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Towards Community-Robot Interactions

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Abstract. Technical advances in multi-user robotics are supporting their increased real-world robot deployments in community and organizational settings. However, interactions with robots in these settings are viewed mostly as an aggregate of individual interactions with robots, separate from their social context. Through my Ph.D. research, I raise awareness about the need for a community perspective to Human-Robot Interactions (HRI) and use real-world studies to demonstrate the conceptual and methodological relevance of community-centric approaches to robot use. The goal of my research is to provide a value framework of 'Community-Robot Interactions' for systematic study of the use and development of robots for communities and probe the role of the robots as a community resource having theoretical and design implications for HRI.

Overview of Research

Life around social robots is envisioned in a variety of social contexts such as community organizations and institutions. In line with these applications, robots are being developed to collaborate with humans on complex tasks and to interact socially in open-ended environments. Despite such technical advancements and broadening of the use contexts, most research in HRI is limited to enabling robot's interactions with individuals and more recently, with small group and teams. HRI interactions beyond the individual and small groups are presented as equivalent to an aggregate of individual interactions, in shared settings. This approach has been useful to support technical advancement of robotics but has proved to be less productive for understanding the potential benefits of r o bots f o r collective purposes, the broader consequences of using robots in society, and the issues around deployment in communities where social dynamics are at play.

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Critical perspectives on the use and development of technology for communities have been extensively researched in CI, CSCW, and HCI. HRI, however, is yet to produce systematic and critical investigations of the potential use of robots to serve communities. Most research in HRI is oriented to understanding individual interactions with and perceptions of robots for a specific task or behavior, to aid technical advancement in robotics. This also reflects in the discussion of HRI metrics and taxonomies, such as by Steinfeld et al. (2006); Yanco and Drury (2004) that show a focus on technical factors, with less attention to contextual aspects of social settings. Previous literature by Sabanović (2010) has called for research to move away from a focus on acceptability and adaptation towards an emphasis on social and cultural factors in use, design, and evaluation. Although a holistic consideration of the community context is missing in most HRI literature, studies indicate the potential for usefully integrating different aspects of community. For example, previous studies have deployed robots in organizational and community settings to encourage social interactions found that shared robots provided communal experiences: Kidd et al. (2006). Recent work, also showed how robot use could enable community empowerment and foster knowledge and culture by catalyzing new opportunities for community interaction: Nourbakhsh et al. (2010). It is time for research to provide ways for systematic design and evaluation of robots for communities, and support their collective values and goals.

Through my Ph.D. research, I show how community is currently an invisible and unrecognized actor in HRI studies and indicate the need for and potential benefits of employing a community perspective to the design and study of HRI. I draw upon scholarship on community and technology from inter-disciplinary literature and point to its relevance for the study and design of HRI. Finally, using real-world studies, I outline an initial framework for Community-Robot Interactions to guide systematic research and design of HRI for communities and highlight the interplay of robots and social-organizational aspects of communities. I describe four such studies below.

Research and Findings to Date, and Next Steps

Study 1 - Robots and The Community Perspective

The goal of this study by Joshi and Šabanović (2017) was to demonstrate how roles and purposes of robots for community contexts would vary from those discussed in previous studies of individual interactions with robots. I conducted interviews of members of a retirement community to understand shared robot uses and roles they would desire for their community. My approach of discussing their community goals, initiatives and their vision for robot roles to support the community provided an understanding of how their sense of community-guided their desire for robot use to strengthen social interactions and increase community participation. I showed how their imagined roles for robots, were communal in nature, such as 'community organizer', 'social enabler' and 'resourceful facilitator'.

Study 2 -Community-centered Use and Deployment of Robots

Through this study by Joshi and Šabanović (2019), I intended to show how a community-centric approach, supporting community-oriented goals and using community member's insights in research, design, and evaluation is crucial to successful use of robots in the real world. The complex social settings of this community organization- a 'co-located inter-generational facility', posed various challenges such as from the varying needs of its different actors - frail elders with dementia, preschool children and staff/teachers. Using a community-centric approach allowed to identify specific community goals and guided robot use, such as to reduce social isolation for elders and teach patience and tolerance to children. Evaluation of HRI, in this otherwise complex social context, became straightforward from knowing how community members valued and desired peer and inter-generational interactions and desired increased involvement in social activities. Working closely with this community revealed how the social and organizational factors supported the use of robots in this setting.

Study 3 - The Community-Robot Interaction Framework

To derive an initial framework for Community-Robot Interactions, I used findings and experiences from Study 1 and Study 2 as case studies, along with relevant literature on community and technology from Sociology, CSCW, HCI, and CI. Based on the work so far, I conceptualize that 'Community-Robot Interaction' moves away the focus of HRI from the individual to the community, its goals, and values. Robots in this context, integrate into the community, to catalyze its interactions and support its initiatives.



Figure 1. An Initial Framework of Community-Robot Interaction.

The initial framework (Figure 1) shows different aspects of the community, its practices and processes, and their relation to research methods and robot use. It shows community, as the social unit, the key element of study, and the desired outcome for HRI. It requires design and research methods to be informed by the goals, values, and practices of a community. It suggests research and design to be shaped by leveraging skills, expertise and resources from the community and its members. It aims for HRI to empower and to be enabled by the community practices and social processes.

Study 4 -Configurations of the Robot and the Community

Next steps involve a close examination of the interplay of community life, social and community processes, and organizational practices around the use of and interactions with robots, to refine the initial Community-Robot interaction framework. To do so, using observations and interviews, I plan to study how the use and adoption of robots by a community shapes their everyday interactions and practices.

Expected contributions

My research aims to motivate HRI scholars to consider a community perspective as integral to their research, and to the design and deployment of robots for real-world uses. By outlining a framework for Community-Robot Interactions, I intend to provide grounds for debate and discussion on community-centric possibilities and approaches for HRI and encourage context-specific improvements to the framework.

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Appropriation and Practices of Working with Voice Assistants in the Kitchen

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Motivation and Research Questions

Voice Assistants (VAs) like Amazon Alexa or Google Home assistant are getting more and more common in private homes. They provide various affordances such as controlling smart devices, telling jokes, playing music or even talking about feelings. Specifically interesting is their capability of natural speech. Interaction with VAs is supposed to be very easy and subject to anthropomorphism due to the human-like voice and "character" of the assistant (which, for instance, might tell jokes or express feelings (Purington et al 2017)). As speech interaction also has strong limitations in the current implementations, users nonetheless need to learn how to talk to the assistant in order to receive the desired response. Incorporating them into daily routines and practices requires a certain understanding about limitations as well as strategies for working around those. Studying such sociotechnical aspects of appropriation can be very informative and interesting for better understanding the role and potentials of technologies (Wulf, Rohde, Pipek, Stevens, 2011).

Recent research found that VAs suffer from lack of self-descriptiveness (Pyae and Johnson, 2018), especially regarding their available functions. From the perspective of CSCW, it is interesting to study how users discover and learn to interact with their VAs, how they share their experiences and knowledge with others, and what strategies they use to work around common breakdowns and

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misunderstandings—for instance in the context of more complex social situations with parallel activities (Porcheron, Fischer, Reeves, Sharples, 2018).

Other interesting questions that we want to explore are how the experiences of interacting with VAs affect the confidence towards the capabilities of the technology. Research on the social perception of Computers like the CASA paradigm (computer as social actors) (Nass, Steuer, Tauber, Reeder, 1993) makes it likely that social norms and expectations affect the interactions with a VA, especially regarding the role of anthropomorphism and the uncanny valley paradox (Mori et al., 2012). Furthermore, VAs can be studied as knowledge and information agents (Brown, 2000), leading to the questions about the role of confidence (building) as well as the social construction of reality (Berger and Luckmann, 2004).

For our research, we focus on the kitchen as an important space at home that is not only used for cooking but also has a strong social role in the household (Johannes-Hornschuh, 2010). Many housekeeping tasks take place in the kitchen that can be supported by VAs, such as managing a shopping list or the (family) calendar or researching nutrition and food. These interactions are interesting to study in terms of their social and collaborative components. The kitchen offers many relevant tasks which are often rather complex and might require mixedmedia approaches for successful support that might well exceed the capabilities of the VA technology in the current form (Moore, 2017). Better understanding where there are areas for innovation and what we can learn from the current practices of interaction to work around the current limitations is a further aim of our work.

