

Master Thesis

July 3, 2021

# AmbientTeams

An approach to stay socially connected in  
remote teams

**Dario Bugmann**

of Aarau, Switzerland (15-708-852)

**supervised by**

Prof. Dr. Thomas Fritz

Dr. André Meyer, Alexander Lill



University of  
Zurich<sup>UZH</sup>





Master Thesis

---

# AmbientTeams

An approach to stay socially connected in  
remote teams

Dario Bugmann



University of  
Zurich<sup>UZH</sup>



**Master Thesis**

**Author:** Dario Bugmann, [dario.bugmann@uzh.ch](mailto:dario.bugmann@uzh.ch)

**URL:** <https://github.com/HASEL-UZH/PA.AmbientTeam>

**Project period:** 15.2.2021 - 22.7.2021

Human Aspects of Software Engineering Lab  
Department of Informatics, University of Zurich

---

# Acknowledgements

credits für avatar library



---

# Abstract

With the shift towards remote work, casual, informal conversations are no longer guaranteed to happen because of the lacking serendipity. Such informal discussions are further challenged because of missing cues from co-workers about their availability or social states. In addition, despite increased challenges with mental health, tools focusing on the social challenges of remote work are still lacking. For this reason, we developed AmbientTeams, a casual and informal tool that attempts to reduce the perceived distance in remote work by creating opportunities for more informal interactions. AmbientTeams attempts to achieve this by sharing moods and status messages with the team, or more generally, fostering informal communication among team members. We evaluated our research prototype on a group of 6 knowledge workers who agreed on using AmbientTeams for one workweek.





---

# Zusammenfassung

Mit der Verschiebung in Richtung Fernarbeit sind zwanglose, informelle Gespräche aufgrund der fehlenden zufälligen Zusammentreffen nicht mehr garantiert. Solche informellen Gespräche werden außerdem durch fehlende Hinweise von Kollegen über ihre Verfügbarkeit oder ihren sozialen Status erschwert. Darüber hinaus gibt es trotz der zunehmenden Herausforderungen im Bereich der psychischen Gesundheit immer noch keine Tools, die sich auf die sozialen Herausforderungen der Fernarbeit konzentrieren. Aus diesem Grund haben wir AmbientTeams entwickelt, ein zwangloses und informelles Tool, das versucht, die wahrgenommene Distanz bei der Fernarbeit zu verringern, indem es Möglichkeiten für informellere Interaktionen schafft. AmbientTeams versuchte dies zu erreichen, indem es die Möglichkeit schafft, Stimmungen und Statusmeldungen mit dem Team zu teilen, oder allgemeiner gesagt, die informelle Kommunikation zwischen den Teammitgliedern fördert. Wir evaluierten unseren Forschungsprototyp an einer Gruppe von 6 Wissensarbeitern, die sich bereit erklärten, AmbientTeams eine Arbeitswoche lang zu nutzen.



---

# Contents

<b>1</b>	<b>Introduction</b>	<b>1</b>
<b>2</b>	<b>Related Work</b>	<b>3</b>
2.1	Workplace Isolation . . . . .	3
2.2	Communication . . . . .	4
2.2.1	Informal Communication . . . . .	4
2.3	Awareness . . . . .	5
2.4	Well-being: Emotions, Moods, and Sentiments . . . . .	6
<b>3</b>	<b>Approach</b>	<b>9</b>
3.1	Minimal Design . . . . .	9
3.2	Focus on People . . . . .	10
3.3	Spontaneous Interactions . . . . .	10
3.4	Research Questions . . . . .	11
<b>4</b>	<b>Prototype</b>	<b>13</b>
4.1	Technology Stack . . . . .	13
4.2	Windows . . . . .	13
4.2.1	Team Overview Window . . . . .	13
4.2.2	Ambient, glanceable Window . . . . .	14
4.3	Availability Status . . . . .	14
4.4	Sharing . . . . .	15
4.5	Breakroom . . . . .	16
4.6	1:1 Interactions . . . . .	16
<b>5</b>	<b>Preliminary Evaluation</b>	<b>19</b>
5.1	Participants Recruitment . . . . .	19
5.2	Participants . . . . .	20
5.3	Initial meeting . . . . .	20
5.4	Prestudy Questionnaire . . . . .	20
5.5	Evaluation Phase . . . . .	20
5.6	Poststudy Questionnaire . . . . .	20
5.7	Interview . . . . .	20
<b>6</b>	<b>Data</b>	<b>21</b>
<b>7</b>	<b>Results</b>	<b>23</b>

---

<b>8 Conclusion</b>	<b>25</b>
<b>Appendices</b>	<b>27</b>
<b>A Additional Documents</b>	<b>29</b>
<b>B Interview Transcriptions</b>	<b>31</b>

## List of Figures

4.1	Team overview window . . . . .	14
4.2	Ambient window . . . . .	15
4.3	Sharing window . . . . .	15
4.4	Breakroom creation . . . . .	16
4.5	Breakroom, pictures are artificially created with <a href="https://generated.photos/">https://generated.photos/</a>	17
4.6	1:1 interaction overlay . . . . .	17
4.7	Messaging window . . . . .	18
4.8	1:1 interactions . . . . .	18
5.1	Study timeline . . . . .	19

## List of Tables

6.1	The data collected during the preliminary evaluation and its relevance for the RQs .	21
-----	--	----

## List of Listings



# Introduction

In Software Development, remote working has become very popular over the past years. Due to the Covid-19 pandemic, this trend has grown even stronger, forcing many companies and their employees to work from home. Further, the majority of managers expect to have more flexible work from home policies post-pandemic, and employees would like to continue working from home at least partially [Spa20b], making the topic very much relevant also after the pandemic.

While working from home has numerous benefits, it also comes with a range of challenges. On the benefits side, employers can realize savings in real estate costs, and the employee can benefit from more flexible work hours and spending less time and money commuting [Mul+09]. However, shared challenges from working from home are that communication is reduced [KEG88] and suffers in quality [Mul+09]. More specifically, informal communication drastically reduces when working from home [HM05]. This reduction of informal communication can lead to difficulties building trust, maintaining work relationships, or not feeling attached to the team [Com+20; OO06]. Another consequence of remote work is the feeling of workplace isolation [Mul+09; MMM07]. The feeling of isolation leads to not knowing whom to turn to in case of a problem or not feeling part of the company and is said to be caused by missing support from co-workers and opportunities for social and emotional interactions in a team [MMM07]. The pandemic further reinforces this influence leading to almost 60% feeling less connected to their co-workers compared to before the pandemic [Spa20b]. Since strong team cohesion has been shown to have a positive impact on the team's effectiveness and productivity [Car+17], and the feeling of being disconnected from colleagues have been shown to impede engaging in productive tasks [Eco20], the connectedness with the team is of particular interest to us.

A lack of awareness causes the challenges of working remotely: less information about co-workers is exchanged, e.g., no or fewer cues are available to identify team members' interruptibility or emotional states. This missing information makes it a lot harder to find opportune moments to initiate a conversation because it is often unknown whether a person might be in a deep focus state or whether a person might be more than happy to chat. Informal communication is further challenged because serendipity is missing when working remotely because people no longer randomly bump into each other at the water cooler or the coffee machine. Therefore, improving awareness in the workplace is the foundation of our approach.

