**ISSN 2510-2591**


Reports of the European Society for Socially Embedded Technologies

volume 4 issue 3
2020

# Proceedings of 18th European Conference on Computer-Supported Cooperative Work - Doctoral Colloquium

**Guest Editors**

Rossitto, Chiara
Tolmie, Peter

**Series Editor**

Michael Koch

## Impressum

The **'Reports of the European Society for Socially Embedded Technologies'** are an online report series of the European Society for Socially Embedded Technologies (EUSSET). They aim to contribute to current research discourses in the fields of 'Computer-Supported Cooperative Work', 'Human-Computer-Interaction' and 'Computers and Society'.

The 'Reports of the European Society for Socially Embedded Technologies' appear at least one time per year and are exclusively published in the Digital Library of EUSSET (https://dl.eusset.eu/). The main language of publication is English.

**ISSN 2510-2591**

https://www.eusset.eu/report-series/

EUSSET is an institute of Social Computing e.V., a non-profit association according to the German legal system – founded on November 13th 2012 in Bonn, Germany (Nordrhein-Westfalen Amtsgericht Bonn VR 9675).

c/o Prof. Dr. Volker Wulf
Fakultät III
Universität Siegen
57068 Siegen
E-Mail: volker.wulf@uni-siegen.de

# Table of Contents

## Doctoral Colloquium

*Axel Niklasson (2020): AI for teams: The future of assisted collaborative work. In: Proceedings of the 18th European Conference on Computer-Supported Cooperative Work: The International Venue on Practice-centred Computing on the Design of Cooperation Technologies - Doctoral Colloquium, Reports of the European Society for Socially Embedded Technologies (ISSN 2510-2591), DOI: 10.18420/ecscw2020_dc01*

# AI for teams: The future of assisted collaborative work

Axel Niklasson
HCID, City, University of London
axel.niklasson@city.ac.uk

In this brief overview of my ongoing PhD studies I give an introduction and brief background to my research interest, touch on my empirical work and early findings, and finally account for my anticipated next steps and expected contribution.

My ethnographic fieldwork is focused on the role of artificial intelligence in the workplace, building on well-established themes in CSCW and also identifying new challenges in observations of distributed agencies and skill in collaborative work. Grounded in an increased and varied academic interest in the environments, policies and rights related to the future of work and a strong industry narrative around ways of work made possible by technology, I am interested in the deep change aspirations of artificial intelligence and machine learning applications and their role in a push for "digital transformation." (CHI, 2019; National Science Foundation, 2019; Butterfield, 2018; Microsoft, 2018)

I seek to complement extensive but seemingly narrow studies of e.g. bias, trust and explanation in specific implementations where these fail to capture concerns we should have for work. Broadly, I want to ask, What is it that we're trying to digitally transform with artificial intelligence? What happens in that transformation? How can we zoom out and expand our frame of reference?

Recent discussion around future automation and AI has focused on the impact on occupations as varied as radiologists, lawyers, gardeners and drivers, (Alkhatib et al., 2017; Stone et al., 2016; Brynjolfsson and McAfee, 2016, e.g.) but little attention has been paid to the office team, and what impact the introduction of AI in collaborative tools may have on practices such as decision support and

performance management. (Woyke, 2018; Booth, 2019) The need to investigate how AI affects teamwork and associated potential new ways of working remains an important research objective and consequently the aim of my studies is to explore collaboration in and between organisational teams, how technology features in these collaborations and in particular the role and potential of AI-enabled assistance in teamwork.

As well as enriching the understanding of team-working at a seemingly pivotal moment in collaborative tools and services, I expect my research to deepen the understanding of people's collaborative practices with AI, and orient insights towards future design trajectories for workplace collaboration tools.

## Empirical work and early findings

In my PhD I have reported on ethnographic fieldwork at MediaCo, an international news organisation head-quartered in London. Embedded with a newsroom technology team over a period of five months in 2019, I had an interest in questions of assisted collaborative work and team practices.

With attention to the role of the communication tool Slack (Slack, 2019) I observed the team in their daily effort to roll out Newscope, an article writing and work-flow tool for the MediaCo journalists. The activities included formal and informal meetings and conversations; team planning, feature kick-offs and user research. The observations were complemented by contextual conversations and semi-structured interviews with software engineers, designers, business analysts, project- and product managers and others involved with the Newscope team.

In an ongoing reflexive, interpretative analysis I took an interest in how participants made sense of work in practice, how collaborative tools afforded skilled practice, and how skilled practice was made visible and accountable. (Marcus, 1995, e.g.)

As an example, one report departed in how the communication data accumulated by tools like Slack might be used to provide employers with "Operational Insight" or "Workplace Analytics" and how breaking apart Slack data and the infrastructure in which it is entangled implies losing sight of fundamental parts of the practice. I argued that skilled practice is distributed across the people and things entangled in this infrastructure; and that as a consequence, any attempt to augment or assist the Newscope team without a continuous attunement to the distribution of skill and the infrastructure will fail to take the organisation seriously.

Complementing an image of discrete, blackbox-able skill prevalent in much study of artificial intelligence, in an attempt not to presume the strict categories of 'human' or 'technology' as observable units, I suggested to expand the frame and develop a notion of skill as a property not of the individual but of "the total field of relations constituted by the presence of the organism-person, indissolubly body and mind, in a richly structured environment." (Ingold, 2000)

Drawing on infrastructure studies (Star and Ruhleder, 1996; Jackson and Barbrow, 2013, e.g.) I claimed that work and collaboration technologies such as

Slack are deeply entangled in the organisational infrastructure; that the skilled practice of a team is distributed across people and things in this infrastructure; and that for these reasons any effort to augment or assist collaborative work without considering characteristics of skill in infrastructure can not take full account of what we effectively regard as work.

## Next steps

While continuously revisiting my data and refining my analysis, I am now planning for continued studies and expect to return to the field shortly.

Iterating on previous empirical findings I will take a more specific interest in how skilled practice is distributed across the organisational infrastructure, anticipating to extend the participant scope beyond the developers of the Newscope system and include e.g. journalists and editors, allowing study of "objects" such as Slack channels or articles as they join together communities of practice.

The resulting findings and analysis, a further expanded view on the organisational infrastructure and the distribution of skilled practice will provide a base for an intervention. Provisional plans include designing and developing this as a Slack integration based on communication data, with the potential for co-design (Simonsen and Robertson, 2012, e.g.) and related activities in the Newscope team and elsewhere in the MediaCo organisation.

## Expected contributions

Building on well-established themes in CSCW, with empirical observations and analysis uncovering new challenges, I expect to contribute to the development of theory in questions of e.g. infrastructure and skilled practice in the context of workplace studies.

With a keen eye to the implications of these theoretical questions and through my own design and development efforts I will pay close attention to how my research speaks to the design of AI and data-driven collaborative systems.

In sum, I expect to contribute to an increased understanding of the problem space relevant to the design of features based on machine learning and data in collaborative tools.

## Acknowledgements

I'm very thankful for the patient and kind support from my Microsoft Research advisor Dr Sean Rintel and my City, University of London supervisors Dr Stephann Makri and Dr Alex Taylor.

This work was supported by Microsoft Research through its PhD Scholarship Programme.

# References


Alkhatib, A., M. S. Bernstein, and M. Levi (2017): 'Examining Crowd Work and Gig Work Through The Historical Lens of Piecework'. Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems - CHI '17, pp. 4599–4616.

Booth, R. (2019): 'UK businesses using artificial intelligence to monitor staff activity | Business | The Guardian'.

Brynjolfsson, E. and A. McAfee (2016): 'Will Humans Go the Way of Horses?'. vol. 94, pp. 8–14.

Butterfield, S. (2018): 'AI and the future of work: A conversation with Slack - Interviewed by Walter Frick'. Harvard Business Review.

CHI (2019): 'Position Pieces – The Future of Work'.

Ingold, T. (2000): The Perception of the Environment: Essays in Livelihood, Dwelling, and Skill.

Jackson, S. J. and S. Barbrow (2013): 'Infrastructure and vocation: Field, calling and computation in ecology'. In: Conference on Human Factors in Computing Systems - Proceedings. pp. 2873–2882.

Marcus, G. E. (1995): 'Ethnography in/of the World System: The Emergence of Multi-Sited Ethnography'. Annual Review of Anthropology, vol. 24, no. 1995, pp. 95–117.

Microsoft (2018): 'Microsoft Build: Modern Meetings Demo'.

National Science Foundation (2019): 'Future of Work at the Human-Technology Frontier: Core Research'.

Simonsen, J. and T. Robertson (2012): Routledge international handbook of participatory design. Routledge.

Slack (2019): 'Where work happens | Slack'.

Star, S. L. and K. Ruhleder (1996): 'Steps Towards an Ecology of Infrastructure: Design and Access for Large-Scale Systems'. Information Systems Research, vol. 7, no. 7, pp. 111–138.

Stone, P., R. Brooks, E. Brynjolfsson, R. Calo, O. Etzioni, G. Hager, J. Hirschberg, S. Kalyanakrishnan, E. Kamar, S. Kraus, K. Leyton-Brown, D. Parkes, W. Press, A. Saxenian, J. Shah, M. Tambe, and A. Teller (2016): 'Artificial Intelligence and Life in 2030: One Hundred Year Study on Artificial Intelligence'. Technical Report September, The One Hundred Year Study of Artificial Intelligence.

Woyke, E. (2018): 'Slack Hopes Its AI Will Keep You from Hating Slack'. MIT Technology Review.

*Chloe Eghtebas (2020): Perception Change With Ubiquitous AR in Social and Individual Scenarios. In: Proceedings of the 18th European Conference on Computer-Supported Cooperative Work: The International Venue on Practice-centred Computing on the Design of Cooperation Technologies - Exploratory Papers, Reports of the European Society for Socially Embedded Technologies (ISSN 2510-2591), DOI: 10.18420/ecscw2020_dc02*

# Perception Change With Ubiquitous AR in Social and Individual Scenarios

Chloe Eghtebas
Technical University of Munich
*Contact Author: eghtebas@in.tum.de*

**Abstract.** AR will become ubiquitous and with it, many challenges emerge in a socio-technical context. Given the wide range of devices not all AR is made equal. From what the AR is technically capable of, to who is using it, and how it looks; there are different perceptions of different devices. From the heterogeneous landscape of AR, the social circumstances of informational inequality can emerge giving way to a social advantage or hierarchy. Furthermore, when AR becomes ubiquitous, it can be used to mediate perceptions of reality which can be applied in moderating communication in a multi-user environment [Mann (2002)]. In this Doctoral Consortium (DC) paper I motivate a vision, outline some challenges, report on progress already made and speculate the next steps in how to understand and direct the influence of perceptions to overcome, rather than increase the prevalence of social inequality.

## Introduction

Augmenting technology is the original motivation towards pursuing technological advancements for better quality of life and to push the boundaries of humankind. Based on market trends of the ever evolving AR Head Mounted Display (HMD), from google glass, to Hololens, Magic leap, and new nReal glasses, we look at HMD's in particular which is a form of an augmenting technology that can reach

ubiquity. For ubiquitous AR to live up to its potential, it needs to overcome social reservations. Previous experience has shown that augmented reality HMD's are perceived based on their appearance and its user. In the case of google glass, users were observed to view the device as intrusive because of the camera [Hong (2013)] and also to have a different purpose based on the device color [Starner et al. (1999)]. Furthermore the perception of the device changes based on who is wearing the device, such as someone disabled [Profita et al. (2016)]. However, as AR and ultimately other augmenting technologies scale, there are social repercussions that have still yet to be understood, such as the informational inequality that can emerge giving way to a social advantage, that can ultimately impact the acceptability and quality of life of persons who could benefit from new technology.