Methodological approach

As a first step, we have conducted interviews with 10 users to identify practices and experiences with VAs in the home and particularly in the kitchen. In doing so, we have also analyzed log files of interactions in order to better understand breakdown situations and workarounds, and discussed those with the interview partners. We oriented our analyses on Grounded Theory (Strauss, 1996), to identify codes and patterns in the material. We plan to continue with this approach until we reach theoretical saturation.

As next steps, we want to deepen our understanding of how users interact with their VAs in the kitchen and how they perceive the interaction. For this, we want to use a mixed-method approach of further interviews and ethnographic observations in combination with a Living Lab study that we are currently planning with the University of Siegen. In this context, we also plan to perform more detailed analyses of the interaction logs, for instance by means of Objective Hermeneutics (Wernet, 2006) and Conversation Analysis (Baker, Emmisson, Firth, 2005). By doing so, we hope to obtain a deeper understanding of successful interactions within the kitchen, as well as about common problems or misunderstandings and how users handle those.

Based on our analysis of the interactions, we further intend to engage in codesign sessions with users in order to create tools for supporting appropriation of skills and identifying design guidelines for more successful voice interaction interfaces. For doing so, we plan to use wizard of oz as well as prototypes of skills to engage users with different kinds of interactions in order to test our assumptions from the previous steps.

First Results

We have conducted interviews with ten households about their general usage of VAs in autumn 2018. Interviews lasted 1-1,5h each, households where chosen by convenience sampling in the personal contacts of the researchers. We also asked participants to show us the log files of interactions with the VAs to identify and examine situations that involved misunderstandings and breakdowns.

All households placed their main device in the living area, which in many cases was open-connected to the kitchen. The primary use of VAs was playing music, setting timers or reminders (for instance for cooking), controlling smart Home devices and accessing news or weather feeds. Other use cases involved managing shopping lists, asking for information (opening hours, films, persons, recipes etc.) or scheduling appointments.

All participants considered hands free usage as the main benefit of VAs. Language commands would need to short, clean and accurate as possible with the VA to achieve a high probability of successful understanding. Longer or more complex interactions were rare or not used at all. Especially acquiring complex information such recipes for cooking often resulted in problems because of the limited possibilities for overview and navigation. Because of the short and command-like interaction, people did not perceive the VAs as very human-like. Interesting is, however, that during the conversation they personified the VA by calling it a "she" or giving it a name, and some asked for more social or human-acting behavior (such as better manners or more proactive behavior).

The participants felt generally comfortable with the interaction. Once they had learnt how to talk to them, interactions generally became more fluent and trusting over time. The usage-situations were often very demand-driven, new skills and functionalities were rarely discovered. Even when that happened, they were often disregarded quickly because they provided limited value or required complex, tedious and error-prone interactions. Users reported that they first had to learn the right words to increase the chance of understanding. In order to help family members, we also found that users created artifacts such as "command list" to help family members appropriate the VA. Additionally, users found it very helpful to look at the log files with us, which helped them to understand why certain breakdowns that puzzled them occurred, indicating possibilities for supporting appropriation.

So far, our research shows that most use cases are very simple and linear. The users trust in their VAs, but within limited scopes of functionality. Interactions that are more complex often lead to misunderstandings, breakdowns and usability problems. Our research also shows that the kitchen was a rather common place for VAs, but that their usage for housekeeping tasks was rather limited and intertwined with additional media such as smart phones, indicating opportunities for design and support that we want to explore in our future studies.

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Sustainability in Crisis: Towards Business Continuity in Small and Medium Enterprises

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Abstract. Small and Medium Enterprises (SMEs) epitomize a vital part in all developed and developing economies. SMEs being peculiar in nature and operations are often the most affected in case of an emergency or a crisis. Mostly, the scarcity of resources in respect to employees, time and capital make them more vulnerable to crisis. This article instantiates the need of risk assessment and disaster preparedness, and hence the utility of BCM in the context of SMEs as a viable option. It further establishes the technological foundation of a comprehensive BCM realization for SMEs.

Introduction

The industrial revolution changed the whole economic paradigm; evolving the household workshops into corporations and production units, and giving rise to the taxonomy of enterprises with a classification of big, small, medium, meso and micro enterprises, respectively. All sorts of enterprises are valid and essential but SMEs are crucial for a progressive economy. As claimed by European Commission (2017), SMEs are the backbone of Europe's economy. They represent 99% of all businesses and have created around 85% of new jobs in Europe during the past 5 years. SMEs are often global leaders within their

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numerous niche markets (so-called 'hidden champions' by Simon, 2007) (Ludwig et al., 2018).

The European Commission (2017) defines SME as an organization with less than 250 employees and less than a (or equal to) 50 million turnover. Ingirige, Jones & Proverbs (2008) concluded that, SME sector suffers the most in times of a crisis and are the least prepared of all the organisations. Crises are undeniable realities and with the ever increasing digitalization, high reliability on IT and energy infrastructures, and the challenges imposed by global economies, SMEs have become more vulnerable. Sullivan-Taylor & Branicki (2011), demand more strategic and proactive approach to manage the threats and actuality of extreme events for SMEs. According to ISO 22301, Business continuity management (BCM) is the holistic management process which emphasizes the need for a well-defined incident response structure (Tangen et al., 2012). But BCM is mostly opted for big companies and is under-represented in SMEs (Kaufhold et al., 2018). This research article addresses the challenge of adapting BCM for SMEs, and put forward a work in progress towards more sustainable SMEs.

Literature review & research Gap

Tierney (2014) explained that disasters (or crisis) do not follow preordained scripts. Since crisis management in SMEs often does not address the respective vulnerability of the company, it has become consequential to extend the realms of BCM to SMEs. Approximately 45% of US and European SMEs have no business continuity concept (Thiel & Thiel, 2010). Federal Emergency Management Agency (FEMA) claims that more than 40% of businesses never reopen after a disaster (Scott, 2016). Lack of resources, limited finance, inefficient and delayed business continuity and recovery processes appear to be the biggest constraints for SMEs in adapting to BCM ((Saleem et al., 2008), (Kirchhoff, 1994)).

The realization of BCM for SMEs in a technological paradigm is even more challenging. The reasons are several: SMEs are too different in structure that it is infeasible to provide with a generalized solution fitting the needs of all the SMEs (Dahlberg & Guay, 2015). Furthermore, the main obstacle in the development of computing environments is to provide the right information to the right person, at the right time and place (Fischer, 2012). A dashboard can be a viable solution for the realization of BCM, as an inlet to detailed information, if needed ((Kaufhold, et al., 2018), (Nascimento et al., 2016), (Andrienko & Andrienko, 2007), (Canós et al., 2010)). Support to the decision making process was also included in executive dashboards (Zagorecki et al., 2012).

(Executive) Dashboards are not a new concept but they are mainly focused on the visualization from civil crisis management perspective in the form of control room apparatus and less or not focused on SMEs. But BCM is not just an information visualization process, it also requires collaboration between multiple stakeholders in order to create and execute the Business Continuity Plan (BCP). Therefore, we propose a solution in the form of a BCM suite; as a technological aid not just for the top level emergency manager but also for the bottom up management, employees and other stakeholders.

Methodological approach & contributions

Stakeholders participation is a key to sustainable design (Meurer et al., 2018), therefore qualitative interviews and surveys are done in "Kontikat" project. At this stage of my Ph.D, I am co-developing the BCM suite (with a student assistant named Simon Gruseck), based on the information from the empirical pre-studies with SMEs but also the literature on matter. The proposed BCM suite (as shown in Fig. 1) is to be realized with a service oriented architecture & evolutionary design and it mainly constitutes of three major architectural components: (1) a collaborative visualization (C&V), (2) a BCP creator (BCPc) and (3) a decision support system (DSS).



Figure 1. The overall proposed architecture demonstrating the interaction and collaboration between different components of the infrastructure.