While there are several prior approaches to improve awareness within teams by showing the current coding tasks and work items that others are working on [Bie+07; Jak+09], they do not focus on the person behind that work item. They thus do not put teams into the center of attention. To make this point stronger, recent research shows concerning numbers in regards to workers' well-being and mental health, stating that the pandemic has led to an increase in stress for 65.9% of people and 44.4% reported a decrease in mental health [Qua20]. Therefore, our concept, AmbientTeams, follows a different approach by "putting people first". It includes an ambient always-

on-top overview of the core team members and their moods, status messages, and other states. In addition to such a microblogging approach, where team members can share information about their moods (and potential context), we aim to study further possibilities to foster and motivate serendipitous, informal exchanges with the team.

In the next chapter, existing approaches and their underlying concepts are discussed before introducing our approach and its differences. The resulting prototype is then introduced in chapter 4 and analyzed in the scope of a preliminary evaluation in chapter 5.



# Related Work

Remote work offers numerous benefits for both the employee and employer compared to traditional co-located work. Benefits on the employee side include a more flexible schedule, higher job productivity, and less time and money spent commuting [Flo19; Mul+09]. The increased flexibility and autonomy allows employees to more easily deal with their family responsibility and leads to higher levels of job satisfaction and higher employee retention [Mul+09; GH07; Mad11], both highly beneficial for the employer. The employer can further profit from savings in real estate costs and increased productivity [Mul+09]. In addition to those general benefits, there is another popular reason for building distributed teams: the possibility to build teams with talents from all over the world [Car99].

However, remote work creates new challenges for the company and its employees. Therefore, it is not surprising that much research has been done in this area, most of which coming from Computer-Supported Collaborative Work (CSCW). The general goal of existing solutions is to support distributed teams in accomplishing work as effectively and efficiently as possible. While a lot of research goes into collaboration and coordination challenges in remote work, the goal of AmbientTeams is fostering social, informal interactions. As a result, we identified four main social challenges that are the result of working, namely the feeling of workplace isolation, reduced informal communication, missing awareness, and reduced well-being. Together with existing solutions aiming at solving those problems, those four challenges are discussed in the subsequent sections.

## 2.1 Workplace Isolation

Marshall, Michaels, and Mulki define workplace isolation as the "psychological construct that describes employees' perceptions of isolation from the organization and from co-workers. Isolation perceptions are formed by the absence of support from co-workers and supervisors and the lack of opportunities for social and emotional interactions with the team" [MMM07, p. 198]. They further suggest a categorization into social isolation and organizational isolation. Organizational isolation stems from the perception that remote workers might feel "out of sight, out of mind" [BK99], which is related to a lack of awareness, which is discussed in section 2.3. Social isolation relates to the fact that remote workers miss informal chats, spontaneous discussions, and meetings around the water cooler [CK02]. For those reasons, a closer look at communication and, more specifically, informal communication will be given in the following section.

## 2.2 Communication

Research in the field of software development states that co-workers are the most used source of information used by developers [KDV07], emphasizing the importance of team communication inside software development teams. When shifting from traditional, co-located work to remote work, studies find different results regarding the communication frequency. While Kraut, Egidio, and Galegher [KEG88] and Allen et al. [All+84] find a decrease in communication, Mulki et al. [Mul+09] find increased communication in a remote setting. A possible reason for more communication includes the need for remote workers to over-communicate their availability status to their co-workers [KSO12]. Reasons for communication reduction could be the active effort required to bring back ad-hoc meetings [Mil+21], or the lack of the required awareness to initiate a conversation. Regardless of communication frequency, working remotely and thus using software to communicate leads to having more misunderstandings due to missing cues, leading to more misunderstanding and thus reducing communication effectiveness [Mul+09]. This is because text-based communication (which is often used in software development) has very limited capacity, and thus a lot of socio-emotional information is lost [Has+17]. This likely is a reason why face-to-face communication is still very important for many developers [Sto+16] and a lack thereof, which is caused by working remotely, can lead to workplace isolation, making it harder to develop personal relationships and build trust [Mul+09]. Gajendran and Harrison [GH07] state that working from home with high-intensity (more than 2.5 days a week) harmed relationships between co-workers, something that is enforced because of the Covid-19 pandemic. Since informal communication helps developing work relationships [Com+20; OO06], it is of special importance in distributed teams.

### 2.2.1 Informal Communication

Kraut et al. define informal communication as "communication that is spontaneous, interactive and rich" [Kra+, p. 5]. Differences to formal communication include lack of planning and the fact that the content of the communication is unknown in advance. Kraut et al. [Kra+] further state that over 85% of all conversations are informal, and that informal communication happens more often if there is a short physical distance between parties. Similarly, Hinds and Mortensen [HM05] find that members of distributed teams engage less in informal conversations. This reduction of informal communication is unfortunate since informal communication is crucial for achieving high productivity and social goals [Kra+] such as developing work relationships [Com+20; OO06]. More concretely, in the field of software development, informal communication plays a critical role due to the fast speed at which informal communication distributes knowledge across a team or company [FL98; MH01]. Also, informal communication can increase awareness, enabling developers to work efficiently [HM01]. In the ever-changing field of agile software development, this is particularly useful because requirements can change, and formal communication channels cannot spread the news as fast. Besides, informal communication is essential for conflict identification and handling [HM05]. The fact that teams with a high degree of social interactions often have better team cohesion [SCS14], and informal communication is normally much more frequent than formal forms of communication [Kra+], further pronounces the importance of informal communication.

Because of those benefits, it is no surprise that numerous approaches are fostering informal communication inside distributed teams. One of the earliest proposed solutions for promoting informal communication in distributed teams was VideoWindow [FKC90]. Despite being an early solution, the authors already identified two essential requirements such a system must offer: low personal cost and the need for a visual channel. If the cost for initiating conversations are too high, the system will not be helpful because the tool will not be used. The visual channel also

plays a vital role by recognizing the presence of other people, indicating whether a conversation can be initiated. Sasaki [Sas99] developed a hallway system that was able to raise awareness and helped to indicate that one might have a question but failed to promote casual interactions. In comparison, Lou et al. [Lou+12] manages to provide awareness information that is relevant to engage in everyday conversations and a low-effort mechanism to initiate such informal discussions. It does so by providing social cues which help understand the availability of others and thus creating a context for subsequent communication.

As a consequence of the global pandemic, many commercial tools have been published recently. Branch<sup>1</sup>, Reslash<sup>2</sup>, Wonder<sup>3</sup>, or Gather<sup>4</sup> also follow the goal of increasing spontaneous, informal communication by creating virtual offices where users can move around with avatars and interact with others. Tandem<sup>5</sup> is another tool with a focus on collaboration and takes a less playful approach by being more similar to traditional communication apps user interfaces.

Another form of communication that has been studied extensively is the concept of microblogging. Studies have shown that microblogging is a form of informal communication [ES10] that is "like a virtual coffee machine as a meeting place" [ES08, p. 158]. Further, many existing microblogging approaches have found that microblogging results in people feeling more connected [ES10; Zha+10]. Likewise, their study participants found microblogging very helpful because it allowed them to stay aware of what their team members are doing [Zha+10]. In addition to purely sharing text-based contents, which is the standard in microblogging, Dullemond et al. [Dul+13] developed a microblogging system that allows the users to attach a mood to each message which helped the teams feel more connected. What they did not measure, however, is the isolated effect of mood sharing.

Due to the value of providing additional awareness and sharing moods in the workplace, the following two sections focus on those two concepts.