# Research Questions

The research questions are broken down in Figure 1 into the themes of social and individual settings looking against topics of perception of the Augmenting Technology and the interaction for the augmented technology.

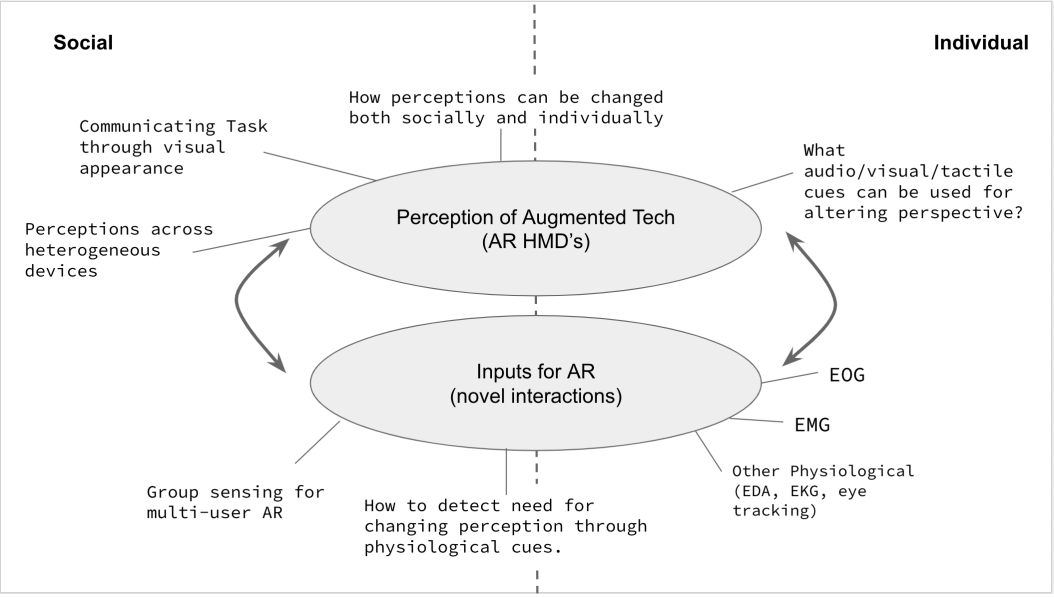


Figure 1. Figure shows the research questions with the themes of Perception Change of Augmented Technology and Interaction methods along the social and individual contexts.

**RQ1: How perceptions can be changed both socially and individually?**

The first series of questions address how can social and individual perceptions be changed. How can visual signals be applied to socially communicate the functionality of the device? If an indicator light or a physical covering of the camera, such as the trend for covering up laptop webcams, can be the most effective or if changing other aesthetics of the HMD's physical aspects could

communicate more benign intentions? Furthermore, when there are multiple-user settings with various AR displays, what are the telling capabilities or perception of capabilities that can lead to a social advantage? And on an individual basis, in what ways can an individual have their reality be mediated by certain audio, visual, and tactile cues?

**RQ2: How to detect the need for perception change through physiological sensing in individual and group contexts?** The second research areas looks towards understanding how to distinguish when to detect social versus individual physiological responses? Additionally, what devices (EOG, EMG, etc.) or fusion of devices can best detect a need for group mediated perception change?

# Methodology

| | **Individual (I)** | **Social (II)** |
|---|---|---|
| **Perception Change (A)** | 1. Case study on when perception change can be applied.<br>2. Measuring physiological responses to successful perception change mediated by AR. | 1. Augmenting Zoom: Perceptions and Asymmetric Encounters of Ubiquitous AR [√]<br>2. Follow up studies investigating different social roles and device capability.<br>3. How physical appearance change can signify device task. |
| **Augmenting Interaction Methods (B)** | 1. Investigation into Natural Gestures Using EMG for SuperNatural Interaction in VR [√]<br>2. Novel interactions in AR (with physiological triggering) | 1. Investigate social acceptability and perception of interaction method based on social role, device capability, and device appearance. |

Figure 2. Figure showing the methodology and next steps..

Figure 2 shows the overview of the proposed methodology to address the research questions. The rows and columns represent the themes from Figure 1 and subdivide the research questions into categories. Each cell has the initial experiment or series of experiments to address the intersection of the corresponding themes in order for the research question to be answered.

# Results

To go about answering our research questions, we built an initial social acceptability model, explored the three attributes of social perception, appearance, social role, and device capability, of the augmenting technology, and investigate interaction methods such as Electromyogram (EMG) for interaction and looked into Brain Computer Interface (BCI).

We started with an initial framework for generalizing the perception of all augmenting technologies Eghtebas et al. (2017b). This framework describes that

the acceptability is based of the individual cost or benefit versus the social cost or benefit and goes onto presenting different domains, such as education, law enforcement, sports, and business applications, which fall into a domain of these subsequent quadrants on the framework.

Next we looked at a specific augmenting technology, such as AR with ultra zooming capabilities [submitted waiting for results]. We developed a prototype to investigate the interaction and possible application and social concerns for such a super zooming device through qualitative interviews (n = 12). From the interview results, we identified themes around usability expectations, individual perceptions and preferences on privacy, and social permissions which we further investigated by a follow up survey of 100 participants. The survey varied social roles of who wears the zoom HMD across scenarios of the participant actively wearing the device, someone else wearing the device, and observing two people interacting with only one of them wearing the device and also the appearance of the HMD as a helmet, glasses, and futuristic contact lenses. The results showed that across all three scenarios, the contacts were perceived to have the highest advantage and the highest potential for misuse. These results address the research question, A.II.1, in the methodology Table 2.

Additional work has been done in looking into natural gestures for interaction in Virtual Reality (VR) which analyzed a series of gestures used to trigger a extendable abstract arm in VR [Eghtebas et al. (2018)]. Exploratory work has also been done on the interaction methods with BCI's which looked into the possible applications of BCI's and suggested criteria for integration of the calibration procedure of BCI's with the core application usage [Eghtebas et al. (2017a)].

# Next Steps and Expected Contributions

Future work will be carried out by filling in the missing points highlighted in Table 2. Addressing quadrant A.I.1 and A.I.2, Electrooculography (EOG) will be used in conjunction with an AR HMD to understand which situations require AR mediated intervention as well as the model to detect physiological changes that indicate the needed intervention in a social group. Quadrant A.II.2 + 3 a follow up study from the survey results will look into varying the device capability to instead of just zoom also investigate other augmenting abilities (thermal, x-ray, other visible frequency spectrum, etc.) and investigate just how dominant the social role of the wearer is in understanding perception of acceptability of an AR HMD.

I plan to make contributions in understanding the social dynamics surrounding the likely ubiquity of AR HMD's and make design and implementation suggestions towards the usage of AR applications that are used in a social setting. Furthermore, I plan on highlighting the benefits of an augmenting technology, such as AR HMD's, for an individual in social situations while exploring ways that perception change can occur.

# References


Eghteabs, C., B. Ritter, A. Parikh, and L. Lischke (2017): 'Effects of Color and Threshold on User Perception of Heat Maps'. In: *Proceedings of the 2017 ACM Conference Companion Publication on Designing Interactive Systems*. pp. 275–279.

Eghtebas, C., C. Haupt, and G. Klinker (2017a): 'Recommendations for Building Gamified Calibration Technologies for BCI Applications'. In: *Extended Abstracts Publication of the Annual Symposium on Computer-Human Interaction in Play*. pp. 527–533.

Eghtebas, C., Y. S. Pai, K. Väänänen, T. Pfeiffer, J. Meyer, and S. Lukosch (2017b): 'Initial Model of Social Acceptability for Human Augmentation Technologies'. In: *Amplify Workshop@ CHI 2017*.

Eghtebas, C., S. Weber, and G. Klinker (2018): 'Investigation into Natural Gestures Using EMG for SuperNatural Interaction in VR'. In: *The 31st Annual ACM Symposium on User Interface Software and Technology Adjunct Proceedings*. pp. 102–104.

Hong, J. (2013): 'Considering privacy issues in the context of Google glass'.

Mann, S. (2002): 'Mediated reality with implementations for everyday life'. *Presence Connect*, vol. 1.

Profita, H., R. Albaghli, L. Findlater, P. Jaeger, and S. K. Kane (2016): 'The AT effect: how disability affects the perceived social acceptability of head-mounted display use'. In: *proceedings of the 2016 CHI conference on human factors in computing systems*. pp. 4884–4895.

Starner, T., B. Rhodes, J. Weaver, and A. Pentland (1999): 'Everyday-use wearable computers'. In: *International Symposium on Wearable Computers*. p. 9.

*Clélie Amiot (2020): Trustworthy chatbots assisting large-scale collaboration. In: Proceedings of the 18th European Conference on Computer-Supported Cooperative Work: The International Venue on Practice-centred Computing on the Design of Cooperation Technologies, Reports of the European Society for Socially Embedded Technologies (ISSN 2510-2591), DOI: 10.18420/ecscw2020_dc03*

# Trustworthy chatbots assisting large-scale collaboration

Clélie Amiot
Inria, Université de Lorraine, CNRS
*Contact Author: clelie.amiot@loria.fr*

**Abstract.** Cognitive assistants are a promising solution to the increasing complexity of large-scale collaboration. By providing support in data processing and decision making, they could lighten the cognitive load put on human collaborators. More precisely, conversational agents are especially suited to large-scale collaboration as they are user-friendly and could be integrated into existing collaboration tools. However, to be successfully integrated into the collaboration process, the assistant needs to be trusted. My doctoral research aims to identify which factors determine trust in a chatbot's advice during collaboration.

## 1 Introduction

Large-scale collaboration describes a joint effort between dozens of people working towards the same goal, who often come from multiple organizations with different work processes and have varying levels and areas of expertise. The release of a new product by a multinational brand, the organization of the Olympics, and the coordination of relief efforts after a flood are all examples of large-scale collaboration. Successful collaboration relies on trust between the agents, in their intentions and competences, or at the very least trust in their organizations (Dodgson, 1993). Without trust, communication lines deteriorate as

they get disregarded more often, and poor decisions might be taken (Daim et al., 2012). In large-scale, this is made even more difficult as most agents do not know each other, and their work processes might clash.

While modern communication technology can ease collaboration, it also is the source of growing complexity. More data sources, such as sensors, crowd-sourcing, and social media, are leveraged (McAfee et al., 2012), and it has become harder to make suitable decisions, as there is too much available information to process (Vieweg et al., 2014). Our goal is to introduce cognitive assistants to large-scale collaboration who could lighten the cognitive load put on collaborators, by summarizing data and keeping better track of relevant contextual information. We are mainly interested in conversational agents, also referred to as chatbots, which are text or vocal interfaces that simulate human speech (Dale, 2016). We hope that chatbots could be integrated into already existing tools for collaboration, who often provide direct messaging functionalities, and provide assistance to users without prior training, as conversational interfaces are relatively user-friendly (Zadrozny et al., 2000).