As a first step in evolutionary development, C&V portal is being developed. The emergency manager can add the collaborators for concurrent information sharing and plan execution. They can select data for visualization from an agglomeration of various data sources, hence can customize their preferential view settings. The visualization also enables the user to reach for more detailed information, if required. The prototype implementation of the C&V portal is currently realized with an open source visualization framework open.Dash (Open.Inc).

The next step will be the development of the BCPc. The BCPc will aid the user to plan for an individual or collaborative task. It will provide a variety of planning options ranging from Gantt Charts, Load chart, to Risk Maps, Decision Trees etc. The emergency manager can identify the inter-relationship between the processes and validate an effective plan ensuring the security of process, people and product. Finally, the DSS is to be implemented which works with visualization and planning services respectively. Emergency team needs to identify the key performance indicators (KPIs) and the data sources which will be monitored by these KPIs. KPIs measure the different aspects of an organization's condition. The triggers will detect the anomalies on the basis of KPIs and generate alert for the emergency team to act in time. KPIs are also used to generate the post crisis and process evaluation reports.

Further considerations

The proposed architecture is primarily forced on disaster preparedness which is a pre-crisis concern. It does not hold a strong foundation for in-crisis usability. Apart from identified risks as alerts, situation awareness can be a useful approach for crisis handling. I have kept it as an open concern for future consideration.

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Feedback Practices in Collaborative Video Editing

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Abstract.

This project focuses on feedback practices in collaborative video editing. Video editing is commonly done collaboratively, but when done in a distributed and asynchronous setting, there are challenges tied to how to give feedback and refer to particular issues and segments of the moving images. This project aims to understand these feedback practices through interviews and observations of video workers, identify implications for design, and conduct design workshops with video editing professionals to prototype solutions for supporting awareness in collaborative video editing.

Background

Video production has turned from an inherently professional activity into something that an amateur with a cheap phone can perform. The cost of video production dropped dramatically as video cameras have become affordable and mobile (Juhlin et al., 2014). However, video production is a complicated activity which requires certain skills that not all users possess (Engström et al., 2010). Hence, it is an activity which often requires participants of various skills and expertise to collaborate to achieve a common goal.

Video production involves an infrastructure of connected components, devices and pieces, of software (Guribye and Nyre, 2017). The organisation of various parts of the working environment requires the right configuration of people (participants and stakeholders), skills and knowledge (e.g., montage and sound mastering skills), tools and artefacts (Bødker and Klokmose, 2011).

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This project is carried out in collaboration with a Norwegian company Vizrt which produces software and hardware solutions for TV stations and other media companies. One of the latest products of the company, VizStory, is the core of the current project. VizStory is a web-based nonlinear video editing software which aims to provide groups of co-authors with opportunities to work collaboratively. VizStory works similar to other video editing tools: user ingests their raw footage, then loads clips of it into the timeline and manipulates them to produce a final video. A user also can insert graphics generated from pre-made templates, manipulate audio tracks and add subtitles. Unlike most video editing tools, VizStory allows multiple users to work simultaneously on the same project. This project aims to deliver insights into the current practices of collaborative video editing and design ideas which will support effective collaboration.

Video production includes typically three stages: pre-production, production, and post-production. This project's scope is delimited by post-production and video editing, leaving aside various other activities, e.g., sound mastering, filming, screenwriting.

While having participants with varying skills and backgrounds (such as editing, visual storytelling, graphics, domain expertise) might in some ways foster a creative video editing in that it allows for different views and perspectives on the ongoing activity, there might also be problems in communicating and having a shared understanding of the issues at hand.

Research Question

The initial research question of the project was broad: how teams of co-authors collaborate in creating videos. The very first interviews and some literature research indicated that feedback giving is an essential part of communication between collaborators. As video production often involves participants with different backgrounds, it is often the case that they struggle to communicate their ideas properly.

The concept of awareness (Gutwin and Greenberg, 2002; Schmidt, 2002) will be used as a theoretical framework in the project, especially when discussing how the collaborators give feedback but also when designing features supporting collaboration in video editing software.

The research question in this project is the following: how awareness and coordination can be supported in collaborative video editing. In the project, it is divided into sub-questions:

- How collaborators receive and communicate their feedback during the video editing process.
- How feedback practices can be supported in a web-based collaborative video editing tool.

These questions will be addressed in upcoming papers. The first one will focus on understanding collaborative video editing in general and feedback processes in particular, the second one - on design ideas and features which support collaboration between co-authors. Then, we will re-iterate with design interventions and do field trials with journalists and news agencies that produce video stories.

Current Work

I conducted eight in-depth semi-structured interviews with ten participants: two interviews with pairs of collaborators and six one-on-one interviews. Each interview lasted from 45 minutes to 2 hours. Seven of the interviewees are video production professionals who work with video on a daily basis. Three are amateurs who did video editing as side projects. During the interviews, participants recalled their recent projects and gave accounts of their collaborative video editing experience. Paired interviews are particularly interesting in the respect that participants who worked in different capacities on the same projects provide different accounts of the same events.

All participants agree on the necessity of collaboration during the video editing, as it requires various skills and competencies, and, in some cases, just a second opinion.

A video project is usually organised by a single person, a producer, who distributes the work between editors, colourists, graphics editors, sound directors, etc. After the shooting process, which is a very complicated process by itself, they gather raw materials and organise them into a data structure of a hard drive. Interviewees have experience with various methods of sharing materials with collaborators: from flash drives to emails and file-sharing services. There is no standard way of sharing big video files or other media. All participants reported that the used free services provided by either third-party companies or their institutions, whichever is suitable for them personally: email (n=10), social media (n=7), instant messaging services (n=6), and file sharing services with social features like Google Docs (n=10).

In general, there are two sources of feedback, which video editors get during the editing process: colleagues/superiors and clients/customers. When working with colleagues, some editors strongly prefer face-to-face communication while others report having face-to-face meetings and discussions occasionally.

Professionals delegate certain tasks and trust their colleagues do their work. Feedback between colleagues is mostly very specific: they refer to certain points in the video and provide detailed constructive comments with timecodes. Timecode refers to a specific time in the timeline of a video editing software and is often accompanied with a frame number making it possible to point out a single frame in the video. Feedback from clients or customers, on the other hand, often lacks specification and can be very hazy. All interviewees who work with clients (n=7) note that they have to educate their customers to provide feedback.

Future Work and Expected Contribution

Preliminary analysis shows some interesting collaboration patterns of video editing, e.g., the ways producers and editors utilise the available infrastructure of hardware and software tools to produce the video. These patterns will be explored further. One particularly interesting pattern is the employment of the timecode as a universal instrument for navigation and referencing in the video editing process. Regardless of means of communication, it is the core component of communication between co-authors and between producers and customers.

To better understand the interactional organisation of collaborative editing, we intend to conduct observations of the face-to-face collaborative editing process during which an editor works with a customer together in one room on creating a video. With these observations, we hope to unveil detailed social aspects, communicational hiccups and emerging issues which might be overlooked in the interview.

We will also organise a design workshop in which designers and video editors will ideate collaborative features for non-linear editing software. These design ideas will then be evaluated and developed in prototypes for further testing.

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SOCIAL AUGMENTATION OF ENTERPRISE COMMUNICATION SYSTEMS FOR VIRTUAL TEAMS USING CHATBOTS

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Abstract. Innovative collaborative applications like Slack or Microsoft Teams have become an integral part of the working environment. The communication in teams, especially at work, is aggravated by socio-technical challenges which prohibit teams from reaching their optimal performance. This research addresses these problems and designs an enterprise communication system to actively support team interaction in order to increase team performance. Through social augmentation of the communication processes with chatbots this is achieved, leveraging cognitive-affective user states. First results of the system prototype evaluation are promising, showing an improvement of team cohesion and communication effectiveness induced through the design. Serving as indication, future steps are outlined guiding the research path for social augmentation of team communication.