## 2.3 Awareness

A reason for coordination and communication challenges in a remote work environment is the lack of awareness, so it is of great interest to increase awareness in distributed teams. Literature provides various definitions of awareness [CE07; Gro13; GST05]. Due to the popularity and granularity of the model proposed by Gutwin, Greenberg, and Roseman [GGR96], we decided to use their definition of awareness for this work. Gutwin, Greenberg, and Roseman [GGR96] define group awareness as a combination of:

- **Informal Awareness**

The general sense of the presence, availability, and activities of others. It is the "glue that facilitates casual interactions" [GGR96, p. 6].

- **Group-Structural Awareness**

"Group-structural awareness involves the knowledge about people's roles and responsibilities, their positions on an issue, their status, and group processes" [GGR96, p. 6].

- **Social Awareness**

"Social awareness is the information that a person maintains about others in a social or conversational context" [GGR96]. It includes, for example, the attention state of the other person, their emotions, or the level of interest [GGR96, p. 6], or whether a person can be disturbed [GG95].

---

<sup>1</sup><https://branch.gg>

<sup>2</sup><https://reslash.co>

<sup>3</sup><https://wonder.me>

<sup>4</sup><https://gather.town>

<sup>5</sup><https://tandem.chat/>

- **Workplace Awareness**

Workplace Awareness defines the awareness that results from the ‘real-time’ combination of elements workers keep track of when working together. Such elements could be people, actions, objects, and many more [GG95].

It is important to note that those four awareness types are not excluding but rather overlapping with each other. Put differently, informal, social, and group-structural awareness are all part of workplace awareness. In the case of software developers, for instance, a study shows that developers checked the availability status of their co-workers almost as many times as their compiler output [KDV07]. This indicates the importance of informal awareness. Providing group-structural awareness is essential because of difficulties when trying to find experts in a distributed team [HM03]. Social awareness is a necessity to initiate and carry on a conversation, and thus very relevant due to the high communication needs of software developers [PSV94]. Additionally, with less face-to-face communication and more computer-mediated communication, it is consequently more difficult to transfer emotional information [RCB96].

To address the problem of missing awareness when working remotely, a wealth of research developed approaches to increase awareness in distributed teams. Popular tools made explicitly for software development teams focus on providing awareness by on work items, developers’ activities (e.g., which files they have opened or recently changed) and thus put the code base and tasks in the foreground of coordination [Bie+07; Jak+09; ESS+92; DCR05]. Cheng et al. [Che+03] introduces JazzBand, an IDE plugin visualizing the team members to increase peripheral awareness enhanced with status messages and chat functionality facilitating coordination.

While the majority of the above-mentioned awareness tools require user interactions to be helpful, there have also been attempts for creating ambient approaches to raise awareness in the work environment [MCR20; OMF06; DPH12; AD12; R6c+04]. Downs, Plimmer, and Hosking define ambient devices as devices that “present dynamic information in an at-a-glance manner and have low attentional requirements” [DPH12, p. 508].

## 2.4 Well-being: Emotions, Moods, and Sentiments

A common finding in research regarding remote work is that employees work longer hours, experience more stress, and have difficulties with mental health [Spa20a; Mul+09; Qua20]. A recent study in the context of the global Covid-19 pandemic lists the negative impacts from working from home, such as increased burnout, lack of separation between work and life, and feeling disconnected from co-workers [Spa20a]. A Psychological study highlights that the mental health of remote workers should be considered and is very important to be communicated and talked about [GWS13]. Yet, emotions can get lost or misunderstood inside text messages due to the lack of cues in text-based communication [H66+08]. For this reason, Kuwabara et al. [Kuw+02] highlights the need for connectedness-oriented communication, because it is critical for developing social relationships, and harder to do over distance. McDuff et al. [McD+12] further state the usefulness of being able to assess one’s emotional state (e.g., when considering mental health issues). Their approach, AffectAura, is developed using different kinds of sensors to predict emotions and provide an overview of them in a diary-like fashion with the purpose of self-reflection [Dul+13]. Guzman and Bruegge [GB13] emphasize the importance of emotion in software development, however focusing on the emotional state towards a project, not of individuals. MobiMood is a mobile application focusing on individuals by letting them share their moods, but not targeting a work environment [CHO10]. Saari et al. [Saa+08] developed another mobile application with mood sharing features aimed at knowledge workers. However, while the researchers developed the prototype, their approach’s usability and use cases were not studied.

To communicate one's well-being, different types of affective responses exist that can be useful for sharing with the team, namely emotions, moods, and sentiments. Emotions are typical reactions to events and therefore have a definite cause and are typically short-lived. Emotions differ from moods in that moods are longer in duration, have no clear target, and are less intense [Fri+94; BN07]. Sentiments can be described as states associated with objects rather than individuals and therefore are relatively permanent [BN07].

When it comes to measuring emotional experiences, the literature does not reach a consensus on the best measurement method. However, the valence-arousal dimensional model is most commonly referred to as the better model [Rus80; MR09]. It is a two-dimensional model where the valence dimension contrasts states of pleasure with states of displeasure (positive vs negative), and the arousal dimension contrasts states of low arousal with states of high arousal (high vs low) [MR09]. More concretely, the arousal dimension "describes the degree to which an emotion is associated with high or low energy" [Tse+14, p. 1334]. High arousal thus represents emotions such as surprise or excitement, while low arousal represents states of low activation such as sleepiness. Results of this model can then be used to map onto a discrete set of basic emotions such as surprise, fear, disgust, anger, happiness, or sadness [BN07].



# Approach

While the team awareness gained by existing tools allows knowledge workers to understand who they are working with and what they are working on, and what the impact of a change can have on others, which is essential for successful collaboration [DB92], they only cover a very limited view of awareness by providing very limited social or emotional information. Because of that, we put more emphasis on social, casual information exchanges to help remote teams facing challenges with workplace isolation, team awareness, informal communication within their team, and well-being. We aim to tackle these issues by allowing knowledge workers to quickly learn about the availability, moods, and other states of their core team members in a lightweight, informal manner. The critical underlying concepts of our approach are elaborated in the following.

## 3.1 Minimal Design

By mimicking real offices, virtual office approaches, which have been coming out a lot due to the COVID-19 pandemic, all have a significant downside: requiring a fair bit of user interaction due to the visually complex interface. We argue that this adds a lot of unnecessary overhead and reduces long-term usability. In contrast, there are exceptions, such as Tandem<sup>1</sup>, which takes a slightly different approach in that it is less playful and visually demanding than the other commercial tools. However, our approach goes a step further by introducing a glanceable, ambient view, which does not require significant, additional effort to be helpful. Having a limited amount of information on an ambient display is critical for both not being interruptive and costly to use [DK04]. Thus, we want to keep interactions lightweight and casual, so the functionality is kept simple, maybe even limited, by design. The information shared and displayed will be transient, meaning that there will be no chat history available, making the tool essentially unuseful for formal communication and keeping the user interface as clean and straightforward as possible. In addition, our approach visually emphasizes the topicality of information displayed to avoid outdated data that clutters the user interface. Further, to minimize interruptions and distractions, targeted use of notifications and the ability not to be contacted and to hide potential distractions is required. What's more, many existing ambient solutions include physical devices (e.g., [DPH12; AD12; R c+04]), which might not be suitable for a remote team setting due to the size of the device or the device with the awareness information not being visible to off-site team members.