# 2 Related work

Chatbots are a booming technology that sees more use in recent years but is yet still relatively overlooked in large-scale collaboration or crisis management (Misiura and Verity, 2019). Its primary use case is commercial prospecting and customer service. Concerning trust, Følstad et al. (2018) identified multiple trust factors for commercial chatbots and sorted them as either internal or external. The internal factors (relevance of the answers, personality, transparency on its limitations, and general appearance) are determined by the chatbot itself. In contrast, the external factors depend on the environment of the chatbot (company, security, privacy, and importance of the task). Müller et al. (2019) have described three different personality profiles when it comes to trusting voice assistants using the HEXACO model of personality. Those profiles are "introverted careless distrusting user", "conscientious curious trusting user", and "careless dishonest trusting user". However, those studies are not interested in measuring how this trust affects future actions and the dissemination of the information given. One study by Ramchurn et al. (2016) about a crisis management cognitive assistant did show that the ability to debate the assistant's decisions was an important factor when following its advice.

As chatbots get more reliable, we see an increase in interest for health chatbots who are closer to our application domain, as the conversations tend to be more critical and time-sensitive. The trust factors for medical chatbots identified by Wang and Siau (2018) are similar to the ones for commercial use with an emphasis given to data security and the explainability of the chatbot's advice.

Aside from the application domain of the chatbot, most of the current research have in common that they are interested in dyadic conversations and do not explore how group dynamics are affected by the introduction of a conversational agent.

# 3 Proposed experimental design

We are working on a minimal protocol to study the impact of a chatbot assistant on problem-solving. A subject has to answer a sequence of questions with an assistant helping her over a real-time chat. We propose a between-subject design with a first group interacting with an assistant presented as a human researcher and a second group interacting with an assistant presented as a conversational agent. However, we do not want technical difficulties to impair the conversation and deteriorate the participant's trust in the chatbot. For this reason, we will use a wizard of Oz approach for the group interacting with the "chatbot" (Dahlbäck et al., 1993). This means that while the participants think that they are conversing with a chatbot, they will actually be conversing with an experimenter following a script. The assistant for the two groups will be working off the same script to avoid introducing any disparity in the experimental setups. The subject will have to answer a list of multiple-choice questions requiring her reasoning and logical skills. The questions are designed to be non-trivial enough that the assistant can be helpful and provide advice. For example, some of them are based on NASA's survival on the moon scenario, where the participant has to rank a list of various objects by their usefulness on the moon. Some non-obvious answers are that a compass is useless without Earth's magnetic field, and a parachute can provide protection against the sun's rays. When questioning the subject, the assistant will have different interactivity levels, assigned randomly: simply asking the question, providing a tip beforehand, or challenging the answer provided by the subject. Whatever the level of interactivity, the assistant will also provide additional advice to the subject if prompted.

We will measure the number and length of the messages sent to the assistant, as well as their time distribution (evenly distributed, clustered towards the beginning or the end of the conversation). The messages will also be classified by type (for example, questions about the assistant or requests for help). We will evaluate the performance of the participant by the reflection time for each question and the number of right answers given. As we want to assess the participant's trust in the assistant, we will determine how many times the subject followed the assistant advice and changed her answer. The participant will also fill a post-experiment survey with her perceived fluency with instant messaging, her estimated score, and her trust in the assistant's advice.

# 4 Expected contributions and future works

With this first experiment, we should get our first results on how communication and trust with an agent differ depending on whether he or she is perceived as human or as a robot. We theorize that the participants will exchange more when they think they are discussing with a chatbot, as they should feel less self-conscious and more inclined to ask for advice (Brandtzaeg and Følstad, 2017). However, we are aware that the results might be affected by the observer's effect as the subjects know that

their conversation logs will be read. We also expect them to use shorter sentences, as people tend to speak less courteously to robots and more directly (Hill et al., 2015). Next, we expect the human assistants to be given a better score in the survey and to have their advice followed more often. Indeed, chatbots tend to be perceived less favorably than humans when their tasks are not purely technical (Seeger et al., 2017).

With those results, our next step will be to introduce more human participants in the experiment by having three humans communicating by chat and trying to efficiently resolve a task with the help of the assistant. This next experiment will allow us to see how group dynamics are affected by the help of a conversational agent and how the participants integrate the agent in their reflection. This will bring us one step closer to our research goal, which concerns large-scale collaboration.

Additionally, we aim to organize focus groups with some of the anticipated users of the conversational agent: firemen or the army, for example. With this, we will be able to have a more accurate picture of the actual needs and expectations for this chatbot and design the first prototype accordingly.

# References


Brandtzaeg, P. B. and A. Følstad (2017): 'Why people use chatbots'. In: *International Conference on Internet Science*. pp. 377–392.

Dahlbäck, N., A. Jönsson, and L. Ahrenberg (1993): 'Wizard of Oz studies: why and how'. In: *Proceedings of the 1st international conference on Intelligent user interfaces*. pp. 193–200.

Daim, T. U., A. Ha, S. Reutiman, B. Hughes, U. Pathak, W. Bynum, and A. Bhatla (2012): 'Exploring the communication breakdown in global virtual teams'. *International Journal of Project Management*, vol. 30, no. 2, pp. 199–212.

Dale, R. (2016): 'The return of the chatbots'. *Natural Language Engineering*, vol. 22, no. 5, pp. 811–817.

Dodgson, M. (1993): 'Learning, trust, and technological collaboration'. *Human relations*, vol. 46, no. 1, pp. 77–95.

Følstad, A., C. B. Nordheim, and C. A. Bjørkli (2018): 'What makes users trust a chatbot for customer service? An exploratory interview study'. In: *International Conference on Internet Science*. pp. 194–208.

Hill, J., W. R. Ford, and I. G. Farreras (2015): 'Real conversations with artificial intelligence: A comparison between human–human online conversations and human–chatbot conversations'. *Computers in human behavior*, vol. 49, pp. 245–250.

McAfee, A., E. Brynjolfsson, T. H. Davenport, D. Patil, and D. Barton (2012): 'Big data: the management revolution'. *Harvard business review*, vol. 90, no. 10, pp. 60–68.

Misiura, J. and A. Verity (2019): 'Chatbots in the humanitarian field - Concepts, uses and shortfalls'. https://www.digitalhumanitarians.com/chatbots-in-the-humanitarian-field-concepts-uses-and-shortfalls.

Müller, L., J. Mattke, C. Maier, T. Weitzel, and H. Graser (2019): 'Chatbot Acceptance: A Latent Profile Analysis on Individuals' Trust in Conversational Agents'. In: *Proceedings of the 2019 on Computers and People Research Conference*. pp. 35–42.

Ramchurn, S. D., F. Wu, W. Jiang, J. E. Fischer, S. Reece, S. Roberts, T. Rodden, C. Greenhalgh, and N. R. Jennings (2016): 'Human–agent collaboration for disaster response'. *Autonomous Agents and Multi-Agent Systems*, vol. 30, no. 1, pp. 82–111.

Seeger, A.-M., J. Pfeiffer, and A. Heinzl (2017): 'When do we need a human? Anthropomorphic design and trustworthiness of conversational agents'. In: *Proceedings of the Sixteenth Annual Pre-ICIS Workshop on HCI Research in MIS, AISeL, Seoul, Korea*, Vol. 10.

Vieweg, S., C. Castillo, and M. Imran (2014): 'Integrating social media communications into the rapid assessment of sudden onset disasters'. In: *International Conference on Social Informatics*. pp. 444–461.

Wang, W. and K. Siau (2018): 'Trust in Health Chatbots'.

Zadrozny, W., M. Budzikowska, J. Chai, N. Kambhatla, S. Levesque, and N. Nicolov (2000): 'Natural language dialogue for personalized interaction'. *Communications of the ACM*, vol. 43, no. 8, pp. 116–120.

Ganiat Omolara Kazeem (2020): Risk prediction and decision making in *policing – Humans, Algorithms and Data. (A study of processes at Bedfordshire, Hertfordshire and Cambridgeshire police) In: Proceedings of the 18th European Conference on Computer-Supported Cooperative Work: The International Venue on Practice-centred Computing on the Design of Cooperation Technologies, Reports of the European Society for Socially Embedded Technologies (ISSN 2510-2591), DOI: 10.18420/ecscw2020_dc04*



# **Risk prediction and decision making in policing – Humans, Algorithms and Data**. (A study of processes at Bedfordshire, Hertfordshire and Cambridgeshire police)

Author(s) Ganiat Omolara Kazeem
Affiliation(s) Department for Computing and Communications & The Centre for Police Research and Learning (CPRL), The Open University, United Kingdom.
*Email address(es)* ganiat.kazeem@open.ac.uk

**Abstract** My inductive interpretivist study focusses on understanding of the police process of information collection/acquisition, management and exploitation during risk assessments and decision making in the counties of Bedfordshire, Cambridgeshire and Hertfordshire located outside the metropolitan area. It is examining the role of humans in the production (through interactions with staff in police control rooms), generation (during day to day policing) and creation (through intelligence collected via community policing and detectives investigating focused criminal issues) of information through ethnography. It is focussed on gathering narratives and perspectives to enable an understanding of the information cycle in policing and nature (culture, context, practices, processes) of information collection, management, use and exploitation and determining how these shape the use and exploitation of data generated. It also considers the critical issues related to use of information for risk assessment and decision making in policing using advanced metrics or statistics, algorithms and other advanced technologies.

# Introduction

My doctoral research concentrates on three closely related police forces that have a resource sharing agreement and operate unified information and communication technology (ICT) solutions, armed policing units, dog units, firearms and explosives licencing, road policing, major crimes, police support and scientific services. Together, they operate a single integrated collaborative enterprise resource management system. They have worked over the last 5 years to implement their single ICT solution called Athena which works in conjunction with STORM command and control software (Black, 2017).

My work explores working cultures, strategies and the impact of modern technologies on compliance with legislation and guidance on evidence such as the police and criminal evidence act of 1984 (PACE) and the management of police information within the confines of the policing environment from worldviews of police officers (NPIA & ACPO, 2010). I am seeking clarity and understanding of what, who, why, how and when does communication occur. I am particularly interested in understanding the social aspects of creation and representation of information systems as a means of understanding how technologies alter or create human activities. I focus on the flow and flux of information, interaction with technological artefacts and the social context in which this all happens by inductively exploring information use, information sharing, information storage and the context in which data sharing, collection and exploitation occur engaging member checking and incorporating systems thinking for validation.

# Research Questions

My research questions seek understanding of the human role in the lifecycle of information including the innovative technologies related to and/or used for risk assessment and decision making with limited disruption to the natural setting.

a. How do police officers understand their own role and the role of ICTs in the collection, storage and exploitation of information for the purpose of risk assessment and decision making?
b. How aware are police officers of the critical implications that information and communication technologies have on the execution of duty including ethical issues, fairness, balanced and appropriate risk assessment and decision making with respect to citizens?
c. How do police officers feel about predictive tools that use historical data for mining, artificial intelligence, predictive policing, machine learning or for artificial decision making?
d. What are the concerns about the future of data use for identifying, assessing or detecting risk and making decisions from the perspectives of police officers and how will this affect their practices?
e. How are all the above impacted by the COVID-19 pandemic event?

