

Master Thesis

June 8, 2021

AmbientTeams

An approach to stay socially connected in
remote teams

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

Project period: 15.2.2021 - 22.7.2021

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Acknowledgements

Abstract

Zusammenfassung

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Introduction

In Software Development working remotely 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 part-time) [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, common challenges from working from home are that communication is reduced [KEG88] and suffers in quality [Mul+09]. More specifically, informal communication is drastically reduced when working from home [HM05]. This 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]. This feeling of isolation leads to not knowing who 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 be an impediment to engaging in productive tasks [Eco20], the connectness with the team is of particular interest to us.

The challenges of working remotely are caused by a lack of awareness: less information about co-workers is exchanged, e.g. no or less cues are available to identify the interruptibility or emotional states of team members. This 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 are no longer randomly bumping 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 with the goal of improving awareness within teams by showing the current coding tasks and work items that others are working on [Bie+07; Jak+09], they don't focus on the person behind that work item and thus don't 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, Ambient Teams, follows a different approach by "putting the people first". It does so

by showing ambient always-on-top overview of the core team members and their moods, status messages, and other states. Other approaches (e.g. [ES10; ES08; Zha+10]) follow a similar philosophy by studying micro-blogging at the workplace, an easy way of broadcasting short texts. Their results look promising and indicate higher connectedness with team members. 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, with the goal of studying the behavior of mood sharing when making it optional, something that was not done by Dullemond et al. [Dul+13].

In addition to microblogging, we aim to study further possibilities to fostering and motivate serendipitous, informal exchanges with the team or individual team members, while keeping interruptions at inopportune moments low.

In the next chapter existing approaches are discussed before our approach and its differences are introduced. Our approach is then analyzed in the scope of a preliminary evaluation and its results are discussed.

Related Work

Working remotely 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 bigger job satisfaction and higher employee retention [Mul+09; GH07; Mad11], both very much 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 software development teams: the possibility to build teams with talents from all over the world [Car99].

However, working remotely creates new challenges for the company and its employees. It is therefore not surprising that much research has been done in this area, most of which coming from research in Computer Supported Collaborative Work (CSCW). The general goal is to support distributed teams in accomplishing work as effective and efficient as possible. We identified four main challenges that are the result of working remotely. All of them, together with existing solutions, are discussed in this chapter.

2.1 Workplace Isolation

Marshall, Michaels, and Mulki [MMM07] defines workplace isolation as the "[...] desire to be part of the network of colleagues who provide help and support in specific work-related needs. It represents employees' perceptions of availability of co-workers, peers, and supervisors for work-based social support." They further suggest a categorisation into social isolation and organizational isolation. Organizational isolation comes from the perception that remote workers might feel "out of sight, out of mind" [BK99]. 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 informal communication will be given in the following.

2.2 Communication

Research states that coworkers are the most used source of information used by developers [KDV07], emphasising the importance of team communication inside software development teams. In the context of 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. A possible reason for more com-

munication include the need of remote workers to over-communicate their availability status to their co-workers [KSO12]. Reasons for communication reduction could be the active effort to bring back ad-hoc meetings [Mil+21]. Regardless of communication frequency, working remotely and thus using software to communicate leads to have more misunderstandings due to missing cues and thus reduces communication effectiveness [Mul+09]. Other researchers argue that the reason for those misunderstandings is the fact text-based communication (which is often used in software development) has very limited capacity and thus a lot of socio-emotional information (non-verbal cues) is missing [Has+17]. 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 with coworkers, something that is enforced because of Covid-19.

2.2.1 Informal Communication

To facilitate communication, some awareness tools also have basic informal communication tools built into them. Cheng et al. [Che+03] introduces JazzBand, a visualization of the team members with the goal of increasing peripheral awareness enhanced with status messages and chat functionality. By being a IDE Plugin however, we argue the communication likely is tightly coupled to the code, thus being work-related and only used when actually coding, and limited to software developers. AmbientTeams expands the JazzBand ideas and bundles them in a more general-purpose awareness desktop application with informal communication functionality.