---

<sup>1</sup><https://tandem.chat/>

## 3.2 Focus on People

Remote workers fear being "out of sight and out of mind" [BK99] and potentially suffer from the perception of workplace isolation [Mul+09; MMM07]. Additionally, virtual workers might fear that their efforts are not recognized or valued as much as their co-located colleagues [CK02]. Despite those facts, existing ambient approaches developed for use at the workplace don't seem to focus on social awareness, an essential type of awareness at the workplace [GGC96]. Some, such as JazzBand and ContactMap [Che+03; Whi+04] follow similar principles by visualizing individual team members. However, by being an Integrated Development Environment (IDE) plugin, we argue that JazzBand's resulting communication likely is work-related and only used when coding and limited to software developers. Similarly, ContactMap facilitates email communication, a formal type of communication and thus being unlikely to include any form of social awareness. For those reasons, our approach does not focus on task-related awareness and its implications for more effective and efficient collaboration, but rather the people behind those tasks by representing different team members' social states to raise social awareness.

One essential part of our people-centered approach is purely visual; avatars of the team members are prominently placed in an ambient manner, as explained above.

### Mood and context sharing

To leverage the positive impact of microblogging on the feeling of connectedness among colleagues [Dul+13], the users can share their feelings with their colleagues through microblogging with optional mood sharing. Because of the fact that topics that are blogged about are usually informal [ES10], and mood sharing seems to act as a springboard for conversations according to Church, Hoggan, and Oliver [CHO10], microblogging is one way to foster informal and spontaneous chats in our approach. Existing microblogging tools designed specifically for use at work lay the foundation of our approach and the information we want to visualize in our glanceable, always-on-top view. However, microblogging is a purely text-based form of communication. As García, Favela, and Machorro [GFM99] already mentioned in 1999, there is a need for emotional awareness inside groupware. Therefore, and similar to [MRM11], we argue the awareness of moods in a work environment is underrepresented in research, especially in a society where many are facing mental challenges caused by the global COVID-19 pandemic. Extending the purely text-based microblogging systems, Dullemond et al. [Dul+13] developed a microblogging system that shares selected moods in addition. We use their idea as a foundation for our work, to study the behavior of mood sharing when making it optional, something not done by Dullemond et al. [Dul+13]. Last but not least, combining an ambient approach introduced above with such micro-blogging functionality is a combination that has not yet, to our knowledge, been proposed in existing research. In contrast to Saari et al. [Saa+08], who developed another mobile application with mood sharing features aimed at knowledge workers, we will study both of our approach's usability and use cases in a preliminary evaluation.

## 3.3 Spontaneous Interactions

Remote workers miss the social interaction of informal chats and spontaneous discussions [CK02], which makes the fostering of those types of communication a goal of our approach. While the microblogging concept employed by our approach has to potential to increase spontaneous interactions, our approach also offers additional functionality, namely an ever-running break room and quick one-on-one interactions, to further foster and allow such conversations to occur.

### Ever-running break room

Allowing to see the team, and not just relying on text-based information, is possible by joining



an ever-running break room. The goal is to mimic the water-cooler in the office. Thus, visiting a breakroom as simple as possible, similar to just walking to the coffee machine in an office and signaling to the other team members that you are now on a break, is required. This effortless joining of a breakroom is motivated by Chang and Ehrlich [CE07], who emphasize that initiating a conversation must be as simple as possible. This approach also applies to the next concept on the list, interactions that target individual team members.

#### **1:1 interactions**

For scenarios where the content you want to share is intended for a single person, or you want to get another team member's attention, there's an easy way to start a private conversation. This can be done through a direct message or by nudging a team member. This concept aims to help in cases of help-seeking, a known problem when working remotely [HM03]. Recalling the transient nature of our approach, this communication mechanism is best suited for making a non-interruptive request that is not urgent. Should a user feel the need to talk to another team member, they can indicate that now would be an appropriate time for a short informal conversation. If other team members feel the same, two team members can randomly be paired up for a virtual video call.

## **3.4 Research Questions**

Following the above-outlined concepts, we developed AmbientTeams, a research prototype introduced in the next chapter. To evaluate, three main areas of interest and the research questions we would like to answer in the scope of this master thesis are as follows.

#### **Information Sharing**

*RQ1:* Is there a need for sharing moods/states with team members, and what are the reasons? (e.g., share your status with them to indicate states or know more about your team)

*RQ2:* What are knowledge workers willing to share with their team? (is that impacted by what others on the team are sharing?)

#### **Impacts**

*RQ3:* What are the effects of Ambient Teams?

*RQ3.1:* Do mood and state sharing increase the awareness between team members, and how? What do they learn from each other?

*RQ3.2:* Does it make users feel better to share information with their team?

*RQ3.3:* Does it stress/relax users to see more about their team?

*RQ3.4:* Does AmbientTeams reduce the feeling of isolation in remote knowledge work teams?

#### **Tool usage and workflows**

*RQ4:* How do knowledge workers use and interact with AmbientTeams? How do they integrate it into existing workflows?



# Prototype

The above outlined key concepts were then developed into the key features of our research prototype, *AmbientTeams*. Before stepping into the core features employed in *AmbientTeams* and aligning them to the above-mentioned key concepts (see chapter 3), a brief introduction into the more technical aspects and a general overview of the application are given.

## 4.1 Technology Stack

*AmbientTeams* is a cross-platform desktop application based on Electron<sup>1</sup>. To facilitate the implementation of the interactive user interface in *AmbientTeams*, VueJS<sup>2</sup> is used as the JavaScript framework for the front-end. To maintain JavaScript as a common language for the front-end and back-end, NodeJS<sup>3</sup> is used on the server-side. The server provides both a REST API for basic CRUD functionality for users and teams and a WebSocket endpoint since much of the data required for *AmbientTeams* comes from the server in real-time.

## 4.2 Windows

On the front-end, *AmbientTeams* comes with two main windows; the team overview and the ambient window.

### 4.2.1 Team Overview Window

The team overview window is responsible for maintaining a connection to the server, authenticating, login functionality, settings. Additionally, once users have authenticated inside the team overview window, they are redirected to the team overview view where all teams and team members are visible (see Figure 4.1). There are two types of teams in *AmbientTeams*; regular teams are stored on the server and require a unique identifier to join, similar to a straightforward invite-based approach often seen in practice. For scenarios where a user is part of multiple such teams, team members from different teams can be linked to a "favorites" team. These favorite teams only exist on the local machines of the users. By clicking on the edit icon next to the team name, the user can select team members from each team that will then be displayed on the other main

---

<sup>1</sup><https://www.electronjs.org/>

<sup>2</sup><https://vuejs.org/>

<sup>3</sup><https://nodejs.org/>

window, the ambient window. This is demonstrated in Figure 4.1, where the user is selecting the team members to be displayed on the ambient window.

At the core of the approach sit the avatars of the users. While we could have opted for traditional profile pictures that allow users to upload an actual photograph, we decided to use the abstract form due to privacy reasons, allowing relatively simple mood manipulation on such avatars. Also, using an avatar library gives the user interface a more clean, uniform look, which is why we make use of <https://getavataaars.com> to create and manipulate avatars.