Doctoral Research

"The whole is greater than the sum of its parts" (Aristotle)

Applications like Microsoft Teams and Slack have revolutionized the workplace by combining communicative, cooperative and coordinative functions into one application facilitating team work. A recent survey documented that 41%

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Permission to make digital or hard copies of part or all of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Abstracting with credit is permitted. To copy otherwise, to republish, to post on servers, or to redistribute to lists, contact the Authors. of users expect to use Microsoft Teams in 2020 (Finnegan, 2019a). These applications have also brought new constellations of teams to the workplace plugging in chatbots into the team communication which has not been realized before in applied work practice. Slack or Telegram provide a dedicated API to enable third party developers to add their own applications which can be used to boost team collaboration (Lebeuf, Storey, & Zagalsky, 2017). Slack for example supports a community of over 200.000 weekly active developers using their API (Finnegan, 2019b) showing the immense interest in this area. Research, on the other hand, is scarce on this area of chatbots in multi-user scenarios (Seering, Luria, Kaufman, & Hammer, in print).

Simultaneously, enterprise communication systems facilitate teams working together remotely connected from different cultural origins all around the globe. These teams, commonly labelled as virtual teams (Griffith, Sawyer, & Neale, 2003), are a major component of collaboration at the workplace and their functioning without obstacles is a core driver of productive enterprises. The famous quote above of the ancient Greek philosopher Aristotle paraphrases well the promise of effective teams. Google has also identified their importance and therefore started "Project Aristotle". The study exploring factors of team effectiveness, following the quote above, confirmed the assumptions about teams and identified important factors as shared social norms and the ability of team members to recognize emotions of others (Camarote, 2019; Google, 2017).

Nevertheless, enterprise collaboration still faces great challenges and especially remote communication is one of the major breakpoints for teams to be productive. Communication serves specific informative and coordinative team needs, typically, it takes place through instant-messaging, telephone or video conferencing. These media support multi-tasking and generate interruptions (Li & Gupta, 2009), which produces stress and negative emotional wellbeing (Kushlev & Dunn, 2015). Further, it aggravates the attention (Gutwin, Bateman, Arora, & Coveney, 2017) and in succession participation in the meeting. In its structure these media show a low ability of transferring social signals and cues (Kuber & Wright, 2013), which differentiates it from face to face meetings and is one of the main sources of these challenges. In consequence, they influence the team in its development. As the core process in working virtual teams is hindered, they cannot develop their strength and productivity. Finally, the team effectiveness and performance is impaired (Powell, Piccoli, & Ives, 2004).

This research will design a system which is supporting actively communicative processes in the working environment. The system shall increase team performance and master communicative challenges through the application of matured technologies of text- and speech-based chatbots, the detection of user states and selective transmission of social signals. This research is conducted as an artifact-centric approach by designing social augmentation in an enterprise communication system for virtual teams. I pick up on social augmentation defined as "supporting users during social interaction" (Damian & André, 2018) and focus specifically on the context of team communication. The work shall be realized through a design science research project (DSR) in two cycles. The following overall research question shall be pursued:

How to design an enterprise communication system for virtual teams using social augmentation chatbots to overcome the challenges in virtual team communication at the workplace in order to increase team efficiency and effectiveness?

To answer this question this research aims at providing a social augmentation of virtual team communication using chatbots. Based on the theory of media synchronicity (Dennis, Fuller, & Valacich, 2008) and team process models (Ilgen, Hollenbeck, Johnson, & Jundt, 2005; Marks, Mathieu, & Zaccaro, 2001) social augmentation shall be accomplished to provide a richer virtual team communication resulting in better team performance. The cycles are further built upon the theoretical work of social signal processing (Pentland, 2007; Vinciarelli, Pantic, & Bourlard, 2009), feedback intervention theory (Kluger & DeNisi, 1996), and the computers are social actors paradigm (Nass, Steuer, & Tauber, 1994). It is known that both cognitive and affective user states play an important role in communication and are closely related factors for the mentioned challenges (Kelly & Barsade, 2001; Oatley & Johnson-Laird, 1987). Increased arousal and stress are expressions of affective states, as well as attention is for cognitive states. These shall be targeted with the system design, exemplary visualized through a prototype in figure 1 including a legend about its main components.



Figure 1. System prototype design in Slack.

First, a chatbot will be developed which is plugged into the virtual team communication. The usage of chatbots in teams as fully fledged team member shall support the team character and equipped with abilities and functionalities it can support the team. Some studies have started to investigate its application in collaborative context with auspicious results (e.g. Derrick, Read, Nguyen, Callens, & De Vreede, 2013; Tegos, Demetriadis, & Karakostas, 2011). Leveraging chatbots as foundation is providing the innovative and accelerating aspect for the system. Second, a feedback functionality shall be designed to increase emotional and cognitive awareness of the individuals and the team (Algesheimer, Dholakia, & Gurău, 2011) employing chatbots as objective team members. Further, team cohesion can be strengthened with this approach which supports team performance. This has already been investigated in a first experimental study (Benke, Ruoff, & Maedche, currently under review). Last, the channel of communication, e.g. IM, shall be extended based on affective and cognitive user states. Usually limited in medium's transmitting capacity the team members reveal problems in expressing themselves and transporting information, a condition for successful teams, especially for affective information. According to the mentioned study by Google members of successful teams had an high ability to read emotions of the others based on facial expressions (Camarote, 2019; Google, 2017). Using the social signal processing paradigm this research aims to help the system understand the users' states better and provide additional information based on this. Through a team member a chatbot may be, this information will be transferred more efficient and thereby improving communication effectiveness and team performance.

Findings & Next Steps

This research focuses on the social augmentation of virtual team communication using chatbots. Based on the theory of communication (Shannon & Weaver, 1949) which is embedded in the theory of media synchronicity I apply a package of three components to expand the communication medium. Through this, I design an extension of the medium by integrating user states which have been excluded from considerations before. This enables the medium to become more user-sensitive and flexible on the team communication demands.

My research is now in the process of further develop the system design and investigating it through empirical studies. First, a systematic literature review has been conducted giving an overview about collaboration technologies and their investigation upon user states in the dedicated body of literature. Additionally, a study on designing chatbots in team conversations has been published investigating chatbot design features. Results show that the chatbot design should balance both functionalities and human-like design features to achieve the best possible usefulness and ease-of-use (Rietz, Benke, & Maedche, 2019). This serves as the foundation of the following design cycles. In a second study I designed and developed a chatbot, which was plugged into virtual team communication and provided the users with feedback on their affective state. A design for presenting the feedback was derived in a pretest and the system was evaluated in an empirical experiment (see fig. 1 for the design). The results are promising as it could be shown that team cohesion and communication effectiveness was increased significantly under the treatment condition. Also individual satisfaction was augmented significantly through the system. Both the latter ones are seen as predecessors of team performance. Though significant effects on this construct could not be observed, it indicates a positive implication for the overall dependent variable of this research.

In the future two further experimental series are planned. Firstly, a further developed and refined artefact shall be evaluated in a large field experiment on its effect on the team processes and performance. This finalizes the first design cycle of the DSR project. Secondly, the system will be expanded and evaluated focusing on the transfer of missing social signals like attention. Here as well, the goal is to conduct a large field study. This concludes the second and final cycle of the DSR project.

Expected Contribution

With this research I expect to make three theoretical and several practical contributions. On the theoretical side as main contribution, prescriptive knowledge will be acquired by designing a system for social augmentation of team communication using chatbots. Through the design principles derived in the two cycles in combination with their evaluation, concrete design knowledge of how to build such a system in detail will be generated. By doing so, a starting point of a new theory of design and action (Gregor, 2006) will be established. Through this design, the kernel theories can be tested under unexperienced context conditions. As context matters in theorizing the application of these theories have to be investigated for the combination of new scenarios and technologies like chatbots in teams. Besides prescriptive knowledge, also descriptive knowledge will be acquired as the underlying theory of media synchronicity will be extended with the implication of moderating factors as application of user states, in teams and team constellations with chatbots. On the practical side, team managers and team members as users will experience higher virtual team performance and benefit from the system when collaborating. This may have major influence on the enterprise productivity. System designers and developers receive guidance through a resulting prescriptive knowledge on how to socially augment communication systems. Finally, the results will enable better virtual team work and possibly make a small contribution to the ambitious goal of creating a better future of work.

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Using Software Agents to Raise Awareness and Lower Information Overload in a Multi-user Collaborative Environment

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Abstract. Ubiquitous devices provide users with notifications that continue to blur the distinction between work and personal activities and can lead to information overload. This research aims to support users of multiple collaborative and social systems who may experience this, by designing and evaluating a personal software agent to support the user and ameliorate the effects of overload. A technique uniting personas and Empathy Map has been applied to model typical user behaviours, goals and pain points, which will inform the design of a solution to manage interruptions and information overload.