# Methodological approach

My inductive interpretive research paradigm approach enquires and seeks socially constructed meanings which emerge from observed phenomena and I am gaining understanding of the relationships in policing (Wilson & Chaddha, 2010). I am experiencing the role of powershifts and human nature in processes alongside functional technologies in policing (Balcioglu & Pala, 2015; Radovan, 2013). This is allowing me to derive a robust range of perspectives while iteratively subjecting my data to evaluation to draw out themed conclusions to hold against various concepts and theories to increase or enhance understanding (Babones, 2015; Klein & Myers, 1999; Walsham, 2017).

# Work/Findings to date

Intelligence led policing guides the way policing is conducted at these police forces and they predominantly use the information and intelligence they gather to maximise resources and deter or prevent crime. I have so far observed the intricacies around how information passes through the tacit-tacit to tacit-non tacit loop from humans to data (which is expected to be meaningful, accurate and prejudice/bias free), from the worldviews of police officers across ranks. Policing work involves the need to acquire and share and routinely distribute information which has been shown to be a crucial element of agile working (Bider & Jalali, 2014). I have noted how little time there is to make decisions on the fly using agile working processes.

So far, my role as an observer-participant has enabled me to gain more understanding and reminded me of how emotionally, physically and mentally taxing the role of policing is. I have found that the way information is supplied, acquired, shared and used in policing influences risk assessment and decision making. Technologies are 'adequate' but not very advanced for communication and information dependent, complex, multifaceted and challenging work. There are some limitations, such as chronic disruptions to/unreliability of communication networks, clunky, and complex systems with limited uptimes leading to inevitable dependency on legacy systems and lost manhours. There are feasibility issues related to using handheld devices to access and/or facilitate response work on the fly. I have observed malleability and resilience of police officers as they interact and adapt to the new and old technological artefacts in their workplace. There are also concerns about and around the intended plans by the home office to move airwave communications to mobile 4 and 5G networks, which retroactively relate to the extant problems with introducing new technologies and the experiences police officers have of forced technology adoptions.

There are potential benefits such as better accountability, swifter crime investigation and evidence collection through the use of body worn cameras, centralised database systems with wider information sharing capabilities across three policing counties and easier information retrieval and intelligence recording. Additionally, I have noted use of EBIT a predictive tool used for decision making with respect to investigations and collaborative working including joint response activities which involves sharing and interaction between police officers, ambulance and paramedic services and fire services that demonstrate that communication and sharing of information between officers and these services is critical. Beyond this the concerns regarding persistently diminishing funding which I first observed four years ago as an early stage researcher remain. Significant policing resources are expended on receiving,

recording, monitoring, reporting and sharing information as a direct result of being used as a service of first, last and convenient resort by health and social care agencies.

# Next Steps

My field immersion was ongoing until 10th of March, at which time after 177 hours in field person to person contact with the public was suspended. In light of the current pandemic, I am continuing with digital ethnographic tools and I have extended my research questions to include a supplementary question that contextualises research conducted during the pandemic. This will enable me to collect insights related to my research and account for/include insights about the unique conditions during my research.

# Expected Contributions

The views, perspectives and opinions from the police gained through my research will highlight and enable closer evaluation of the interlocking of people, policy and public service with respect to use and governance of data, communication practices, information flows, management of information and balanced risk evaluation, risk management and decision making. It will highlight processes, habits and practices and promote understanding of people, policy and policing in the process of risk evaluation, risk management and decision making and provide insights and narratives from the worldviews and perspectives of those who do the work, giving a voice to police officers.

**References**


Babones, S. (2015). Interpretive quantitative methods for the social sciences. *Sociology, 50*(3), 453-469. doi:10.1177/0038038515583637

Balcioglu, E., & Pala, E. (2015). Police accountability system in England and Wales. *Journal of Sociological research, 18*(1), 30-56. doi:DOI: 10.18490/sad.50186

Bider, I., & Jalali, A. (2014). Agile business process development: why, how and when—applying Nonaka's theory of knowledge transformation to business process development. *Information Systems and e-Business Management, 14*(4), 693-731. doi:10.1007/s10257-014-0256-1

Black, J. (2017). *The Bedfordshire police, Cambridgeshire constabulary and Hertfordshire Constabulary (BCH) ICT strategy for 2016 to 2021*. (Version 0.7). Cambridgeshire: BCH ICT Management

Klein, H. K., & Myers, M. D. (1999). A Set of Principles for Conducting and Evaluating Interpretive Field Studies in Information Systems. *MIS Quarterly, 23*(1), 67. doi:10.2307/249410

NPIA, & ACPO. (2010). Guidance on the management of police information [MoPI]. *NPIA Practice Improvement Guidance*, 190.

Radovan, M. (2013). ICT and Human progress. *The Information Society, 29*(5), 297-306. doi:10.1080/01972243.2013.825686

Walsham, G. (2017). Doing interpretive research. *European Journal of Information Systems, 15*(3), 320-330. doi:10.1057/palgrave.ejis.3000589

Wilson, W. J., & Chaddha, A. (2010). The Role of Theory in Ethnographic Research. *Ethnography, 10*(4), 549-564. doi:10.1177/1466138109347009

*Nana Kesewaa Dankwa (2020): Diversifying Smart Home Contexts. In: Proceedings of the 18th European Conference on Computer-Supported Cooperative Work: The International Venue on Practice-centred Computing on the Design of Cooperation Technologies, Reports of the European Society for Socially Embedded Technologies (ISSN 2510-2591), DOI: 10.18420/ecscw2020_dc06*

# Diversifying Smart Home Contexts

Nana Kesewaa Dankwa
University of Kassel
*nkdankwa@uni-kassel.de*

**Abstract.** Advances in smart home technological innovation over the years has seen an increase in consumer interests. However, research contexts for smart homes tend to skew towards "traditional" living and housing situations. Through my Ph.D. research, I raise awareness of the need to consider other user contexts and living situations. I do this by exploring opportunities for smart home innovation with elderly women who live alone. I work with the elderly women to understand their values, needs, and collaboratively create new smart home devices. The outcome of my research would be smart home devices that support the lives and contexts of elderly women living alone.

## Overview of Research

The past five years has seen a rise in user interests in smart home devices especially in Germany. Nonetheless, the smart home concept is yet to be realized on a massive scale. This is attributed to research not acknowledging the household as a complexity of relationships and the concept of smart homes advanced as a neutral and bland place (Richardson, 2009). In CSCW and HCI, domestic and home research like Odom et al. (2019) & (2010), Leshed et al. (2014) and Jenkins (2017) examine less mainstream contexts such as collective and mobile living, divorced families, farm families, and co-housing. There however still exists a research gap for other family and living situations (e.g. older lone persons, one parent families with children, etc.). This means including the less mainstream and avoiding the one-size fits all concepts in design. My PhD

research approaches the smart home discourse with a diversity lens. I raise awareness of the diverse contexts of the "home", living situations and social relationships. I work with elderly women (≥65 years) who live alone and investigate opportunities for smart home devices that meet their values, needs, skills and experiences.

Owing to the gender gap in life expectancy, elderly women spend a greater part of their elderly lives alone. In the EU, elderly women represent the largest proportion of women living alone. Elderly women may suffer more from advances in technological innovations as they are designed with young adults in mind. They may also have financial constraints in purchasing smart home technology. Elderly women living alone will have different sets of needs as compared to what Hargreaves et al. (2013) describe as the typical notion of smart home consumers: middle-class white family with children. Furthermore, the social relationships of persons living alone differ from persons who live with others. Identity factors such as age, education, gender, economic status are key determinants of the quality of life in old age (WHO, 2002). Diversifying smart home design acknowledges the complex identities of persons and claims these should drive design.

# Research Motivations and Methodology

This PhD research is part of an overarching research project INTeGER (Innovation through Gender in Computing). The project examines innovations in Computer Science and its gendered aspects. Examining gender and diversity aspects in technology use and development can advance gender equality, avoid oppressive technology, address biases in technology use and ownership and uncover overlooked perspectives (Everts et al., 1998, Eubanks, 2018).

My PhD research examines smart home innovations and the role of gender and diversity in driving design. Academic research is narrow in providing guidance in extending Information Technology development and design to cater for the complexities of user identity, gender and diversity aspects. My research also examines collaborative creation of smart home technology. As tools and techniques in collaborative creation must reflect the users skills, interests, etc., it is interesting to discover which materials, artefacts, tools and techniques deliver prototypes when working with elderly women. My research questions are:

- What tools and techniques support the collaborative creation of smart home technology with elderly women?
- What factors allow the carry-on of gender and diversity stereotypes in creating smart home technology?
- What effects does working with diverse users have on generating diverse ideas?

My first approach to this research was to conduct a literature review of theories and related research in smart homes, innovation, gender & diversity and collaborative creation. I adopted Participatory Design as the design approach for collaborative creation as it empowers less heard voices to equally participate in the design process (Spinuzzi, 2005). Data (qualitative & quantitative) from semi-

structured interviews and co-creation sessions will be analysed to provide insights and inform the design of a smart prototype for the home. Next, a field evaluation using qualitative and quantitative research methods (interviews and device logging) will be conducted.

# Work/Findings to Date

I present below the four stages I have defined to carry out my research work.

- Background Research: Initial research into related research projects and literature was done find the research guiding path. The literature review concentrated on the topics (smart homes, innovation, gender & diversity and collaborative creation above) and gave an assessment of the current state of research on the topics and direction on how to position my research.
- User Research: In the next stage, seven elderly women (see Table I.) were recruited for the study. A getting-to-know session, semi-structured interviews and a study of use experience with a smart speaker (Amazon Echo Dot) have been carried out. The studies brought to light the values of the women. These include freedom, independency, social circles. It highlighted the role of their friends, hobbies, and social as key structure. All women were unable to use the smart speaker due to factors such as lack of Wi-Fi, privacy & security concerns.

Table I. Demographics of the elderly women. All names have been anonymized.

| PID | Age | Years living in current home | Years living Alone |
|---|---|---|---|
| Anna | 81 | 51 | 10 |
| Heike | 83 | 50 | 7.5 |
| Emma | 82 | 50 | 3 |
| Beate | 80 | 38 | 3 |
| Eva | 79 | 45 | 11 |
| Hanna | 75 | 19 | 19 |
| Barbara | 79 | 55 | 1.5 |

- Collaborative Sessions: The next stage will be to conduct co-creation workshops with diverse user groups with tools and techniques identified for this purpose. This will provide the platform for further classification of methods, tools and techniques for gender and diversity driven PD. These workshops will empower users with the needed tools and techniques to innovate smart home technology based on user contexts.
- Development & Evaluation: Design insights, ideas and prototypes from the step above will be conceptualized and developed into research prototypes. A further step will evaluate the prototypes with the elderly women.

# Next Steps

I look forward to conducting regular co-creative sessions with the elderly women this year. This will consist of make activities that lead to smart prototypes for their homes with materials and tools they are familiar with. The prototypes from will inform the design of a smart home device that I will develop. The device will be evaluated with the elderly women for a period.

# Expected Contributions

I contribute to the dialogue on diversifying smart home contexts and raise awareness of the complex identities of older persons. My research addresses age stereotypes especially in the design of smart home technology. It shifts the focus from the stereotypical notions of disability, illness, etc of old age and finds other needs that accommodate the diverse (intersectional) identities of elderly women. Finally, I look forward to presenting design considerations and prototypes to the CSCW and HCI community that works with diverse user groups for smart home design at the end of my research.