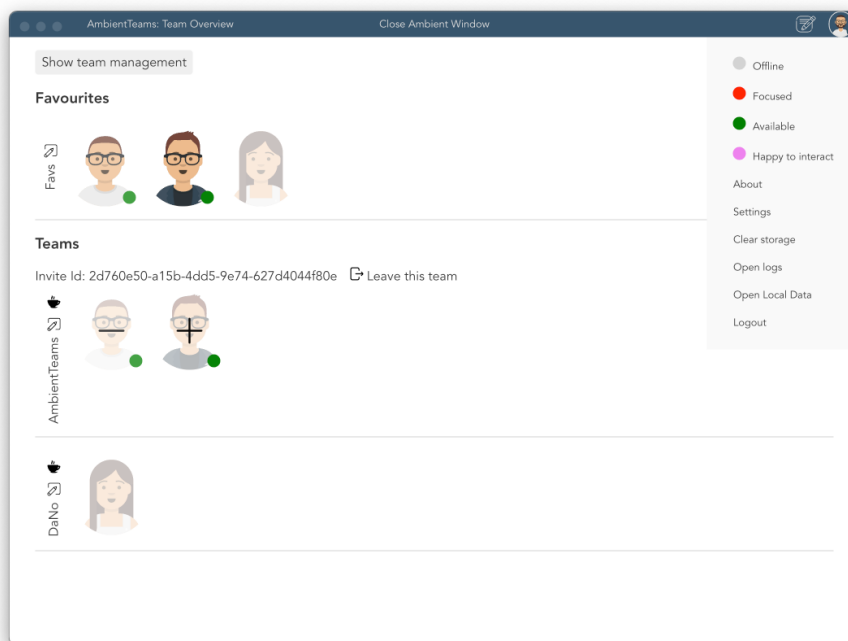


Figure 4.1: Team overview window

### 4.2.2 Ambient, glanceable Window

The ambient window always sits on top of other windows, making it prone to interruptions and distractions. To keep the ambient overlay as ambient and minimal as possible, we employed a transparent window. Further, certain functionality is only visible when the user is hovering over this window. When hovering over the ambient window, the user can select the team they want to show and sees the names of the individual team members, as shown in Figure 4.2b.

## 4.3 Availability Status

AmbientTeams does not want to be a source of interruptions which is why there is "Focused" availability state (see Figure 4.8c) that exists in addition to the three others ("Available", "Offline", and "Happy to Interact"). Users in this focused state cannot be called. Further, they don't see any direct messages or incoming nudges until they leave the focused state. In addition, focused users cannot directly interact with other team members, avoiding potential self-distraction.

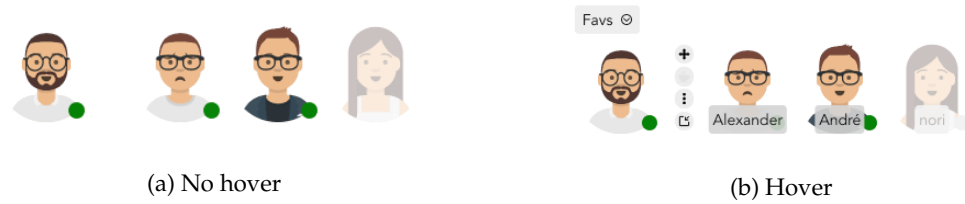


Figure 4.2: Ambient window

## 4.4 Sharing

The user can open the sharing window from both the team overview and the ambient window, as well as the system tray menu. All of those actions will open the sharing window as shown in Figure 4.3a, where on the left, a preview of the current avatar and the selection of predefined moods are listed. There are nine available moods, visualized using popular emoticons. The first four emoticons are more optimistic, the fifth is a neutral face, and the last four are emoticons representing rather negative emotional states. The selection of the emoticons started with the basic emotions surprise, fear, disgust, anger, happiness, or sadness. This list was expanded over time to, in our opinion, suit the work environment better by adding a neutral and tired emoticon, as well as two more positive emotions (loving hearts and grinning) to make the selection more balanced. Due to limitations with the avatar API, we were not able to render the emotion fear well enough, which led us to remove it. On the right, a textbox for providing additional context is shown. The contents of this textbox are, if available, pre-populated with the current status message for the currently selected team. Additionally, the text is highlighted when the window is created, facilitating overwriting the current status without using the mouse to select the text manually. Status messages' length is limited to 140 characters, motivated by the initial limit of Twitter (TODO: cite). Below the textbox, the user can find a button to share the status message with either all teams or a single team.

As a reminder for the user to share his moods and/or additional context with the team members, the sharing window is also automatically scheduled to appear on the lower right corner of the user's primary monitor to minimize the distraction potential. All in all, the window has the same functionality but includes two additional buttons to postpone the prompt for either 5 minutes or 1 hour (see Figure 4.3b). The scheduled sharing window is shown at three predefined times throughout the day, namely at 9:00, 13:00, and 16:00 local time.

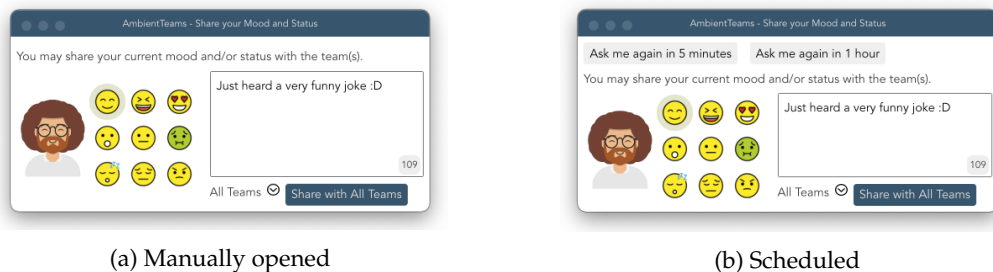


Figure 4.3: Sharing window

To ensure that information shared within AmbientTeams is up-to-date, a couple of measures

have been taken. The first is a purely visual effect which leads to the avatars fading out when no recent activities took place Figure 4.2a. Such activities include status and mood sharing, direct messages, and nudging. In addition to potentially motivating users to interact with such faded-out team members, this automatic fading out facilitates spotting colleagues' updates quickly. Another measurement we took to avoid outdated content to be shown to the users, status messages and moods are hidden at midnight.

Since the goal of AmbientTeams is to foster informal communication, it has no chat history or any other history built into the application. With this transience, we aim to promote less formal communication and hope to avoid the AmbientTeams becomes just another tool to keep track of for work.

## 4.5 Breakroom

As stated before, our goal was to make the creation of ever-running break rooms as effortless as possible. Figure 4.4a shows the state of the ambient windows when the user clicked on the coffee icon. Having clicked on this coffee icon, the other members of the team see an indication that there is an ongoing break room (see Figure 4.4b). However, to not unnecessarily set up a break room and potentially interrupt the initiating user, the break room is only created once another user clicks on the coffee icon.

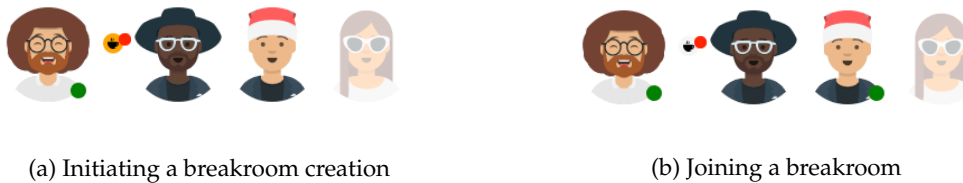


Figure 4.4: Breakroom creation

Once at least two team members are interested in a break room, a break room is actually created, and the two are redirected to the break room view (see Figure 4.5). At any point, other team members can join and leave the breakroom, and it stays active as long as at least one team member is part of it. We want to avoid users forgetting the time and staying too long in the break room. For this purpose, whenever a user enters a break room, a 15-minute timer is started. When this timer reaches its end, the user automatically leaves the break room.