Kraut et al. [Kra+] define informal communication as "[...] communication that is spontaneous, interactive and rich". Differences to formal communication include lack of planning and the fact the content of the communication is not known in advance. They further state that over 85% of all conversations are of informal nature and that informal communication happens more often if there is short physical distance between parties. Similarly, Hinds and Mortensen [HM05] find that members of distributed teams engage less in informal communications. This is unfortunate since informal communication is crucial for achieving high productivity and social goals [Kra+]. 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. In addition, informal communication has been shown to be important for conflict identification and handling [HM05]. Since 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+], increasing informal communication is likely highly beneficial for team cohesion.

Because of those benefits, it is no surprise that there are numerous approaches fostering informal communication inside distributed teams. One of the earliest proposed solutions for fostering informal communication in distributed teams was VideoWindow [FKC90]. Despite being an early solution, they already identified two important key requirements such a system has to offer, namely low personal cost and the need for a visual channel: if the costs for initiating a conversation are too high, the system will not be useful, and, the visual channel plays an important role in recognizing the presence of other people. Sasaki [Sas99] developed a 'hallway' system which 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] manage to provision awareness information that is relevant to engage in casual conversations and a low-effort mechanism to

initiate such informal conversations. It does so by providing social cues which are useful for understanding 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. Branch¹, Reslash², Wonder³, or Gather⁴ follow a similar goal set of increasing spontaneous, informal communication. By mimicing the real office, those virtual office approaches all come with the same 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. Thus, AmbientTeams avoids this overhead and its goal is to be as ambient as possible, while still fostering informal communication. Tandem⁵ takes a similar approach in that it is less playful than the other commercial tools, but still very focused on collaboration and communication. In comparison, AmbientTeams additionally includes a glancable overlay and team members' moods and status messages.

In regards to status messages, the concept of micro-blogging is very similar. Studies have shown that micro-blogging is a form of informal communication [ES10] that is "[...] like a virtual coffee machine as a meeting place" [ES08]. Further, many existing micro-blogging approaches have found that micro-blogging results in people feeling more connected [ES10; Zha+10]. The 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 share text-based contents, Dullemond et al. [Dul+13] developed a micro-blogging system that allows the users to attach a mood to each message which helped the teams feeling more connected. What they did not measure however, is the isolated effect of mood sharing.

We see a lot of value in providing additional awareness and sharing moods in the workplace, which is why the next two sections focus on those two concepts.

2.3 Awareness

Part of the reason for coordination and communication challenges in a remote work environment is the lack of awareness, which is why it is of great interest to us to increase awareness in distributed teams. Gutwin and Greenberg [GG96] defines 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" [GG96].

- **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" [GG96].

- **Social Awareness**

"Social awareness is the information that a person maintains about others in a social or conversational context"[GG96]. It includes things as the attention state of the other person, their emotions, or the level of interest [GG96], or whether a person can be disturbed [GG95].

- **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].

¹<https://branch.gg>

²<https://reslash.co>

³<https://wonder.me>

⁴<https://gather.town>

⁵<https://tandem.chat/>

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 is important because of difficulties when trying to find experts in a distributed team [HM03]. Social awareness is highly 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].

Despite the seemingly clear categorisation of awareness above, the literature does not agree on one common categorisation and terms such as general awareness, peripheral awareness, co-existent and cooperation awareness, and objective self-awareness are used instead. Due to the popularity and granularity of the above definition, it is the definition of choice for this work.

To address the problem of missing awareness when working remotely, a wealth of research developed approaches to increase awareness in distributed teams. Popular tools specifically made 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]. While the team awareness gained by those tools allows developers to understand who you 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. García, Favela, and Machorro [GFM99] already mentioned the need for emotional awareness inside groupware in 1999. Despite yet there is very little research done in that field to date. 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.

While the majority of the above mentioned awareness tools require user interactions to be useful, there have also been attempts for creating ambient approaches to raise awareness in the work environment [MCR20; OMF06; DPH12; AD12; Rös+04]. Downs, Plimmer, and Hosking [DPH12] define ambient devices as devices that "[...] present dynamic information in an at-a-glance manner and have low attentional requirements". Unfortunately, while they increase informal awareness in a non-intrusive way, none of them focus on social awareness, both of which are types of awareness important at the work place [GGC96]. Additionally, many of the above approach include physical devices (e.g. from [DPH12; AD12; Rös+04]) which might not be suitable for a remote team setting due to size of the device or the device with the awareness information would simply not be visible to remote team members.