# References


Eubanks, V. (2018). *Automating inequality: How high-tech tools profile, police, and punish the poor*. St. Martin's Press.

Everts, S. I., & Everts, S. (1998). *Gender and technology: Empowering women, engendering development*. Zed Books.

Hargreaves, T., Wilson, C., & Hauxwell-Baldwin, R. (2013). Who uses smart home technologies? Representations of users by the smart home industry. *European Council for an Energy Efficient Economy (ECEEE) Summer Study on Energy Efficiency in Buildings*.

Jenkins, T. (2017). Living Apart, Together: Cohousing as a Site for ICT Design. In *Proceedings of the 2017 Conference on Designing Interactive Systems* (pp. 1039-1051).

Leshed, G., Håkansson, M., & Kaye, J. J. (2014). " Our life is the farm and farming is our life" home-work coordination in organic farm families. In *Proceedings of the 17th ACM conference on Computer supported cooperative work & social computing* (pp. 487-498).

Odom, W., Anand, S., Oogjes, D., & Shin, J. (2019). Diversifying the Domestic: A Design Inquiry into Collective and Mobile Living. In *Proceedings of the 2019 on Designing Interactive Systems Conference* (pp. 1377-1390).

Odom, W., Zimmerman, J., & Forlizzi, J. (2010). Designing for dynamic family structures: divorced families and interactive systems. In *Proceedings of the 8th ACM Conference on Designing Interactive Systems* (pp. 151-160).

Richardson, H. J. (2009). A 'smart house' is not a home: The domestication of ICTs. *Information Systems Frontiers*, vol. *11* no. 5, pp. 599.

Spinuzzi, C. (2005). The methodology of participatory design. *Technical communication*, *52*(2), 163-174.

World Health Organization. (2002). *Active ageing: A policy framework* (No. WHO/NMH/NPH/02.8). Geneva: World Health Organization.

*Olivia Ruston (2020): Design Fundamentals of Wearable Technology. In: Proceedings of the 18th European Conference on Computer-Supported Cooperative Work: The International Venue on Practice-centred Computing on the Design of Cooperation Technologies - Doctoral Colloquium, Reports of the European Society for Socially Embedded Technologies (ISSN 2510-2591), DOI: 10.18420/ecscw2020_dc07*

# Design Fundamentals of Wearable Technology

Olivia Ruston
University of Bath
*Contact Author: ogr20@bath.ac.uk*

**Abstract.** Wearable technologies have the potential to integrate information that has meaning for people as they go about their everyday lives. In particular they can reflect aspects of the social environment, extending the periphery of the person and allowing them to experience social encounters with greater depth. This research concerns the indicative qualities of interactive clothing to support social relations in informal settings.

## Introduction

Wearable technologies have existed in some form since the late 1960s. From early heads-up displays and the personal information systems developed in research laboratories, to the popular emergence of e-textiles crafting in more recent years. Wearable technologies are typically embodied, in that they require consideration of physical form and the physical spaces people may occupy. They must also respect the viewpoint the wearer has on their world if they are to appropriately support relevant awareness. However, little attention has been given to the use of wearable technologies in public spaces and their effects on social relations. Their applications are numerous and varied, with the potential to be of value to wearers in everyday settings, including emerging work on interactive clothing.

My research concerns the design and indicative characteristics of interactive clothing, focusing on those designed for use in a social context. Social wearable technologies are devices worn on the body, to gather and display relevant information in a social environment. They stand to benefit their wearers and those in their presence by creating new opportunities for initiating, maintaining and discontinuing social relations. Social relations, in this context, focuses on co-located, in-person interactions between two or more people.

The research involves a series of iterative user-centred design and evaluation activities to articulate key parameters of interactive clothing as a social, wearable user experience. It has begun by building on a framework for designing around awareness and embodied user interactions in virtual environments, the Fahlén & Benford (1993) "Spatial Model of Interaction in Large Virtual Environments"(SMILV). The iterative activities will progressively articulate a new framework from this starting point to integrate qualities found in prior research on wearable technologies with new concerns exposed in my original empirical work on user experience in informal social settings.

- My overarching research question is:
  - How might interactive clothing support wearers to coordinate their joint experience as they move through an informal social space?
- To address this research goal, three questions are guiding my current approach
  - How can designers of wearable tech account for joint social use in informal settings?
  - What do designers and potential users of wearable technology consider to be the key parameters of wearer experience?
  - How does appropriateness of clothing effect the wearer experience?

# Related Work

It is widely accepted that the first example of wearable technology was conceived by Thorp and Shannon and designed to aid the wearer in a game of roulette (Thorp 1998). As the size of a cigarette packet, the device was worn inside the shoe with a wired connection to a small speaker by the wearer's ear. Several other significant examples were created but serious research into wearable technology and their applications began in the 1990s. It was at this time that researchers began to explore how wearable technology might be used as a collaborative tool, often to augment face-to-face interactions. The wearer's position in a social space and proximity to a person acts as a trigger for the wearable device to communicate supporting information. The wearable remembrance agent takes the form of a heads-up display and aims to support memory by presenting the wearer with contextually relevant texts (Rhodes 1997). The Hummingbird is an interpersonal awareness device worn around the neck or at the waits, intended to connect members of a group by supplying continuous visual and aural indications of whether other group members are close (Holmquist et al. 1999).

In the past ten years, the advancement and accessibility in e-textiles craft approaches have allowed wearable technologies to exist as interactive clothing, in which the technology is a fully embedded part of the garment (Mackey 2017, CuteCircuit 2009). The choices an individual makes about how they present themselves can affect their subsequent social interactions, both in how the individual is perceived by others and in how the individual feels about themselves (Goffman 1959). Self-presentation and choices of personal style can be better realised in interactive clothing. Prior research has often attempt to describe characteristics of wearable technology that could have general value, using terms such as sensing, perception, and hands-free. My analysis of the literature has identified at least 23 such terms however none point to an understanding of situated interactions and the nuances of meaning in embodied social encounters. My design and empirical work is thus organised around the problematics of wearable technology in informal social spaces so that the meaning and effect of interactive garments on interpersonal relations might be better understood.

# Work to Date

My work in this area over the last three years has involved prototyping garments with interactive components. Early empirical work, carried out whilst still an undergraduate student, involved attempts to adapt the SMILV for use in the design of social interactive clothing by varying parameters of awareness. Scenarios detailed how interactive clothing might control levels of awareness between the wearer and bystanders to evoke some social action, be that initiating, maintaining or discontinuing an encounter.

My most recent design activity has produced the Meetup Jacket: a prototype developed from scenarios based on café and gallery social interactions. The garment is intended for use in informal, social settings. It is an interactive garment that communicates feedback about proximity to a partner jacket through colour-changing LEDs. The aim is to increase awareness of friends when arranging to meeting up.

The Meetup Jacket was evaluated through a study involving two participants coming together in a cafe/gallery space at the University of Bath. The focus of this study was to investigate the social affordances offered by the device, alongside the influence of the wearers' perception of their self-presentation.One participant was seated in the cafe while the second participant made their way to the meetup location. Once the participants had come together, they were asked to walk around the gallery. This allowed insight into wearers' experience of the garment whilst moving around, stationary and with another wearer, demonstrating both the initiation of a social interaction and maintenance of the continued interaction.

Findings from the study were based upon some observations but mostly semi-structured interviews with the participant pairs after the main activities. Making observations was difficult as the study took place 'in the wild' in two

different locations simultaneously. Similarly in the second part of the study, the gallery space was small which made inconspicuous observation impossible.

An interesting area of research that emerged from the study findings was the enhanced awareness of social closeness afforded by the Meetup Jackets. Whilst moving around the exhibition space, several participants said that they had tried keep their meetup light green, thus staying closer together. The light changes to green when the wearers are within approximately two metres of each other:

> "*Keeping in the green space.*" (P3)

The social meaning created by the joint display of green lights could be understood as a new "green space" of sociability.

# Towards Ethnographically Informed Design of Interactive Clothing

My research must now move towards a more coherent approach to studying how my designs may be appropriated by those who wear them. The case of the "green space" seems to show how meaning can be created as an effect of the designs I created; designs that respected and reflected human movement in a gallery space. I want my design work to create opportunities for meaningful interaction in informal social settings so hope that those who participate in my studies will help me gain insights for supporting this. I hope that my involvement in the ECSCW DC will help me to better frame both the idea of an informal social setting and the potential for using an ethnographic approach to inform my design work.

# References


Benford, S. and L. Fahlén (1993): 'A Spatial Model of Interaction in Large Virtual Environments'. *Proceedings of the Third European Conference on Computer-Supported Cooperative Work 13–17 September 1993, Milan, Italy ECSCW '93*, pp. 109–124.

CuteCircuit (2020): 'CuteCircuit - Biography'.

Goffman, E. (2010): 'The presentation of self in everyday life: Selections'. *The Production of Reality: Essays and Readings on Social Interaction*, no. June, pp. 262.

Holmquist, L. E., J. Falk, and J. Wigstrm (1999): 'Supporting Group Collaboration with Interpersonal Awareness Devices', pp. 13–21.

Mackey, A., R. Wakkary, S. Wensveen, and O. Tomico (2017): '"Can I wear this?" blending clothing and digital expression by wearing dynamic fabric'. *International Journal of Design*, vol. 11, no. 3, pp. 51–65.

Rhodes, B. J. (1997): 'The wearable remembrance agent: A system for augmented memory'. *Personal and Ubiquitous Computing*, vol. 1, no. 4, pp. 218–224.

Thorp, E. O. (1998): 'The invention of the first wearable computer'. *International Symposium on Wearable Computers, Digest of Papers*, vol. 1998-Octob, pp. 4–8.

*Richard Paluch (2020): Technical and Affective Practices. In: Proceedings of the 18th European Conference on Computer-Supported Cooperative Work: The International Venue on Practice-centred Computing on the Design of Cooperation Technologies, Reports of the European Society for Socially Embedded Technologies (ISSN 2510-2591), DOI: 10.18420/ecscw2020_dc08*

# Technical and Affective Practices. An Investigation of Service Robots in Nursing Environments

Richard Paluch
University of Siegen
*Richard.Paluch@uni-siegen.de*

**Abstract.** This overview explains the first steps of a participatory design project. The aim is to evaluate a service robot for nursing with a qualitative approach and to explore technical and affective practices. The data will be analyzed with practice theory related to the grounded design paradigm. Expert interviews with five care workers and five IT specialists in the field of robotics will be conducted during 2020. Afterwards a series of participatory workshops with participants in need will be carried out focusing on the practices related to robots in caring settings.

## Introduction

Changes in population structure create new problems and challenges for care work (Sparrow, 2015). The increase in older people with dependencies and the decrease in trained care workers is leading to a search for alternatives worldwide. But in the meanwhile, various models of service robots have come on the market.

They appear to be a way to support mechanical care work and give care workers more time for meaningful, emotional activities (Whitby, 2012).

The research question is *How are technical and affective care practices interconnected in the design process of service robots?* The research deals with the issue of when practice is experienced as technical or robot-like and when practice is understood as affective or human-like. Both practices are present in the care profession (Graf & Treusch, 2020). For example, elderly residents in nursing homes experience some of the tasks of care workers as technical because they are mechanically or routinely carried out. A robot can serve as a replacement with respect to these tasks. On the other hand, care workers also engage in affective practices that require emotion, compassion and empathy. Can a robot do that too? What is of interest here is how these practices are experienced and how this experience of technical and affective practices influences the design, assessment and appropriation of robots. Are there certain practices that have to be executed mechanically for them to be considered good care work? Are there activities that have to include emotion such that they can be understood as solicitude?