## 4.6 1:1 Interactions

In addition to the broadcasting functionality of moods and status messages, there also exists the possibility to interact with a single team member directly. An overlay appears when hovering over individual team members, offering three different interaction possibilities, namely 1) direct messaging, 2) nudging, and 3) direct calling (see Figure 4.6).

Direct messaging is very similar to sharing status messages but without mood sharing and team selection options. Upon a click on the messaging icon, the messaging window (Figure 4.7) is shown at the user's current mouse position to minimize the distance required to interact with the window's contents. As in the status sharing window, there is a character limit of 140 characters.

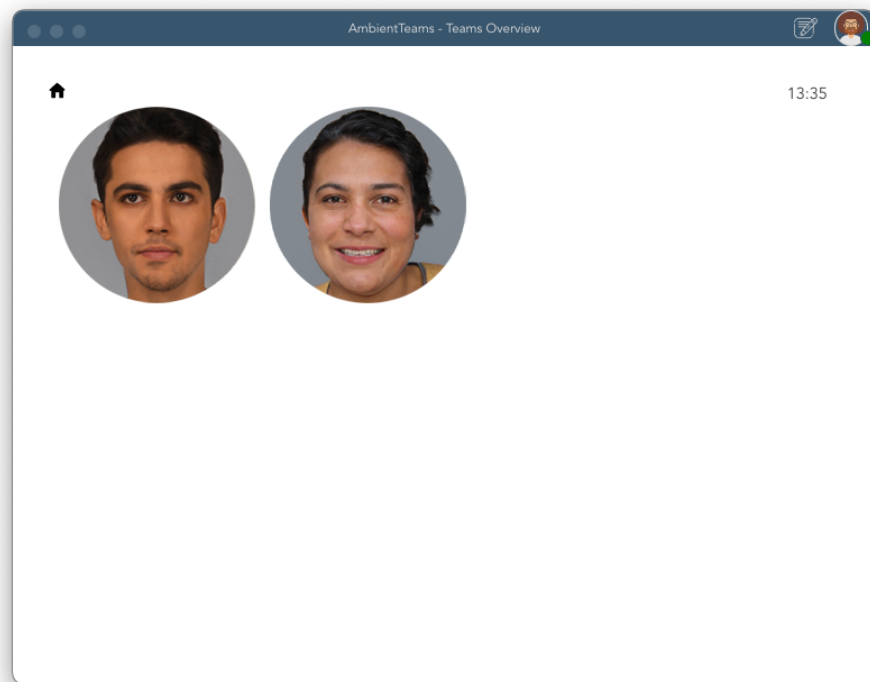


Figure 4.5: Breakroom, pictures are artificially created with <https://generated.photos/>

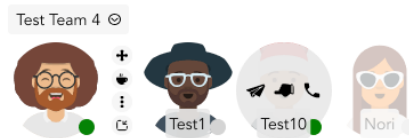


Figure 4.6: 1:1 interaction overlay

In Figure 4.8, the result of a successful interaction for each of the three possibilities is visualized. Direct messages differ from status messages in the messaging icon located left to the message itself. Nuding makes use of a hand icon pointing towards the team member in question. In a video call, the video stream overlays the team member's avatar, and the availability status of both participants is automatically set to "Focused". The users can hover over their avatar should they wish to mute themselves or stop their video stream. To end an ongoing call, one has to hover over the relevant team member and click on the hanging up icon.

The "Happy to Interact" availability status was included to bring back the lack of serendipity in remote work. When selected by at least two members of a team, an automatic match-maker runs every minute and randomly pairs two people, which are then forwarded into a video call.

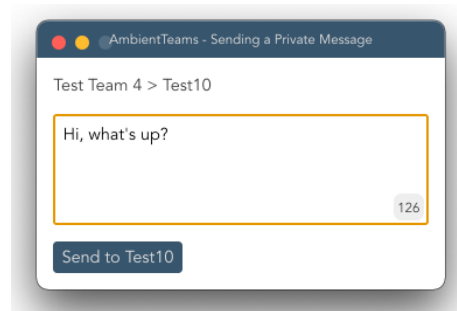


Figure 4.7: Messaging window



Figure 4.8: 1:1 interactions



# Preliminary Evaluation

To evaluate the above mentioned research questions, a preliminary evaluation is conducted. Optimizing and improving our approach with the help of feedback from the participants is the primary goal of this master thesis. Further, we want to learn which status and moods knowledge workers share with their closest team members, what they learn from their team-mates' sharing and the overall impact on their perception of workplace isolation.

TODO: Quickly describe Figure 5.1 in words before jumping into more details in the following sections.

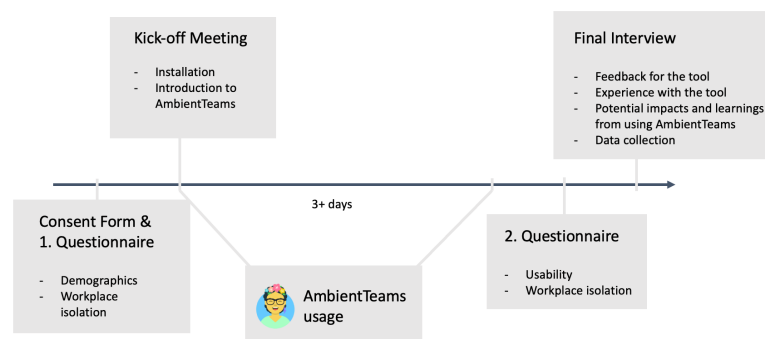


Figure 5.1: Study timeline

## 5.1 Participants Recruitment

As a first step, an interested team had to be recruited. To that end, the researchers' personal network will be used. To that purpose, the study description is forwarded to the contacts, and once an interested team has been identified, it is checked whether it fulfills the participation criteria and if the prospective participants are (technically) allowed to install AmbientTeams on their

computer. If this is not the case, the company's consent and approval to install AmbientTeams is first obtained. To provide the company with as much information as possible about the study and the privacy/confidentiality of the data collected during the study, the consent form and a study description will be given to the company for review. After gaining the company's approval, the individual interested team members are approached by presenting the study, discussing the steps and goals of the study, and emphasizing that participation is entirely voluntary.

The requirements for teams participating were as follows:

1. At least three team members
2. Three or more common working days a week
3. Spending the majority of their workday on the computer
4. Having all the required rights to install AmbientTeams on their work computer
5. Willingness to use AmbientTeams during at least three full days of work (approximately 0800 - 1700)
6. Using macOS or Microsoft Windows
7. An active internet connection

## 5.2 Participants

With our recruitment, we were able to find an interested team. TODO: Describe team

## 5.3 Initial meeting

Installation

## 5.4 Prestudy Questionnaire

The questions are taken from ....

## 5.5 Evaluation Phase

How long?

During the study notes from notion

## 5.6 Poststudy Questionnaire

The questions are taken from ....

## 5.7 Interview

Interview questions and their relevance for the research questions

# Data

Table 6.1 shows an overview of all data collected and for which research question they are relevant. The data used to answer the above research questions came from three different sources. Given the relatively few participants, it was important to have both quantitative and qualitative data.