Introduction

Most users of social and collaborative software have experienced some form of Information Overload (IO) (Schmitt et al., 2018) and studies on social media platforms (Rodriguez et al., 2014) have shown IO to have a measurable negative impact on users. The intersection between personal and work usage has also become increasingly blurred. We aim to design and evaluate an approach to ameliorate IO arising from frequent interruptions and large volumes of content from diverse sources across work and personal contexts. Many systems - such as Facebook and Twitter - have their own algorithmic approaches to sift and prioritise

Copyright 2019 by Authors, DOI: 10.18420/ecscw2019_dc3 Except as otherwise noted, this paper is licenced under the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International Licence. To view a copy of this licence, visit https://creativecommons.org/licenses/by-nc-sa/4.0/. large content volumes. We hypothesised that these approaches were flawed^{1,2} because of: a) inconsistency of design and implementation across applications; b) mismatch between the priorities of the user and those of the provider; and c) privacy concerns over sharing data with the provider. We further hypothesised that the productivity and well-being of individual users can be improved by shifting more work to autonomous software agents supported by Artificial Intelligence (AI), if these can make content decisions that are consistent with those the user would themselves make.

We use the concept of *awareness* (Metaxas and Markopoulos, 2008) to model the domain in which the agent operates, which we take here to mean the ability of actors³ to perceive the activities and output of other actors in the system, as influenced by the actor's own activities and goals. We phrase an "awareness problem" - how does a user maintain awareness of relevant information without being so aware of noise that it impairs their function? Seeking to define a relationship between awareness and information overload, we apply a qualifier: *effective* awareness. That is, the actual awareness that an individual is able to maintain taking into account limiting factors such as the human ability to process information. We contend that reduced processing performance due to information overload has a negative impact on an individual's effective awareness; conversely, reducing the effect of information overload on the user can improve their effective awareness.

To test the validity of the hypotheses and provide a basis for solution design and evaluation, we conducted a survey of users of collaborative and social systems. We then developed a set of Personas (Cooper, 1998) to reveal requirements applicable to distinct types of users. These personas will serve as a design and evaluation aide for a novel software system to address the identified needs.

An Awarenesss Agent

The ability of computers to process large quantities of data and learn from user behaviour can help tackle IO. While approaches such as applying simple filters to data can be effective, we investigate how a more sophisticated software agent can act in concert with a human user to enhance their interaction with multiple collaborative systems.

Consider a software agent that acts on behalf of a user to monitor one or more systems, that brings information to their attention and undertakes certain interactions autonomously. We could say this *awareness agent* extends the *focus* of a user of a collaborative system, while also occupying their *nimbus*.

As Benford et al. (1994) summarised it: "The more an object is within your focus, the more aware you are of it. The more an object is within your nimbus, the

¹ https://www.engadget.com/2018/12/18/twitter-chronological-timeline-feature-latest-tweets/

² https://www.reviewgeek.com/1328/facebooks-news-feed-algorithm-is-completely-busted/

³ An actor is not necessarily human, it can also be a software agent or automated emitter of data

more aware it is of you". Adopting social media terminology, we can describe the focus as the people you are *following* and the nimbus as the *followers*.

An agent may also manage a user's own presence as seen by followers, whereby the agent would monitor the output created by its 'owner', and perform actions such as generating push notifications that other actors may receive. The distinction of this mode of operation is that the agent is processing content using rules defined by the *creator* of the content rather than by a consumer. This allows the creator to deliberately promote content items that they themselves judge to be noteworthy.

While many platforms use their own algorithms to select content, the awareness agent is intended to *democratise* this process, handing more control over selection and sharing to the users themselves. The agents and users together can be considered to comprise a Social Machine (Berners-Lee and Fischetti, 1999).

Research Questions and Approach

The following broad research questions are considered:

- 1. *How should the agent prioritise incoming information and communicate this to the user?*
- 2. How should the agent present the user's activities to others?
- 3. How should the user affect and understand the behaviour of the agent?

The first question considers the *focus* of the user, the second concerns their *nimbus*, while the third examines the relationship between the user and agent itself and considers issues of control, transparency and data privacy.

The domain is intentionally wide: the concept requires that the agent interact with a diverse range of media, applications and individuals to perform its function. However, certain specific cases have been identified, such as the collaboration service Slack, which is widely used, has an extensive API and competes with other media for users' attention. Other cases include email and social media.

An awareness agent should act independently, processing disparate information sources, and should be able to learn via both implicit techniques and explicit training. As well as monitoring *incoming* content, it should also act in an *outward facing* capacity, communicating its owner's activities externally.

A design science methodology is used (Peffers et al., 2007), evaluating theoretical solutions to the problem by developing software implementations of an awareness agent to address specific use cases and then evaluating these solutions.

Survey and Persona Development

User opinions were solicited in a survey, that was advertised with an intention to reach people who may experience IO. This was grouped around five themes:

- Attitudes to interruptions originating from application notifications.
- How well online services understand respondents' preferences and interests.
- Degree of trust and confidence in online services.
- General views on online services, connected applications and smartphones.
- Differentiation between work and personal use of apps and services.

A data-led approach in line with that described by McGinn and Kotamraju (2008) was used to generate the personas, employing a cluster analysis process to map respondent groups to personas (Tu et al., 2010). Persona construction used a hybrid of quantitative and qualitative inputs: the output of the clustering process evidenced the personas, but also supplied some more subjective criteria to enable the creation of a balanced and representative set. The PATHY technique for persona development (Ferreira et al., 2018) was selected for this work because of the improved guidance that it provides to structure users' perceptions and feelings, and to relate software features to personas.

A two-step clustering process was chosen, with individual clusters first generated for each question group, which were then used as a basis for an overall cluster of clusters. This approach was selected because the first analysis suggested that clusters of users tended to respond similarly across a theme. The second level clustering was used to identify commonalities across these theme-based clusters.

Each cluster was assessed for how members had responded to each of the individual questions of the survey (for example, how did Cluster A members respond to the question: *I receive so much information online that I often miss things that are important or time critical*?). Chi-squared tests determined in which cases there was a statistically significant relationship between cluster and response.

Having determined the significant combinations, applicable responses to questions were assigned to individual clusters in order to frame archetypes. For example, members of cluster A said that they separated work and personal usage and were not comfortable sharing personal information. These attributes, combined with demographic information that also emerged from the clusters, fed the PATHY technique to derive individual personas. As well as aspects of data-driven development, some subjective input was also used to generate realistic personas and achieve a reasonable balance of types and demographics. The derived set of personas can be found at https://doi.org/10.21954/ou.rd.7700579.

Discussion and Next Steps

The survey confirmed the assumption that many IT users experience IO and have diverse relationships with online services with varying levels of trust in their integrity and competence. The personas developed using the survey data will now be used to inform the design of the agent test platform, and to act as a basis for subsequent evaluation.

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Understanding and Supporting Collaborative Academic Writing as a Fragmented Process

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Abstract. I present an overview of findings from a qualitative study regarding territorial functioning and fragmentation in collaborative academic writing. The findings demonstrate how collaborative writing may be characterized as a fragmented process, due to territorial functioning manifesting in segregation of the work as well as fragmentation across constellations of tools with similar functionality. I describe co-writers' appropriation of existing tools to achieve double-level language and outline a focus for future design efforts for a co-design process.

Introduction

Collaborative work presents a particular challenge compared to individual work due to the added effort of placing material in common in a way that it is understandable and useful to multiple actors (Bannon & Bødker, 1997). Characterizing this challenge in order to address it necessarily involves understanding the practices of those multiple actors as well as the interplay of their individual motivations.

Classifications of cooperative work often take a perspective in which the collaboration is categorized based on characteristics of the group and the mode of collaboration (Posner & Baecker, 1992; Lowry et al., 2004). While these aspects

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are significant, in particular when attempting to understanding the impact of technological facilitation, restricting the view to those aspects enforces a static perspective that may result in a poor match between the classification and reality (Grudin, 1994). My work falls into the body of research that supplements this view by concentrating on human practice and how it is mediated by technologies for collaboration.