To clarify these questions, the grounded design framework is chosen (Müller, 2019). Ten interviews with experts and several focus groups with participants in need of care will be conducted and qualitatively interpreted. The different experiences of practices will be identified in this context and the practical implications for the robot design process will be explored.

# Methodological approach

Participatory design is the methodological departure of this overview (Müller, 2019). The focus is on designing, assessing and appropriating a product together with its potential users such as people in need of care and social workers and on understanding the product development as an iterative, mutual process. Potential users are not just questioned with a view to a one-time acquisition of knowledge. Instead, the focus is on a reciprocal teaching and learning process where knowledge is generated through mutual exchange. It allows people in need and care workers to not just remain in the role of the user, but to act as active participants.

Practice theory provides the descriptive paradigm for the interpretation of the data (Reckwitz, 2002). This theory is particularly suitable for the analysis of participatory design and robotics. The emphasis is on the social situation and the emergence of mutually connected practices. Several relevant stakeholders are involved in care practice: The care workers, the nursing home staff, the robot developers, the researchers and even the robots. We can determine which practices are to be carried out and which habits the actors will follow by considering the entire constellation of actors.

I will not be developing an actual new product but try to understand the emerging practices in relation to an existing robot. Therefore, the focus is on an

inductive and deductive interpretation of the data and a constant refining of the data collection, interpretation and presentation of the results. However, the work does not follow the approach of Grounded Theory in all respects, but rather adapts it to practice theory. Different types of practices will be identified in the data (Strauss & Corbin, 1990).

# Next steps

Since the work is at its initial stages, research findings will not be presented here. The project is primarily concerned with reflecting on the existing state of research (literature review) and focusing on the research question *How are technical and affective care practices interconnected in the design process of service robots?* Accordingly, it refers to participatory design studies.

The emphasis here is on the design, assessment and appropriation of robotics in care environments from a practice-theoretical perspective (Reckwitz, 2002). After working on the literature review and placing the work in the existing research discourse, I will explain the practice theory and grounded design as methodology. I will then qualitatively analyze expert interviews and focus groups (Müller, 2019).

For the initial analysis, expert interviews with five care workers and five IT specialists will be conducted in order to learn which practices are used in care work and how a robot can be integrated into the nursing process. These experts will also serve as advisors who accompany and comment on the research process. In addition, focus groups with residents of nursing homes will be formed. Workshops will be repeatedly conducted with regard to the various design steps of the robot. These results are conveyed to the workshop participants and integrated into the design process of the robot. The robot will be appropriated in an iterative way, similar to the methodological evaluation of the material.

# Expected contributions

The focus of this research is on the participation of the residents of nursing homes, their relatives, care workers and developers of robots in the design process. The aim is to reveal which requirements can be expected to be fulfilled and how a robot can be appropriated through participatory design. This means that it is not just the usability of an already existing robot that is tested. Instead, a robot is examined in a collaborative design process and its various facets are worked out in this context.

This procedure creates a research process that directly integrates future users and their expectations. This thus makes direct reflection on the expectations present in this process possible. Additionally, it can show how different practices are experienced and how affective and technical practices can be distinguished.

# Open questions

An open question concerns the extent to which a service robot will be accepted in its different appropriation stages and in general what value acceptance plays in participatory design research. Acceptance is a phenomenon that is usually assumed during development (Hagen et al., 2018). Issues that needed to be examined are which user groups are invited, how heterogeneity is ensured and the extent to which these groups are representative of the profession or care environment. For example, are those who the volunteer only persons who are already in favor of robots?

Due to the 2019-20 coronavirus pandemic, it is also unclear, if ethnographic fieldwork can also be conducted so as to observe how a robot could be used in practice. That could give insights as to how a robot is integrated into the everyday life of a nursing home.

Finally, the gender perspective can be considered, for example observable gender differences in interacting with a robot and the gender stereotypes that could be implicit in the manufacturing of a robot (Haraway, 2004). Another open question here is how to address and conceptualize the dimension of gender in workshops and in the appropriation of robots.

# References


Corbin, J. M. and Strauss, A. L. (1990): 'Grounded theory research: Procedures, canons, and evaluative criteria', *Qualitative Sociology*, vol. 13, no. 1, March 1990, pp. 3-21.

Graf, P. and Treusch, P. (2020): '"Und dann fängt er einfach an, den Ball auf den Boden zu werfen!" Einsichten in Interaktionsverhältnisse als Statusverhandlungen mit dem humanoiden Roboter Pepper', in J. Hergesell, A. Maibaum, and M. Meister (eds.): *Genese und Folgen der »Pflegerobotik«. Die Konstitution eines interdisziplinären Forschungsfeldes*, Beltz Juventa, Basel, 2020, pp. 62-92.

Hagen, H., Nitschke, M., Schlindwein, D. and Goll, S. (2018): 'Akzeptanz als Problem, Partizipation als Lösung? Zu Prämissen und Bias in der partizipativen Forschung', in R. Weidner and A. Karafillidis (eds.): *Dritte Transdisziplinäre Konferenz: Technische Unterstützungssysteme, die die Menschen wirklich wollen*, Helmut-Schmidt-Universität, Hamburg, 2018, pp. 127-137.

Haraway, D. J. (2004): *The Haraway Reader*, Psychology Press, East Sussex, England.

Müller, C. (2019): 'Introduction to the thematic focus "Socio-Informatics"', *Media in Action – An Interdisciplinary Journal on Cooperative Media*, vol. 1, no. 1, May 2019, pp. 9-16.

Reckwitz, A. (2002): 'Toward a theory of social practices: A development in culturalist theorizing', *European Journal of Social Theory*, vol. 5, no. 2, May 2002, pp. 243-263.

Sparrow, R. (2015): 'Robots in aged care: A dystopian future?', *AI & Society*, vol. 31, no. 4, November 2015, pp. 445-454.

Whitby, B. (2012): 'Do You Want a Robot Lover? The Ethics of Caring Technologies', in P. Lin, K. Abney and G. A. Bekey (eds.): *Robot Ethics. The Ethical and Social Implications of Robotics*, MIT Press, Cambridge, Massachusetts and London, England, 2012, pp. 233-248.

*Steffi Kohl (2020): Improving collaboration in design thinking teams through automated coaches. In: Proceedings of the 18th European Conference on Computer-Supported Cooperative Work: The International Venue on Practice-centred Computing on the Design of Cooperation Technologies - Doctoral Colloquium Papers, Reports of the European Society for Socially Embedded Technologies (ISSN* 2510-2591*), DOI: 10.18420/ecscw2020_*dc09

# *Improving collaboration in design thinking teams through automated coaches*

*Steffi Kohl*
*School of Business and Economics, Maastricht Univeristy*
Contact Author: stefanie.kohl@maastrichtuniversity.nl

**Abstract.** Effective collaboration requires practice, reflection, and awareness of group dynamics. Expert coaches can facilitate learning these skills. However, while ideal, it is economically not feasible to have a coach for every team in every meeting. Emerging technology, such as sociometric badges, provide a promising opportunity to harness data about interactions to make collocated collaboration visible. These data can help researchers, designers, and users understand the complexity of collaboration and subsequently find means to improve them. This paper introduces a line of multidisciplinary research combining organisational science, business, and computer science. It aims to understand how communication patterns of design thinking teams in real world organizations are related to team performance, with the purpose of building automated coaches. The outcomes of this paper have potential applications in computer assisted coaching and contribute to the body of knowledge spanning multiple fields. It is hoped that the interdisciplinary nature of this research will promote the flow of ideas between social and computer sciences.

# Introduction

Collaborating effectively requires practice and awareness of group dynamics. Teams can develop this beneficial collaborative interaction and thus improving team performance through close expert coaching. Though, while ideal, it may be unrealistic in practice to always have a coach closely supervising each team. An additional challenge is that teams require different information or coaching depending on the type of work they are doing, or the stage of a project they are in. In this line of research I introduce the idea of an automated coach that addresses this need to provide coaching and information given the current team activity.

Automated coaches are particularly applicable to collocated collaboration settings on face to face teamwork, which remains the dominant mode for solving complex problems despite the increase of virtual teams. It may be possible to apply my research to other verbal communication such as phones calls. This would require further investigation and is a promising avenue for future research. Furthermore, collocated collaboration provides unique benefits that are not easy to achieve in digitally mediated forms of group work (Olson et al., 2002). Literature suggests that face to face interaction can increase creativity (Gloor et al., 2014) and performance (Olguın et al., 2009).

Despite the potential benefits to practitioners and researchers alike, research into team dynamics has remained elusive due to its complexity and lack of quantitative measures. However, wearable electronic devices, such as sociometric badges (Sociometric Solutions, 2014), have made it affordable to collect detailed information on team communication. Initial studies indicate that these data can help to predict team outcomes with high accuracy (Parker et al., 2018). This deluge of detailed data unlocks new challenges and insights into collaboration. The analysis of data from sociometric badges enables the exploration of the potential of automated coaches, that can provide feedback on how to improve team performance based on a team's non-verbal communication behavior. I expect that automated coaches will enhance the preexisting benefits of face to face teamwork. This will enable teams to develop their communication and teamwork skill in situations which previously required an in-person coach.

# Research Questions

This research aims to investigate the potential of automated coaches. This is done by analysing rich data streams collected through sociometric badges from new product development teams using design thinking in a real world environment. My research focuses on insights gained from investigating behavioural and verbal rotation in design thinking teams. This line of research is particularly interesting for design thinking teams because the process has distinct phases of group problem solving. Each of these phases has previously been shown to have different properties (Perry-Smith and Mannucci, 2017). Work mode will be used to differentiate interactions for different tasks within teams.

In order to develop the foundational technologies for automated coaches will be done in three stages of research and development. The first stage aims at understanding how and to what extent it is possible to detect team work mode based on sociometric signals. The second stage will revolve around identifying the relationship between team interaction and team performance for the different work modes. The final stage will focus on the design of interventions to improve team performance based on the results from the two earlier stages.

The specific research questions addressed in this line of research are:

- Can the design thinking mode of an individual in a team be predicted by the observed social signals of communication?
- How do the features extracted from social signals help in predicting individual work mode and team performance?
- Can interventions be designed to improve team performance based on the team mode and performance predictions?
- Can these interventions be implemented in an automated coach?

# Findings To Date

To assess the research questions, data has been collected on four teams in a large consulting firm over a period of four weeks, using wearable sensors called sociometric badges (Pentland, 2010). Using this data I have answered my first research question with preliminary results indicating that design thinking mode can be predicted from these signals.

I used sci-kit learn to build models to predict design thinking stage. A variety of different models were trained on the 222 examples. Predictive models have F1 scores of up to 0.76, 0.71 and 0.68 for need finding, ideation, and prototyping respectively. The findings of this investigation complement those of earlier studies. My preliminary results advance prior research (Jayagopi et al., 2010) by increasing the number of work modes and demonstrating that they can be predicted outside of laboratory settings.

This is the first step in order to build an automated coach as to improve team performance, group members need to be presented with relevant information depending on their work mode.