Data collected	Storage	Relevant for
cell4	Local	cell5
cell7	Local	cell8

Table 6.1: The data collected during the preliminary evaluation and its relevance for the RQs



# Results



# Conclusion

Conclusion and Future work





# Appendices



# **Additional Documents**



# **Interview Transcriptions**



---

# Bibliography

- [AD12] Hamed S Alavi and Pierre Dillenbourg. "An ambient awareness tool for supporting supervised collaborative problem solving". In: *IEEE Transactions on Learning Technologies* 5.3 (2012), pp. 264–274.
- [All+84] Thomas J Allen et al. "Managing the flow of technology: Technology transfer and the dissemination of technological information within the R&D organization". In: *MIT Press Books* 1 (1984).
- [Bie+07] Jacob T Biehl et al. "FASTDash: a visual dashboard for fostering awareness in software teams". In: *Proceedings of the SIGCHI conference on Human factors in computing systems*. 2007, pp. 1313–1322.
- [BK99] NBKDE Bailey and Nancy B Kurland. "The advantages and challenges of working here, there, anywhere, and anytime". In: *Organizational dynamics* 28.2 (1999), pp. 53–68.
- [BN07] Scott Brave and Cliff Nass. "Emotion in human-computer interaction". In: *The human-computer interaction handbook*. CRC Press, 2007, pp. 103–118.
- [Car+17] John R Carlson et al. "Virtual team effectiveness: Investigating the moderating role of experience with computer-mediated communication on the impact of team cohesion and openness". In: *Remote Work and Collaboration: Breakthroughs in Research and Practice*. IGI Global, 2017, pp. 687–706.
- [Car99] Erran Carmel. *Global software teams: collaborating across borders and time zones*. Prentice Hall PTR, 1999.
- [CE07] Klarissa T Chang and Kate Ehrlich. "Out of sight but not out of mind? Informal networks, communication and media use in global software teams". In: *Proceedings of the 2007 conference of the center for advanced studies on Collaborative research*. 2007, pp. 86–97.
- [Che+03] Li-Te Cheng et al. "Jazzing up Eclipse with collaborative tools". In: *Proceedings of the 2003 OOPSLA workshop on eclipse technology eXchange*. 2003, pp. 45–49.
- [CHO10] Karen Church, Eve Hoggan, and Nuria Oliver. "A study of mobile mood awareness and communication through MobiMood". In: *Proceedings of the 6th Nordic Conference on Human-Computer Interaction: Extending Boundaries*. 2010, pp. 128–137.
- [CK02] Cecily D Cooper and Nancy B Kurland. "Telecommuting, professional isolation, and employee development in public and private organizations". In: *Journal of Organizational Behavior: The International Journal of Industrial, Occupational and Organizational Psychology and Behavior* 23.4 (2002), pp. 511–532.

- [Com+20] Santiago Comella-Dorda et al. "Revisiting agile teams after an abrupt shift to remote". In: *Retrieved July* (2020).
- [DB92] Paul Dourish and Victoria Bellotti. "Awareness and coordination in shared workspaces". In: *Proceedings of the 1992 ACM conference on Computer-supported cooperative work*. 1992, pp. 107–114.
- [DCR05] Robert DeLine, Mary Czerwinski, and George Robertson. "Easing program comprehension by sharing navigation data". In: *2005 IEEE Symposium on Visual Languages and Human-Centric Computing (VL/HCC'05)*. IEEE. 2005, pp. 241–248.
- [DK04] Laura Dabbish and Robert E Kraut. "Controlling interruptions: awareness displays and social motivation for coordination". In: *Proceedings of the 2004 ACM conference on Computer supported cooperative work*. 2004, pp. 182–191.
- [DPH12] John Downs, Beryl Plimmer, and John G Hosking. "Ambient awareness of build status in collocated software teams". In: *2012 34th International Conference on Software Engineering (ICSE)*. IEEE. 2012, pp. 507–517.
- [Dul+13] Kevin Dullemond et al. "Fixing the 'Out of sight out of mind' problem one year of mood-based microblogging in a distributed software team". In: *2013 10th Working Conference on Mining Software Repositories (MSR)*. IEEE. 2013, pp. 267–276.
- [Eco20] The Economist. *In Search of Lost Focus - The engine of distributed work*. [https://lostfocus.eiu.com/downloads/EIU\\_Dropbox\\_focus\\_executive\\_summary.pdf](https://lostfocus.eiu.com/downloads/EIU_Dropbox_focus_executive_summary.pdf). [Online; accessed 5-June-2021]. 2020.
- [ES08] Martin Ebner and Mandy Schiefner. "Microblogging-more than fun". In: *Proceedings of IADIS mobile learning conference*. Vol. 2008. 2008, 155Y159.
- [ES10] Kate Ehrlich and N Shami. "Microblogging inside and outside the workplace". In: *Proceedings of the International AAAI Conference on Web and Social Media*. Vol. 4. 1. 2010.
- [ESS+92] Stephen G Eick, Joseph L Steffen, Eric E Sumner, et al. "Seesoft-a tool for visualizing line oriented software statistics". In: *IEEE Transactions on Software Engineering* 18.11 (1992), pp. 957–968.
- [FKC90] Robert S Fish, Robert E Kraut, and Barbara L Chalfonte. "The VideoWindow system in informal communication". In: *Proceedings of the 1990 ACM conference on Computer-supported cooperative work*. 1990, pp. 1–11.
- [FL98] Andy French and Paul Layzell. "A study of communication and cooperation in distributed software project teams". In: *Proceedings. International Conference on Software Maintenance (Cat. No. 98CB36272)*. IEEE. 1998, pp. 146–154.
- [Flo19] Marivic F Flores. "Understanding The Challenges Of Remote Working And It's Impact To Workers". In: *International Journal of Business Marketing and Management (IJBMM)* 4.11 (2019), pp. 40–44.
- [Fri+94] Nico H Frijda et al. "Varieties of affect: Emotions and episodes, moods, and sentiments." In: (1994).
- [GB13] Emitza Guzman and Bernd Bruegge. "Towards emotional awareness in software development teams". In: *Proceedings of the 2013 9th joint meeting on foundations of software engineering*. 2013, pp. 671–674.
- [GFM99] Octavio García, Jesús Favela, and Roberto Machorro. "Emotional awareness in collaborative systems". In: *6th International Symposium on String Processing and Information Retrieval. 5th International Workshop on Groupware (Cat. No. PR00268)*. IEEE. 1999, pp. 296–303.