Collaborative writing processes in particular are usually studied with a focus on the text (Olson et al., 2017) and/or on the main writing tool (Neuwirth, et al., 1992; Noël & Robert, 2004). The focus of my research extends to a more ecologically comprehensive view that acknowledges the presence and use of multiple documents and tools during the production of a collaboratively authored text. In addition to examining practices around these multitudes, emphasis is put on writers' motivations for these practices. In particular, I focus on territorial functioning and motivations for territorial behavior in academic collaborative writing. My findings on this so far, which are summarized below, have led to my framing of the collaborative writing process as fragmented¹, in terms of both content distributed across multiple tools (Bergman et al., 2006; Dearman & Pierce, 2008) and separation of work (Clement & Wagner, 1995). The research questions I address are the following:

- (1) What are co-writers' motivations for segmenting writing between each other and across tools?
- (2) What means and strategies do co-writers apply to facilitate fragmented work?
- (3) What challenges can be identified for HCI/CSCW research and design regarding the mediation of collaborative writing as a fragmented process?
- (4) What are potential answers to those challenges?

Questions 1 and 2 are covered by my current findings (Larsen-Ledet & Korsgaard, 2019). Question 3 is partly addressed in these findings and will be addressed further in future work along with Question 4. It is too soon for me to say what form answers or solutions to the challenge posed by collaborative writing as a fragmented process may take. I imagine that it might take multiple directions at once: Design guidelines, implementation of concrete tools, or a push for a paradigm shift.

¹ This terminology is inspired by Clement and Wagner's (1995) paper on disarticulation in collective communication spaces.

Methodological Approach

My current findings come from a combination of interviews about co-written projects and programmatically facilitated visual analysis of revision logs from project documents.

The interviews involved 13 university students and 19 researchers whom I talked to about their experiences with collaborative writing, focusing on a particular recent project but allowing the conversation to turn to other cases. The interviews totaled 23 (some were group interviews) and covered 18 different projects. The questions focused on both practical and social aspects of the collaborations: The tools and text production strategies applied when writing; ways of editing text written by others; ways of coping with others editing one's own text; personal strategies for draft writing; and approaches to decision-making during the writing process.

To support the analysis specifically of how territorial functioning manifests in the writing, a colleague and I developed a tool that allows visual exploration of revision logs of GOOGLE DOCS documents. Since only a subset of the interview participants used GOOGLE DOCS, only documents from this subset were analyzed.

Current Findings

As already stated, participants' accounts of their writing practice and experiences paint a picture of a process that is fragmented in multiple ways. Firstly, the writing and other involved work is spread across multiple tools with overlapping functionality: Text editing takes place in different writing tools at different stages of the writing; and multiple means of communication are used, even in collaborations involving only two people. The reconciliation of co-writers' multiple views of the situation and the object of work is highly effortful, involving copypasting to transfer text and manually porting formatting, coordinating the state of the text across multiple instances being worked on, and maintaining awareness of the activities of co-writers. Furthermore, oftentimes communication is decoupled from the content addressed in the communication.

Given the availability of tools supporting both writing and communication, such as GOOGLE DOCS, OVERLEAF or GIT, an obvious question is why writers include multiple tools offering similar functionality into their tool constellations (Rossitto, et al., 2014). We found that co-writers' motivations for these practices partly pertain to territorial functioning (Taylor, 1988), including a desire for privacy or a need for a space in which to work uninterrupted. Multiple participants reported occasionally copying text into a local text editor, such as MICROSOFT (MS) WORD or NOTEPAD, to be able to work in private. This behavior was, for some, also due to preferences for certain kinds of functionality for certain tasks (e.g. better spell checking in MS WORD). This practice results in work becoming fragmented and co-writers having trouble keeping up with the work of other co-writers.

From our interviews we also found that the original writer of a piece of text acquires a form of *local expertise*; a particular expertise in navigating the region of text that they have crafted. Participants both expect and demonstrate respect for this kind of local expertise, demonstrating an attentiveness to territorial affiliation.

Participants reported many forms of appropriation intended to support territorial functioning and/or achieve capabilities not included in a tool's design. To achieve better coupling of communication and content, many of the participants described communicating directly within the text being edited. In these cases, text formatting (most often coloring) is sometimes used to keep track of who is saying what in such discussions. To pay respect to the territories of co-writers participants described making changes in comments rather than changing text directly. In this way they would not directly "touch" the original writers work and/or the original writer would be able to reject the change, in either case remaining in control. In this way, writers make comments into a double-level language (Robinson, 1991): The comments in and of themselves contain edits or serve to explain rationale, but additionally they provide writers with a way to express compliance with territorial expectations. Based on our findings we may classify two kinds of double-level language: *expressive*, such as the color coding signaling expectations, and *operative* like the comments demonstrating compliance.

These findings expand the prevailing image of collaborative writing from the production of text in a document to a complex coordination effort around multiple tools and files that involves pragmatic as well as social concerns. Furthermore, the findings feed into a debate about application silos and current paradigms for software development (Nouwens & Klokmose, 2018).

Next Steps

To address the issues related to territorial functioning and the fragmentation of content and communication across constellations of tools, as well as the possibility for appropriation to support double level language, I plan to conduct a series of codesign workshops. The idea is inspired by traditional participatory design and will be dialogue-based and take outset in concrete writing projects, similar to the interviews. Visualizations of these projects will potentially be used to spur on the dialogue.

The theme of the co-design workshops will be to design (components) for flexible sharing and withholding in collaborative writing. Currently, my idea is to begin with open discussions, potentially in a focus group format. Following this, potentially in a new session a couple of weeks later, I plan to have an ideation session. Implementing the ideas envisioned will be worked on in a final session. In preparation for this my plan is to pre-construct program components based on the generated ideas, to allow participants to construct a working solution while still facilitating quick progress (hopefully mitigating the problem of participants becoming disengaged (Bødker & Grønbæk, 1992)). For the implementation I plan to use Webstrates (Klokmose et al., 2015), an open source document editor and toolkit that allows composition and exchange of software components (see Klokmose, *The Webstrates project*).

I would particularly like to discuss ways of approaching the co-design process, both methodologically and regarding what to aim for (empirical take-aways vs. supplying participants with a usable tool or skills to continue on their own (Bødker & Kyng, 2018)). Methodologically I am mostly in doubt about how to facilitate ideation with the participants, but also to what extent participants can and should be involved in building/modifying the technology directly. In connection with this I would also like to discuss opinions on, and experiences regarding, how to balance discussion, ideation, and construction.

Biography

Ida Larsen-Ledet is a second year Ph.D. student in the Computer Mediated Activity (CMA) group in Aarhus University's Department of Computer Science. Her project is part of the Horizon 2020 project *Common Interactive Objects*² which explores possibilities for extending human understanding and control of technological artifacts used for collaborative purposes. Ida obtained her master's degree in computer science from Aarhus University with electives in cognitive semiotics and information studies in 2017. Ida's Ph.D. work is supervised by Professor Susanne Bødker.

Following the courses offered by the CMA group during her bachelor's and master's and doing her master's thesis under Professor Bødker has provided Ida with an activity-theoretical background. The activity-theoretical view of tools as mediators for human activity and behaviors is the foundation for her human-centered approach which focuses on people's practices and motivations, in general and as they relate to specific tools. Due to this focus she favors qualitative methods in her work, as she aims to provide nuanced accounts of collaborative practices and personal motivations.

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² cs.au.dk/research/pages/cio, Common Interactive Objects

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Academic Library Managers' Use of Artefacts in their Everyday Cooperative Work Practices

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Abstract. This interpretive focused-ethnographic study was conducted to illuminate and gain deeper understanding on managers' everyday cooperative work practices using artefacts. In the dissertation, artefacts refer to digital technologies and information. The doctoral research specifically examines how artefacts in the workplace of an academic library are used in academic library managers' everyday cooperative work practices; and provide suggestions of how artefacts can be used to better fit those practices. The empirical data was collected through participant observations, face-to-face interviews and documents from two technologically advanced academic libraries, one in Sweden and another one in Australia. The study uses soft systems thinking theory and concepts from computer-supported cooperative work (CSCW) such as awareness, articulation and appropriation to analyze and discuss how cooperative work is conducted in the everyday work practices of academic library managers with the use of artefacts. Thus, this research contributes insights from the field of computer-supported cooperative work to the information systems and library domain by considering social aspects of cooperative everyday work practices.