# Next Steps

While the research so far focused on demonstrating the feasibility of predicting work mode, the future contributions will be threefold. Firstly, the accuracy of predicting work mode will be improved through model refinement improvements. Secondly, the relationship between work mode, communication behavior and team performance will be studied, resulting in an overview of which type of interaction is related with improved team performance for the different work modes. Lastly,

investigating the potential of interventions through automated coaches will be the final step towards building automated coaches.

Future directions in terms of modeling include changing the threshold for positive labels and predicting on smaller windows of time. The positive labels for need finding, ideation, and prototyping are currently selected when participants report at least 50 percent of their time was spent in a given mode. Increasing this threshold may improve the ability to predict a given mode but will reduce the number of positive data points to classify. Future work could look at modeling the design thinking mode of entire teams, and study the mixture of modes within a team in relation to other outcomes, such as team performance.

# Expected Contributions

This paper introduced the problems that need to be overcome in order to facilitate automated coaching in design thinking teams. This research is positioned within the literature covering both computer and social sciences. To the best of my knowledge there is no other line of research that enables automated coaching taking design thinking mode into account. This research also demonstrates the value that analysing team communication can provide. The predictions can be used directly for an automated coach as well as uncovering insights as to what makes team communication effective.

This will be the first study to predict design thinking modes and team performance from nonverbal behavior. The expected findings of this investigation are expected to complement those of earlier studies. As previously mentioned in the 'Findings To Date' section, our results will advance prior research by increasing the number of work modes predicted and showing they can be predicted outside the laboratory.

This work will offer valuable insights into the possibilities that automatically generated data offers towards team task classification. The expected outcomes have potential applications in computer assisted coaching and contribute to the body of knowledge spanning multiple fields.

# References


Gloor, P., A. Almozlino, O. Inbar, W. Lo, and S. Provost (2014): 'Measuring team creativity through longitudinal social signals'. *arXiv*.

Jayagopi, D., T. Kim, A. Pentland, and D. Gatica-Perez (2010): 'Recognizing conversational context in group interaction using privacy-sensitive mobile sensors'. In: *MUM*.

Olguın, D., P. Gloor, and A. Pentland (2009): 'Capturing individual and group behavior with wearable sensors'. In: *AAAI SSS*.

Olson, J. S., S. Teasley, L. Covi, and G. Olson (2002): 'The (currently) unique advantages of collocated work'. *Distributed work*, pp. 113–135.

Parker, J. N., E. Cardenas, A. N. Dorr, and E. J. Hackett (2018): 'Using sociometers to advance small group research'. *Sociological Methods & Research*, pp. 0049124118769091.

Pentland, A. (2010): *Honest signals: how they shape our world*. MIT press.

Perry-Smith, J. E. and P. V. Mannucci (2017): 'From creativity to innovation: The social network drivers of the four phases of the idea journey'. *Academy of Management Review*, vol. 42, no. 1, pp. 53–79.

Sociometric Solutions (2014): 'Sociometric badge 03-02: Preliminary user guide'.

*Yisi Han (2020): Understanding Developers' Linguistic Behaviors in Hierarchical Open Source Communities. In: Proceedings of the 18th European Conference on Computer-Supported Cooperative Work: The International Venue on Practice-centred Computing on the Design of Cooperation Technologies, Reports of the European Society for Socially Embedded Technologies (ISSN* 2510-2591*), DOI: 10.18420/ecscw2020_dc10*

# Understanding Developers' Linguistic Behaviors in Hierarchical Open Source Communities

Yisi Han
Software Institute, Nanjing University, Nanjing 214000, P.R.China
*hanysannie@gmail.com*

**Abstract.** Online communication among developers is critical for the success of Open Source Software (OSS) communities. As a typical complex sociotechnical system, an OSS community often forms a hierarchical structure in which a few developers are elite while the rest are non-elite. The differences in social status among developers would unavoidably result in different linguistic behaviors. I sought to develop an understanding towards such differences in linguistic behaviors and how they influence project outcomes. Using data from GITHUB, I designed three interrelated studies. The first will characterize such differences at a collective level. The second will further explore the dynamic changes on linguistic behaviors with the focus on individual developers who experience non-elite and elite transitions. The last aims to quantify the impacts of linguistic behaviors on project outcomes. I also plan to build a tool to help developers achieve better communication within and across hierarchies.

## Research question

The success of an Open Source Software (OSS) project depends on the collaboration and communication of its developers. Research into online

collaboration in OSS communities have repeatedly shown that communication plays an important role in collaboration (Steinmacher et al., 2019a,b; Singh et al., 2012). Effective communication depends on the proper language use among developers. The goal of this study is to understand communication among developers in OSS communities from the perspective of people's linguistic behaviors in the lens of social status. I focuses on the large OSS projects hosted on GITHUB which is one of the most widely adopted platforms by OSS projects. Projects hosted on GITHUB often form a hierarchical structure of developers where some users are elite and the rest are non-elite(Wang et al., 2020). The differences in social status would result in different linguistic language behaviors. This study aims to identify the differences in linguistic behaviors and characterize how they influence project outcomes. Data of 20 projects in GITHUB were collected including information of developers and the texts of all communication.

To find the differences in linguistic behaviors, I designed two studies to analyze the linguistic differences of developers in two aspects. The first (Study I) focuses on the linguistic behaviors of developers in different status. This study will provide a collective view about the linguistic differences of all developers. To further understand differences in linguistic behaviors of individual developers, the second (Study II) will explore the dynamic changes in linguistic behaviors of developers who experience non-elite and elite transitions. Based on the above two studies, I plan to conduct the third one (Study III) investigating how linguistic behaviors, with the presence of the social status system consisting of the elite and the non-elite, influence project outcomes. In this study, both OSS developers' social status and their linguistic behaviors will be taken into consideration. While prior literature, e.g., Blincoe et al. (2016); Scacchi (2004), confirms the importance of the hierarchical social status system, this study extends our knowledge of the joint impacts of social status and linguistic behaviors. Specifically, the three studies will provide answers to the following three high-level research questions:

**RQ1** *What are the differences regarding the linguistic behaviors between elite and non-elite OSS developers?*

**RQ2** *How one's linguistic behaviors changes if his/her social status experiences transitions (elite↔ non-elite)?*

**RQ3** *How OSS developers' social status and their linguistic behaviors jointly influence project outcomes?*

In addition to the above empirical studies, I would also plan to apply the results of these studies to build a tool that helps developers achieve better communication within and across hierarchies.

# Methodological approach

Developers' linguistic behaviors will be investigated with computational approaches (Pennebaker et al., 2014; Zhang et al., 2019) has been put to

investigate linguistic behaviors of different users. Based on the previous work, we may hypothesize that elite and non-elite text exhibit different linguistic behaviors in their projects. Some text analysis tools will be applied to the text of communication. Given that conversations in GITHUB are short text and their structures are not complex, Linguistic Inquiry and Word Count (LIWC) Pennebaker et al. (2001) will be the main analytical tool. LIWC has two components: the processing component and the dictionaries. The processing component is a computational analysis tool. A dictionary refers to the collection of words that define a particular category. LIWC calculates the percentages of words in text belonging to its dictionaries. LIWC detects meaning including attentional focus, emotionality, social relationships, thinking styles and individual differences Pennebaker (2011); Tausczik and Pennebaker (2010).

I plan to apply LIWC to identify the differences between elite and non-elite developers' linguistic behaviors in Study I. Similarly approaches will be applied in Study II. We would also employ several other computational linguistics techniques, for example, word embeddings. Since Study III focuses on identify relationships among several constructs (social status, linguistic behaviors, project outcomes), I will apply regression techniques.

# Work to date

I had done a substantial amount of data preparations. Historical data of 20 large projects hosted in GITHUB between 2010 and 2019 has been collected. For each project, four categories of data are collected to constitute a corpus, including users' information, data of pull and request, data of commits, and data of issues. To investigate the linguistic behaviors of developers, we divided all conversations in the corpus into elite texts and non-elite texts according to the identification of users. There are 142,993 non-elite texts and 101,938 elite texts. Matching techniques were adopted to filter data to guarantee elite texts and non-elite texts are a prior balanced on any observable features so that some features would not bias the results. I have chosen four features of the text as feature set for matching: (1) the number of words in a text, (2) the number of pull and request, commit and issue, (3) the year of a text, (4) the project of a text. I used the nearest neighbor matching technique to estimate similarities of texts in the corpus. I compared p-values of four features of texts before and after the matching procedure which shows that filtered texts achieved a prior balance on the four features.

Study I is ongoing. In the next step, I applied LIWC to find differences in the linguistic behaviors of elite developers and non-elite developers. Then I used *TF-IDF* to calculate the score of each word to find the most important keywords in elite and non-elite texts. Finally, I investigated the observed patterns from the discussion of important keywords in elite and non-elite texts. The results revealed that some words like "branch", "release", elite developers use them much more times than non-elite developers; and elite developers have a clear and concise description of issues. Elite and non-elite developers have different rhetorical

patterns describing some keywords. For example, non-elite developers like using "minor" and "small" to describe "fix" while elite developers like using "address". Furthermore, some elite developers have fixed patterns about how to describe "fix" almost never change.

By the date of ECSCW 2020, I expect that Study has been concluded and a manuscript should be developed. I target CSCW'20 as the potential for this manuscript. The second and third study will be starting shortly.

# Next steps

From now, I plan to take the following steps towards finishing my dissertation work:

- Refine the current work on the differences in linguistic behaviors between elite and non-elite developers.
- At the individual developer level, filter and adjust information of developers. Then analyze dynamic changes on linguistic behaviors of developers who experience transitions between non-elite and elite .
- Develop regression models to identify the relationships among social status, linguistic behaviors, and project outcomes.
- Use results of the above studies to build a tool that aims to help developers achieve better communication within and across hierarchies.

# Expected contributions

This study makes the following three major contributions:

- The work extends the extant CSCW and Software Engineering literature by develop a deep understanding of communication among developers in OSS projects from the perspective of people's linguistic behaviors in the lens of social status.
- The work results a computational tool that help developers to articulate their language, thus achieve better communication within and across social hierarchies in their OSS project.
- The work provides a large labelled dataset of computer-mediated communication happened in online collaboration.

# References

Blincoe, K., J. Sheoran, S. Goggins, E. Petakovic, and D. Damian (2016): 'Understanding the popular users: Following, affiliation influence and leadership on GitHub'. *Information and Software Technology*, vol. 70, pp. 30–39.

Destefanis, G., M. Ortu, S. Counsell, S. Swift, M. Marchesi, and R. Tonelli (2016): 'Software development: do good manners matter?'. *PeerJ Computer Science*, vol. 2, pp. e73.

Parra, E., S. Haiduc, and R. James (2016): 'Making a difference: an overview of humanitarian free open source systems'. In: L. K. Dillon, W. Visser, and L. Williams (eds.): *Proceedings of the 38th International Conference on Software Engineering, ICSE 2016, Austin, TX, USA, May 14-22, 2016 - Companion Volume*. pp. 731–733, ACM.

Pennebaker, J. W. (2011): 'The secret life of pronouns'. *New Scientist*, vol. 211, no. 2828, pp. 42–45.

Pennebaker, J. W., C. K. Chung, J. Frazee, G. M. Lavergne, and D. I. Beaver (2014): 'When small words foretell academic success: The case of college admissions essays'. *PloS one*, vol. 9, no. 12, pp. e115844.