- [GG95] Carl Gutwin and Saul Greenberg. "Support for group awareness in real-time desktop conferences". In: (1995).
- [GGC96] Saul Greenberg, Carl Gutwin, and Andy Cockburn. "Awareness through fisheye views in relaxed-WYSIWIS groupware". In: *Graphics interface*. Vol. 96. Citeseer. 1996, pp. 28–38.
- [GGR96] Carl Gutwin, Saul Greenberg, and Mark Roseman. "Workspace awareness in real-time distributed groupware: Framework, widgets, and evaluation". In: *People and Computers XI*. Springer, 1996, pp. 281–298.
- [GH07] Ravi S Gajendran and David A Harrison. "The good, the bad, and the unknown about telecommuting: meta-analysis of psychological mediators and individual consequences." In: *Journal of applied psychology* 92.6 (2007), p. 1524.
- [Gro13] Tom Gross. "Supporting effortless coordination: 25 years of awareness research". In: *Computer Supported Cooperative Work (CSCW)* 22.4-6 (2013), pp. 425–474.
- [GST05] Tom Gross, Chris Stryker, and Alex Totter. "User-centered awareness in computer-supported cooperative work-systems: Structured embedding of findings from social sciences". In: *International Journal of Human-Computer Interaction* 18.3 (2005), pp. 323–360.
- [GWS13] Christine A Grant, Louise M Wallace, and Peter C Spurgeon. "An exploration of the psychological factors affecting remote e-worker's job effectiveness, well-being and work-life balance". In: *Employee Relations* (2013).
- [Has+17] Mariam Hassib et al. "Heartchat: Heart rate augmented mobile chat to support empathy and awareness". In: *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*. 2017, pp. 2239–2251.
- [HM01] James D Herbsleb and Deependra Moitra. "Global software development". In: *IEEE software* 18.2 (2001), pp. 16–20.
- [HM03] James D. Herbsleb and Audris Mockus. "An empirical study of speed and communication in globally distributed software development". In: *IEEE Transactions on software engineering* 29.6 (2003), pp. 481–494.
- [HM05] Pamela J Hinds and Mark Mortensen. "Understanding conflict in geographically distributed teams: The moderating effects of shared identity, shared context, and spontaneous communication". In: *Organization science* 16.3 (2005), pp. 290–307.
- [Hö+08] Kristina Höök et al. "Interactional empowerment". In: *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. 2008, pp. 647–656.
- [Jak+09] Mikkel R Jakobsen et al. "WIPDash: Work item and people dashboard for software development teams". In: *IFIP Conference on Human-Computer Interaction*. Springer. 2009, pp. 791–804.
- [KDV07] Andrew J Ko, Robert DeLine, and Gina Venolia. "Information needs in collocated software development teams". In: *29th International Conference on Software Engineering (ICSE'07)*. IEEE. 2007, pp. 344–353.
- [KEG88] Robert Kraut, Carmen Egido, and Jolene Galegher. "Patterns of contact and communication in scientific research collaboration". In: *Proceedings of the 1988 ACM conference on Computer-supported cooperative work*. 1988, pp. 1–12.
- [Kra+] Robert E Kraut et al. "Informal communication in organizations: Form, function, and technology". In:

- [KSO12] Benjamin Koehne, Patrick C Shih, and Judith S Olson. "Remote and alone: coping with being the remote member on the team". In: *Proceedings of the ACM 2012 conference on Computer Supported Cooperative Work*. 2012, pp. 1257–1266.
- [Kuw+02] Kazuhiro Kuwabara et al. "Connectedness oriented communication: Fostering a sense of connectedness to augment social relationships". In: *Proceedings 2002 symposium on applications and the internet (saint 2002)*. IEEE. 2002, pp. 186–193.
- [Lou+12] Zhe Lou et al. "PresenceScape: Virtual world mediated rich communication". In: *Bell Labs Technical Journal* 16.4 (2012), pp. 219–242.
- [Mad11] Susan R Madsen. "The Benefits, Challenges, and Implications of Teleworking: A Literature Review." In: *Culture & Religion Review Journal* 2011.1 (2011).
- [McD+12] Daniel McDuff et al. "AffectAura: an intelligent system for emotional memory". In: *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. 2012, pp. 849–858.
- [MCR20] Sarah Morrison-Smith, Lydia B Chilton, and Jaime Ruiz. "Facilitating Team Awareness Through Ambient Displays". In: (2020).
- [MH01] Audris Mockus and James Herbsleb. "Challenges of global software development". In: *Proceedings seventh international software metrics symposium*. IEEE. 2001, pp. 182–184.
- [Mil+21] Courtney Miller et al. "'How Was Your Weekend?' Software Development Teams Working From Home During COVID-19". In: *arXiv preprint arXiv:2101.05877* (2021).
- [MMM07] Greg W Marshall, Charles E Michaels, and Jay P Mulki. "Workplace isolation: Exploring the construct and its measurement". In: *Psychology & Marketing* 24.3 (2007), pp. 195–223.
- [MR09] Iris B Mauss and Michael D Robinson. "Measures of emotion: A review". In: *Cognition and emotion* 23.2 (2009), pp. 209–237.
- [MRM11] Simone Mora, Verónica Rivera-Pelayo, and Lars Müller. "Supporting mood awareness in collaborative settings". In: *7th International Conference on Collaborative Computing: Networking, Applications and Worksharing (CollaborateCom)*. IEEE. 2011, pp. 268–277.
- [Mul+09] Jay P Mulki et al. "Set up remote workers to thrive". In: *MIT Sloan Management Review* 51.1 (2009), p. 63.
- [OMF06] Benoît Otjacques, Rod McCall, and Fernand Feltz. "An ambient workplace for raising awareness of internet-based cooperation". In: *International Conference on Cooperative Design, Visualization and Engineering*. Springer. 2006, pp. 275–286.
- [OO06] Judith S Olson and Gary M Olson. "Bridging Distance: Empirical studies of distributed teams". In: *Human-computer interaction in management information systems 2* (2006), pp. 27–30.
- [PSV94] Dewayne E Perry, Nancy A. Staudenmayer, and Lawrence G Votta. "People, organizations, and process improvement". In: *IEEE Software* 11.4 (1994), pp. 36–45.
- [Qua20] Qualtrics. *The other COVID-19 crisis: Mental health*. <https://www.qualtrics.com/blog/confronting-mental-health/>. accessed February 23 2020. 2020.
- [RCB96] Krisela Rivera, Nancy J Cooke, and Jeff A Bauhs. "The effects of emotional icons on remote communication". In: *Conference companion on human factors in computing systems*. 1996, pp. 99–100.

- [Röc+04] Carsten Röcker et al. "Using ambient displays and smart artefacts to support community interaction in distributed teams". In: *Proceedings of the OZCHI Conference*. Cite-seer. 2004, pp. 22–24.
- [Rus80] James A Russell. "A circumplex model of affect." In: *Journal of personality and social psychology* 39.6 (1980), p. 1161.
- [Saa+08] Timo Saari et al. "A mobile system and application for facilitating emotional awareness in knowledge work teams". In: *Proceedings of the 41st Annual Hawaii International Conference on System Sciences (HICSS 2008)*. IEEE. 2008, pp. 44–44.
- [Sas99] VAKihiko Obata VKazuo Sasaki. "Video communication system that facilitates informal communication among distributed offices". In: *FUJITSU Sci. Tech. J* 35.2 (1999), pp. 141–148.
- [SCS14] Wolfgang H Staehle, Peter Conrad, and Jörg Sydow. *Management: eine verhaltenswissenschaftliche Perspektive*. Vahlen, 2014.
- [Spa20a] Jared Spataro. *A pulse on employees' wellbeing, six months into the pandemic*. <https://www.microsoft.com/en-us/microsoft-365/blog/2020/09/22/pulse-employees-wellbeing-six-months-pandemic/>. accessed February 25 2020. 2020.
- [Spa20b] Jared Spataro. *The future of work—the good, the challenging & the unknown*. <https://www.microsoft.com/en-us/microsoft-365/blog/2020/07/08/future-work-good-challenging-unknown/>. accessed February 23 2020. 2020.
- [Sto+16] Margaret-Anne Storey et al. "How social and communication channels shape and challenge a participatory culture in software development". In: *IEEE Transactions on Software Engineering* 43.2 (2016), pp. 185–204.
- [Tse+14] Angela Tseng et al. "Using the circumplex model of affect to study valence and arousal ratings of emotional faces by children and adults with autism spectrum disorders". In: *Journal of autism and developmental disorders* 44.6 (2014), pp. 1332–1346.
- [Whi+04] Steve Whittaker et al. "ContactMap: Organizing communication in a social desktop". In: *ACM Transactions on Computer-Human Interaction (TOCHI)* 11.4 (2004), pp. 445–471.
- [Zha+10] Jun Zhang et al. "A case study of micro-blogging in the enterprise: use, value, and related issues". In: *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. 2010, pp. 123–132.