimizing the items, the results from study 1a and 1b will be replicated in two online studies and validated by a confirmatory analysis. With the help of the already existing measurement instruments, the criterion validity will be checked. After confirming the results from study 2a and 2b, Study 3 will use the modular questionnaire in a case study in a company, so that the theoretical is verified in practice.