The focus of AmbientTeams is to raise team/group awareness in an ambient manner, but by putting teams and people in the foreground, similar to [Whi+04], yet with the goal of fostering informal communication instead of email.

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]. For those reasons, we see a need for better and easier communication of well-

being and mental health and tools that increase the feeling of connectedness among teams. This is a similar finding to Kuwabara et al. [Kuw+02] who 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] emphasises 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, the usability and use cases for their approach were not studied. Both of which will be analysed in the scope of this study. Further, a mobile application might not be ideal to use in a work environment since this might also introduce more room for interruptions.

Of special importance for text-based communication tools is the fact that emotions are an important part of communication and can get lost/misunderstood inside text messages due to the lack of cues in text-based communication [Hö+08].

In order to communicate one's well-being, there are different types of affective responses that could be useful for sharing with the team, namely emotions, moods, and sentiments. Emotions are typically reactions to events and therefore have a concrete 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 of a rather permanent nature [BN07].

When it comes to measuring affect, the literature does not really reach consensus of one best measurement, 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 arousal dimension contrasts states of pleasure with states of displeasure, and the valence dimension contrasts states of low arousal with states of high arousal [MR09]. 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

Our approach aims to help software developers in remote teams who might be 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 easily learn about the availability, moods and emotions, and other states of their core team members. The key underlying concepts of our approach listed and explained in the following.

3.1 Key Concepts

Ambient always-on-top, people-centered team view

At the core of our approach sits the decision to create a tool that is ambient in nature and does not require significant, additional effort in order to be useful. Having a limited amount of information on an ambient display is critical for both not being interruptive and costly to use [DK04]. With the help of the ambient display, the goal is to create a sense of presence within the team, even when working from different locations. By constantly showing the most important team members the goal is to minimize the feeling of being left and to foster a sense of belonging.

In comparison to existing awareness increasing approaches with emphasis primarily on task related awareness and their implications for more effective and efficient collaboration, our approach puts the humans behind the work items into the center of focus. By fostering a more social communication, our approach does not conflict with or replace existing communication patterns that are established in a company. Rather, it should be looked at additional, social information about the individual team members.

Transience and topicality

We want to keep interactions very "light-weight" and casual, which is why the functionality is very simple, maybe even limited, by design. The information shared and displayed will be of transient nature. Following this approach brings the benefit of really fostering informal communication because there is no guarantee that messages will be read. In addition, our approach visually emphasises on the topicality of information displayed in order to avoid outdated data that clutters the user interface.

Mood and context sharing

As the main text-based informal communication possibility, our approach focuses on status messages to can be broadcasted to the entire team. This concept is also known as micro-blogging, with the difference that common micro-blogging platform often times are public (e.g. twitter) and our approach is scoped to a team. Dullemond et al. [Dul+13] state that micro-blogging is another

strategy that allowed software engineers to share activities and moods with other team members with the result of feeling more connected to each other. Our approach is very similar to theirs in terms of functionality of the mood-based status sharing, yet we do not force the users to always share moods together with a status message; we are interested in use cases for the combined and isolated usage of the two features. Further, topics that are usually blogged about are informal [ES10] which aligns with the goal of our approach. Furthermore, mood sharing seems to act as a springboard for conversations according to Church, Hoggan, and Oliver [CHO10].

Ever-running break room

Additionally, allowing to actually 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 a requirement. This is motivated by Chang and Ehrlich [CE07], which 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 isn't intended for a single person, or you simply 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 of talking to another team member, he/she has the possibility to indicate that now would be an appropriate time for a short informal communication. If other team members feel the same, random matches can be made and the two team members join a virtual video call.

Minimizing interruptions

When developing an ambient always-on top visualization, minimizing interruptions and distractions is one of the most important design principles. Specifically, this means a very targeted use of notifications and the ability to not be contacted and hide potential distractions if desired.

3.2 Prototype

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

AmbientTeams is a cross-platform desktop application based on Electron¹. To facilitate the implementation of the interactive user interface, VueJS² was used. To maintain JavaScript as a common language for the front-end and back-end, NodeJS³ is used on the server side. The server provides both a REST API for basic CRUD functionality for users and teams, as well as a websocket endpoint, since much of the data required for *AmbientTeams* comes from the server in real time.