Introduction

Managers' work in library organizations nowadays is mainly cooperative since it includes a group of multiple actors within a larger work setting that interact through a collection of digital and physical artefacts and their work is

Copyright 2019 by Author Niki Chatzipanagiotou, DOI: 10.18420/ecscw2019_dc2 Except as otherwise noted, this paper is licenced under the Creative Commons Attribution-Noncommercial-ShareAlike license (CC BY-NC-SA 4.0). To view a copy of this licence, visit <u>https://creativecommons.org/licenses/by-nc-sa/4.0/</u> interdependent. Academic library managers constitute good examples of managers' interaction and coordination of cooperative practices through artefacts. In the dissertation, artefacts imply digital technologies and information. Academic libraries have become a complex connection node with a multitude of artefacts that managers not only have to organize, but they use them to manage their organization too. This can be achieved through joint actions and cooperative practices. According to Schmidt and Tiger (1991), the problem in cooperative work is something that emerges out of situations and the aim is how to better support these situations. However, it is difficult to identify the support needed and produce detailed descriptions of the relationship between cooperative work and artefacts. This is because artefacts pervade the work activity and change it, so that the support becomes inseparable from the structure of the work itself. Therefore, more focused contextual studies of cooperative practices of managers are required.

In their work practices, academic library managers interact by using a variety of articulated practices and appropriate artefacts, forming this way systems of complex interrelated coordinative practices and artefacts (Schmidt and Wagner, 2004); for example, systems for organizing documents, meetings, projects, decision-making, communication and collaboration systems. The challenge is to understand the complex interrelationship of these coordinative practices and artefacts (Schmidt and Wagner, 2004).

As a group of individuals that collaborate to manage their organization, academic library managers combine different types of artefacts. The collection of artefacts may comprise of digital or other physical artefacts that are in the same place or they are distributed; for example distributed artefacts situated in different branch libraries. As stated previously, in the dissertation, the term artefacts is used to refer to the combination of digital technologies and information. No matter how heterogeneous or distributed this collection may be, managers will interact and coordinate their cooperative activities through these artefacts. This interaction implies managers' everyday work practices that are ubiquitous in cooperative work. Cooperative work is also distributed physically, in time and space, and logically in the sense that cooperative actors are semi-autonomous in their work.

So, the purpose of the doctoral research is to examine and gain a deeper understanding of how academic library managers use artefacts in their everyday cooperative work practices; and to provide suggestions of how artefacts can be used to better fit those practices.

In order to gain a deeper understanding of the situation as a whole, there is a need to illuminate the various aspects and underlying perspectives. To understand the relations between academic library managers, artefacts and everyday work, it is important to understand how they work within a context (Schmidt, 2011). To understand the context and how it is constructed, it is significant to understand what exactly the academic library managers are doing in their everyday work

practices (Schmidt, 2011). For this, I choose to analyze the work among them and in collaboration with others in the organization through artefacts. By examining the academic library managers' use of artefacts, insights can be gained into how this is expressed in daily cooperative work practices and understand how artefacts can be used to better fit these practices. Thus, the research aims to illuminate and enhance the understanding of managers' everyday cooperative work practices using artefacts.

From the above, the following research questions are formulated:

- (1) How do academic library managers perceive the use of artefacts in their everyday work practices?
- (2) What kind of artefacts do academic library managers use in their everyday work practices?
- (3) What do academic library managers suggest regarding the use of artefacts to better fit their everyday cooperative work practices?

Theoretical Framework

In the dissertation, I adopt the computer-supported cooperative work definition on practice and, therefore, practices refer to what academic library managers do when they do their job using artefacts. According to Schmidt (2018, p.51), "...Practice is used...to address and focus on the actual activities as unfolding contingently in the settings in which collaboration technologies may be used...".

The term cooperative work is used to describe "multiple persons working together to produce a product or service" building on Schmidt and Bannon (1992, p.15). In this research, it applies to multiple academic library managers who work cooperatively together to manage their library organization with the use of artefacts. Work is social and complex (Schmidt and Bannon, 1992). Despite its social nature, work is not intrinsically cooperative and, thus, distinct from individual work. What makes them distinct is that at the core of cooperative work is the notion of interdependence. People engage in cooperative work when they are mutually dependent and, therefore, are required to cooperate in order to get the work done (Schmidt, 1991; 2011). Being mutually dependent in work means that the members of a group rely on each other's work quality and timeliness; they are interdependent. In other words, they cannot accomplish the specific work individually. This interdependence implies cooperative effort that includes activities of mediation and control of the work arrangement. Hence, the cooperative actors need to articulate and coordinate their distributed individual activities (Strauss, 1988; Schmidt, 2011). Cooperative work has certain characteristics such as cooperative groups are often large or are embedded within larger groups, they are not permanent and their interaction changes dynamically depending on the situation (Schmidt and Bannon, 1992). It is distributed in time and space and in the sense that cooperative actors are semi-autonomous in their work.

The term artefacts is also adopted to describe digital technologies and information. To study artefacts we have to take into account the context and use situation (Goldkuhl, 2013, p.92). Digital technologies include various information and communication technologies, administration technologies, as well as tools and devices such as computers, laptops, tablets, mobile phones, projectors and boards, interactive or not. According to Goldkuhl (2013, p.93), digital technologies are physical artefacts based on technology and, therefore, they can be considered digital or IT-artefacts. These artefacts are part technical and part informational, meaning that they act as mediators in information exchange between people (Goldkuhl, 2013, p.93) which is what makes them distinct from other artefacts. Digital technologies are combined with information. For example, information represented in the form of a file which is saved in a computer accessed by all managers. Building on Schmidt (1994, p.63), information can be seen as a "mechanism of interaction" which can be used to facilitate the coordination of work. Additionally, following the information lifecycle, in whatever form, helps the researcher to get to know an organization (Randall, Harper, Rouncefield, 2007). Therefore, artefacts, i.e. digital technologies and information, enable interaction and facilitate coordination.

For the doctoral research, soft systems thinking theory (Checkland, 2011; 1981; Checkland and Poulter, 2010; Reynolds and Holwell, 2010) and concepts of computer-supported cooperative work such as awareness (Schmidt and Bannon, 2013; Schmidt, 2002; 1994; Strauss, 1988), articulation (Schmidt and Bannon, 2013; Bardram and Bossen, 2005; Strauss, 1988) and appropriation (Müller et al., 2016; Suchman, 1987) are used to analyze and discuss the empirical material. The discussion will be set in the context of actors in complex cooperative work settings that develop coordinative practices by articulating the work, while at the same time being aware of their colleagues' ongoing activities. The library organization is conceptualized as an information-intensive ecosystem consisting of complex interplays among managers, cooperative work practices and artefacts. Within the library system, several human activity systems, as illustrated in soft systems thinking, constructed by managers exist which are related to purpose and function within the overall organization. In managers' cooperative practices, the appropriation of artefacts plays an essential role. In academic library managers' complex reality, their different worldviews co-exist and affect their respective approach of managing and using artefacts for that purpose. Re-conceptualizing cooperative work practices of academic library managers that are facilitated by artefacts will provide suggestions of how artefacts can be used to better fit these practices. Academic library managers experiences were brought together to form an insightful picture which could lead to re-designing cooperative work practices facilitated by artefacts.