Pennebaker, J. W., M. E. Francis, and R. J. Booth (2001): 'Linguistic inquiry and word count: LIWC 2001'. *Mahway: Lawrence Erlbaum Associates*, vol. 71, no. 2001, pp. 2001.

Pennebaker, J. W. and L. A. King (1999): 'Linguistic styles: Language use as an individual difference.'. *Journal of personality and social psychology*, vol. 77, no. 6, pp. 1296.

Riehle, D. (2015): 'How Open Source Is Changing the Software Developer's Career'. *IEEE Computer*, vol. 48, no. 5, pp. 51–57.

Scacchi, W. (2004): 'Free and open source development practices in the game community'. *IEEE software*, vol. 21, no. 1, pp. 59–66.

Singh, V., S. Kathuria, and A. Johri (2012): 'Newcomer integration and learning in OSS technical support communities'. In: S. E. Poltrock, C. Simone, J. Grudin, G. Mark, and J. Riedl (eds.): *CSCW '12 Computer Supported Cooperative Work, Seattle, WA, USA, February 11-15, 2012 - Companion Volume*. pp. 215–218, ACM.

Steinmacher, I., M. A. Gerosa, T. U. Conte, and D. F. Redmiles (2019a): 'Overcoming Social Barriers When Contributing to Open Source Software Projects'. *Computer Supported Cooperative Work*, vol. 28, no. 1-2, pp. 247–290.

Steinmacher, I., C. Treude, and M. A. Gerosa (2019b): 'Let Me In: Guidelines for the Successful Onboarding of Newcomers to Open Source Projects'. *IEEE Software*, vol. 36, no. 4, pp. 41–49.

Tausczik, Y. R. and J. W. Pennebaker (2010): 'The psychological meaning of words: LIWC and computerized text analysis methods'. *Journal of language and social psychology*, vol. 29, no. 1, pp. 24–54.

Wang, Z., Y. Feng, Y. Wang, J. Jones, and D. Redmiles (2020): 'Unveiling Elite Developers' Activities in Open Source Projects'. *ACM Transactions on Software Engineering and Methodology*, vol. 29, no. 3, pp. 16:1–36.

Xu, H., Z. Zhang, C. Lin, and Z. Ding (2008): 'The Study on Innovation Mechanism of Open Source Software Community'. In: *International Conference on Wireless Communications*.

Zhang, J. S., C. Tan, and Q. Lv (2019): 'Intergroup Contact in the Wild: Characterizing Language Differences between Intergroup and Single-group Members in NBA-related Discussion Forums'. *Proceedings of the ACM on Human-Computer Interaction*, vol. 3, no. CSCW, pp. 1–35.

*Yoana Ahmetoglu (2020): Understanding and Supporting Daily Planning in Knowledge Work. In: Proceedings of the 18th European Conference on Computer-Supported Cooperative Work: The International Venue on Practice-centred Computing on the Design of Cooperation Technologies (ISSN* 2510-2591*), DOI: 10.18420/ecscw2020_dc11*

# Understanding and Supporting Daily Planning in Knowledge Work

Yoana Ahmetoglu
UCL Interaction Centre, University College London, UK
*yoana.petrova.15@ucl.ac.uk*

**Abstract.** Daily planning habits and skills have an impact on workers' productivity and job performance. While daily planning is essential for modern work, daily plans can often be challenging to execute. My PhD research has investigated the errors and challenges knowledge workers experience when planning their work day. A diary study was conducted with 20 academics as participants to learn how tasks are planned at the start of the day and which tasks are actually completed during the day. Results showed that while participants were good at estimating the duration of time-constrained tasks, they were not very good at estimating the duration of less time-constrained tasks (e.g. the time needed for email and coding tasks was underestimated, whereas the time needed for writing research and planning activities was overestimated). My future work aims to develop and test planning and scheduling (AI) tools to better support knowledge workers daily planning habits and overcome these time estimation biases in their work.

## Motivation

The main aim in this thesis is to investigate how existing technology can better support knowledge workers in achieving their daily plans at work. Although daily planning is essential for many people, creating and sticking to a daily plan can be challenging. Workers often feel overwhelmed by an ever increasing list of to-dos. Distractions are one-click away and can take significant time to recover from.

Studies done by Mark (2015) show that people that people work under high time pressure which causes them stress. Syrek et al. (2017) gave evidence that failures to complete daily tasks can have negative consequences on productivity and can increase work-related rumination during periods of rest and relaxation.

Successful daily planning depends on accurate estimation of how much work can be done in a given time frame. Time estimations involved in planning are especially important for more autonomous knowledge workers, such as academics, who are able to set their own daily agendas. However, people may lack the experience or expertise to make accurate time estimates about how long their tasks will take to complete. Previous studies suggest that time estimates can also be affected by known biases, such as optimism as shown by Newman (2004). Few studies focus on time estimation errors at the workplace and no previous studies look at those in knowledge work tasks. Exploring such biases in scheduling and planning of work can help us design better support systems to reduce their impact.

Existing research aims to support automatic time estimation and scheduling of calendar tasks which can easily be time boxed, such as meetings. There are fewer research efforts to support time estimation of tasks with fewer time constraints. How long would writing a grant proposal take to complete? The person doing the task often cannot estimate this. Can we give them help?

# Research questions

The overall aim of my thesis is to address the research question: How can we improve existing support tools for daily planning to better assist users in estimating the duration of their daily tasks? To answer this question, my research so far has addressed the following sub-questions:

- How accurate are people at planning their daily tasks?
- Why kinds of events cause delays in the successful completion of daily plans?
- What kind of strategies do people use to plan and prioritize their tasks, and why?

# Methodological approach

My PhD research takes a mixed-method approach to understanding how to improve existing support tools for daily planning to better assist users in estimating the duration of their daily tasks. Three stages have been used to address this research question so far. The first stage consisted of a one-day diary study comparing what people aimed to achieve with what they actually did during the day. The second stage explored why people changed their plans during the day of the diary through semi-structured interviews. The third stage investigated people's planning and execution strategies in general again with semi-structured interviews.

In this paper, I shall summarise the results of a recent study that was reported in Ahmetoglu et al. (2020). For this study, academics and doctoral level students in a university were recruited as participants because they are able to set their own daily agendas. This group of people also do a mix between solo and team activities over a wide-range of projects, which allows to gain observations about many different tasks. Building on previous research Newman (2004), an augmented diary method was used. The findings were then complimented with semi-structured interviews in order to contextualise and validate them with different angles. In the following section a high-level overview of the findings of this study are reported; please refer to Ahmetoglu et al. (2020) for a more detailed account.

# Findings

The first stage found that participants were not accurate when asked to estimate the duration of their daily tasks, especially for tasks which were not scheduled in their calendars, such as email and writing tasks. They both underestimated and overestimated the duration of their tasks, suggesting that some tasks were prioritized over others. The average duration of workday tasks was estimated to be 7 hours 44 min (SD = 102 min) whereas the actual duration of workday tasks reported was 6 hours 40 min (SD = 101 min). Participants spent 54 min (SD = 50 min) on work activities which were not included in the plan. Moreover, they did not complete 34% of their planned work. Those findings are in line with a previous study by Claessens et al. (2010) which used retrospective estimations to investigate how people spent their time in comparison to their plans.

To understand why there were errors in time estimations, the second stage (follow-up interviews) investigated the events that prevented people from executing work as they intended to. Thematic analysis indicated that most people made plans which lacked detail. They did not plan for all activities associated with execution of the desired end-goals from the plan during a typical workday. Specifically, participants did not factor in enough time for preparatory work tasks, breaks, requests from others and lost time due to fatigue.

Thematic analysis of interviews about planning in general (stage 3) resulted in five individual styles in daily planning. Some preferred to plan only if necessary, others planned ahead in their minds all the time, a third group updated a task list every day in a simple tool, others planned in multiple task lists (daily, monthly, annual). Finally, some participants reported having no task lists at all because they were too overwhelmed with their work to be able to think ahead of today. Those who had the habit of daily planning made more realistic plans and had more predictable days.

# Next steps

This research contributed to the understanding of how knowledge workers planned and executed their tasks. Findings were triangulated by using different methods. A diary method found time estimation errors in daily plans. Two interviews studies found why those errors occurred and explored personal planning strategies to provide more context to the errors.

One of the main findings from this research was that participants consistently overestimated how much they can get done during the "free" time slots in their calendars. Those who kept a daily to-do list were more likely to execute a task as expected. However, participants reported challenges in developing habits of daily planning with a dedicated to-do list tool. A substantial group preferred to use their calendars to keep track of tasks. Current calendar apps however are not designed for task listing purposes. This points to the importance of integrating calendar and task listing tools to help people make achievable daily plans. The rest of my research will focus on exploring the appropriate ways to do this integration.

The next study will be an app functionality review to describe existing tools that allow to be integrated in a way so that task lists can have a temporal dimension in one's schedule. Existing calendar apps and to-do lists will be evaluated against a list of user needs identified in the previous study. For example, sorting tasks based on their characteristics such as difficulty and urgency when choosing what to do next, scheduling tasks with reminders or providing a record of past tasks related to a project. Functionalities will be evaluated on a scale rather than with a binary yes or no system to allow for richer understanding of "how well" apps support integration (as opposed to "do they").

The final study in my thesis will test the effect of a field intervention. The impact of encouraging daily planning through the use of integrated tools with be compared with the use of disintegrated tools and a control group. The DV will be a measure of perceived control over time and proportion of daily tasks executed as planned.

# Expected contributions

The expected contributions of my thesis are related to both theory and practice. Empirical research on time estimation errors in the workplace has contributions to theory of cognitive biases. A framework of the mechanisms through which those errors occur will expand the understanding of how those errors work. Further, understanding mechanisms and impacts of time estimation errors has direct implications for interventions which aim to encourage more detailed and regular planning. Organisations and universities will benefit from evidence-based strategies to support time management of their employees beyond existing popular press advice. Finally, my thesis will contribute to the body of research by providing design requirements and early stage prototypes for an integrated scheduling and task listing tool which can help people learn how to better estimate the duration of their daily tasks.

# References

Ahmetoglu, Y., D. P. Brumby, and A. L. Cox (2020): 'Time Estimation Bias in Knowledge Work: Tasks With Fewer Time Constraints Are More Error-Prone'. In: *CHI 2020 Extended Abstracts on Human Factors in Computing Systems*. New York, NY, USA, Association for Computing Machinery.

Claessens, B. J., W. Van Eerde, C. G. Rutte, and R. A. Roe (2010): 'Things to do today...: A daily diary study on task completion at work'. *Applied Psychology*, vol. 59, no. 2, pp. 273–295.

Mark, G. (2015): 'Multitasking in the digital age'. *Synthesis Lectures On Human-Centered Informatics*, vol. 8, no. 3, pp. 1–113.

Newman, W. M. (2004): 'Busy days: exposing temporal metrics, problems and elasticities through diary studies'. In: *CHI 2004 Workshop on Temporal Issues in Work*.

Syrek, C. J., O. Weigelt, C. Peifer, and C. H. Antoni (2017): 'Zeigarnik's sleepless nights: How unfinished tasks at the end of the week impair employee sleep on the weekend through rumination.'. *Journal of Occupational Health Psychology*, vol. 22, no. 2, pp. 225.