Empirical Setting

Two (2) academic libraries participated in my research. One academic library of a public university in Sweden and another academic library of a public university in Australia. The twenty one (21) academic library middle managers of the two respective libraries comprise the sample of this research study. Figure 1 provides an illustration of the participants from both academic libraries.

| SWEDISH LIBRARY Library Management Team | AUSTRALIAN LIBRARY Library Leadership Team | |
|--|---|--|
| The 3 section managers | The Associate Director | |
| The head of the communications unit | The Workforce & Infrastructure manager | |
| The financial manager | The 4 branch managers | |
| The 3 function leaders | The 3 section managers | |
| The 2 administrative managers | The Quality and Planning manager | |
| | The Project manager | |

Figure 1. Participants' overview

Methodological Approach

The focused ethnographic approach I have described above and more extended in the dissertation draft, entailed the following methods for the collection of data: documents review, participant observations and face-to-face interviews (Marshall and Rossman, 2016). Figure 2 provides an overview of the empirical material. All participants have given their consent and signed the informed consent forms which were prepared following the ethical guidelines of the Economic and Social Research Council Framework for research ethics (2015).

| SWEDISH ACADEMIC LIBRARY | | |
|-----------------------------|---------------------|---|
| What | When | How many |
| Documents | Weeks 39 - 52, 2016 | Previous and current organizational charts, Strategic and Operational documents, Conference presentations, Surveys, and the University's and Library's webpage |
| Participant Observations | Weeks 46 - 47, 2016 | 10 academic library managers |
| Interviews | Weeks 48 - 49, 2016 | 10 academic library managers (60 – 90 min each) |
| AUSTRALIAN ACADEMIC LIBRARY | | |
| What | When | How many |
| Documents | Weeks 9 – 26, 2017 | Previous and current organizational charts, Strategic and Operational documents, manuals of Policies and Procedures, Statistical reports and the University's and Library's webpage |
| Participant Observations | Weeks 22 – 23, 2017 | 11 academic library managers |
| Interviews | Weeks 22 – 23, 2017 | 11 academic library managers (60 – 90 min each) |

Figure 2. Data Collection overview

My work to date

The empirical material has gone through several rounds of analysis and several theoretical frameworks, such as activity theory (Engestöm, 2015), and ways of analysis, such as 3C's (Lichtman, 2013), have been tried in order to understand academic library managers' everyday work practices including cooperative work and their use of artefacts. However, the use of soft systems thinking theory along with concepts from computer-supported cooperative work (CSCW) such as awareness, articulation and appropriation offered me what I couldn't find in other theories in order to analyze and discuss the data. So, the aforementioned theoretical framework is currently both developed and used to analyze the data and discuss the findings. Also, different approaches of making sense and presenting the data such as vignettes are explored.

Expected contributions

The doctoral research will:

- Enhance the understanding of managers' practices within their context of practice by providing some thick descriptions.
- Contribute to the understanding of how knowledge, communication and joint actions of managers are collaboratively constructed, understood, negotiated and maintained in their context of practice.
- Contribute to the literature on information systems and computer-supported cooperative work.
- Contribute theoretically with the combination of soft systems thinking theory and concepts of computer-supported cooperative work.
- Contribute in the library community and similar information-intensive organizations by offering practical recommendations of how artefacts can better support their cooperative work practices.

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Crafting Unconventional Artifacts to Support Long-distance Relationships: An Overview of Doctoral Research

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Abstract. This paper presents an overview of my doctoral research thus far, which has been dedicated to creating unconventional artifacts that use interaction solutions beyond conventional screen displays to mediate emotional communication in the use case of long-distance relationships.

Research question

Long-distance relationships (LDRs) thrive in the contemporary life. There are a significant number of individuals who have to live apart from their loved ones due to educational demands, career pursuits, military duty, emigration and such circumstances (Stafford, 2004). Luckily, computer-mediated communication tools have enabled a variety of convenient channels for people to interact with their loved ones over distance. Email, instant messaging, cell phone calling, texting, video chat, and social networking sites all create easy ways for remote couples to communicate. However, current long-distance communication is limited to visual, audio, and text-based channels. Moreover, the user interfaces are mostly limited within screens. It has been found out that most available technologies focus on the transmission of explicit information, which neglects the emotional and subtle communication needed for close relationships (Hassenzahl et al., 2012). Thus, my

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Permission to make digital or hard copies of part or all of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Abstracting with credit is permitted. To copy otherwise, to republish, to post on servers, or to redistribute to lists, contact the Authors. research question is centered on: How can design help to bridge the gap between understanding LDR couples' needs in research and designing technologies for them in practice?

Methodological approach

Participatory methodology of design thinking has been employed and developed in my research so as to create empathy and engage the users – remote couples who are in serious LDRs – into the design process. Empathy has been used as a powerful tool and strategy to understand the users in which service design tools and methods, e.g. persona, empathy map, user journey, etc., have been applied. My methodological approach has combined conducting workshops and developing findings through the use of qualitative methods, e.g. semi-structured interviews, focus groups, case studies, etc.

Work/findings to date

My research thus far has resulted in three conference proceedings:

(1) The first presents a systematic literature review which was based on 52 research prototypes for mediating emotional communication between LDR couples. One of the key findings reveal that many reviewed works show a lack of user participation, and strikingly, most of the recruited participants in the lab studies were not authentic remote couples in real life, but substitute participants were used instead. Even though there were a number of studies did engage authentic participants who were involved in LDRs when the studies were carried out, in most cases the participants were only engaged in the evaluation stage (Li, Häkkilä, & Väänänen, 2018).

(2) To address the gap found in the first study, I engaged five remote couples who have sustained a long-term commitment in their LDRs in the second study, with a view to build empathy with them, explore their experiences and skills for coping with LDRs, identify their main challenges and needs, and understand their perspectives on existing artifacts that mediate intimacy between remote partners. The participants were treated as experts on their own LDR experiences, and were intensively engaged as co-designers throughout the design process where they had a chance to express their knowledge and insights on designing desirable LDR-oriented products that could better fit into the lives of the end users. The findings revealed that there is a need to take the strategy of customization into account when designing technologies for LDRs, where customization can serve as an aid to empower remote couples as skilled practitioners to creatively use technologies so as to meet their diverse needs (Li, 2018).

(3) The third proposed a functional prototype which uses a pair of connected candles as peripheral emotional user interface for creating an implicit communication channel to support emotional awareness in LDRs. The aim was to bring a subtle and poetic cue of the presence of a distant loved one by lighting up a candle. The concept is that each partner has an identical set up which consists of an authentic candle and an electronic candle. When the local partner lights the authentic candle, the LED candle of the paired system at his or her remote partner's location will illuminate. Additionally, there is a space between the candles for the users to customize their candle setup by placing a small token or memento, reminding them of the connected partner. Its evaluation based on a focus group with authentic LDR participants revealed that the concept was generally positively received, especially from the aesthetic point of view (Häkkilä, Li, Koskinen, & Colley, 2018).

In addition, two manuscripts are currently under review:

(1) One proposed a non-illuminating electrochromic ambient display and explore its use for supporting the communication LDRs. The unobtrusive display technique was prototyped with an interactive picture frame, which was used as a probe to chart the possibilities of the technique in an interview-based user study (n=12) and an in-the-wild deployment (one couple) of people living remotely from their partner. The salient findings showed positive response especially on the non-light-emitting nature of the display. Moreover, the presented concept added a new communication channel between the remote couple in real-life settings, which supported their communication and relationship through a pair of private, meaningful, and always-on yet calm displays (Li, Müller, & Häkkilä, 2019).

(2) The other presents a conceptual framework of the different aspects that consider the designers should when designing technology-mediated communication systems for LDRs. The framework addresses four main areas of LDR systems: users (the remote couple), LDR, technology, and design. Additionally, a set of six existing systems and prototypes were analyzed in the context of the framework. The analysis indicates that the framework functioned as a practical tool in categorizing and investigating their different aspects in a systematic way, which could be further developed to be used as a tool for design and evaluation of systems for interpersonal emotional communication for LDRs (Li, Häkkilä, & Väänänen, 2019).

Next steps

I regard the in-the-wild study as an important next step. More specifically, I will keep pursuing in the development and evaluation of novel devices which could be used to support LDRs, and deploying those devices with a number of LDRs.

Additionally, I will create a design tool that can help designers to better design and evaluate communication technologies that support LDRs, which is now in the process of developing.

Expected contributions

I hope my research will enlighten the impact of emotional communication on LDRs and result in the new understanding of how communication technologies could be embedded in unconventional forms and humanized with higher levels of emotional communication, thus supporting LDRs. Furthermore, I expect my research can challenge the way the world uses technology, through crafting technologies to become part of our lives and the way we were born to interact, instead of letting technology shape us.

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