AmbientTeams comes with two main windows. The overview window is responsible for maintaining a connection to the server, authenticating, login functionality, settings. Additionally, once the user has authenticated, he/she is redirected to the overview view where all teams

¹<https://www.electronjs.org/>

²<https://vuejs.org/>

³<https://nodejs.org/>

and team members are visible (see Figure 3.1). By clicking on the edit icon next to the team name, the user has the possibility to pick a selection of team members from each team that will then be displayed on the other main window, the ambient window. This is demonstrated in the team called "AmbientTeams" in Figure 3.1.

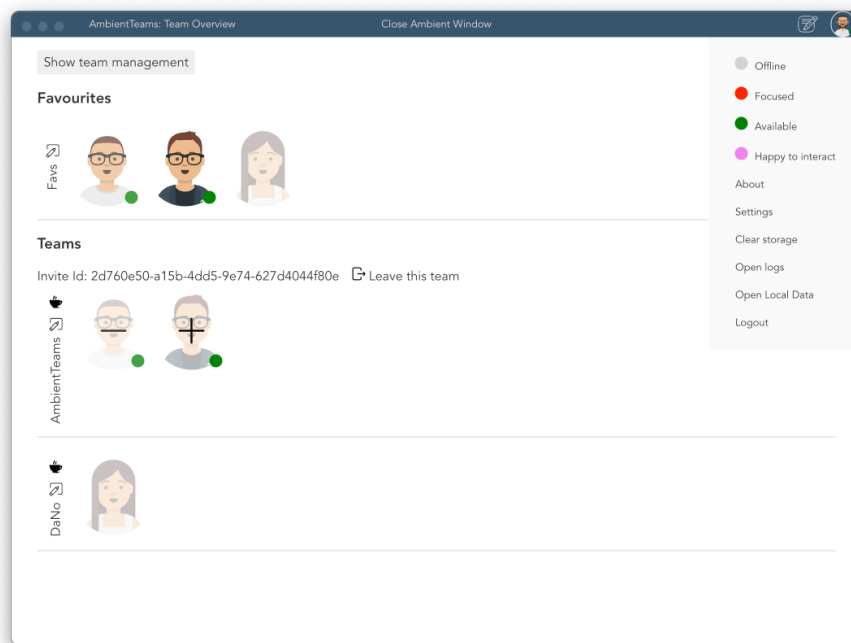


Figure 3.1: Overview Window

Ambient always-on-top, people-centered team view

AmbientTeams consists of two main windows; an overview window and the so-called ambient window. To keep the ambient overlay as ambient and minimal as possible, a transparent window was chosen. Further, certain functionality is only visible when the user is hovering over this window. When hovering, the user can select the team they want to show

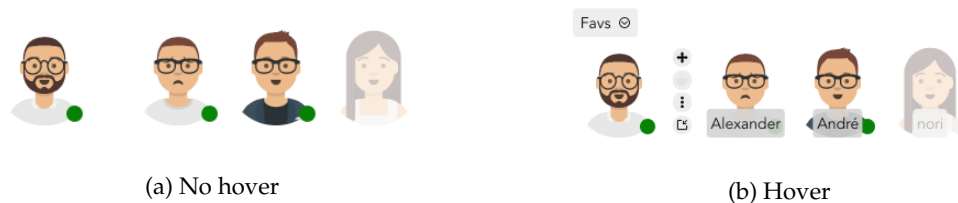


Figure 3.2: Ambient Window

Transience and topicality
Mood and context sharing
Ever-running break room

1:1 interactions

Minimizing interruptions

3.3 Preliminary Evaluation

To evaluate the above mentioned research questions, a small pilot study was conducted. Optimising and improving our approach with the help of feedback from a small team consisting of knowledge workers is the main goal of this master thesis. Further, by collecting additional data we hope to get valuable first insights into the following areas:

1. Common workflows and patterns
RQ1: How do knowledge workers use and interact with AmbientTeams? How do they integrate it into existing workflows?
2. Mood sharing behavior
RQ2: Do knowledge workers want to share their moods with their remote team members? If so, what causes knowledge workers to share their moods with their team?
3. Feeling of isolation
RQ3: Can a people-focused team mood and status sharing approach decrease the feeling of isolation in remote knowledge worker teams?
4. Information consumption
RQ4: What do knowledge workers learn from information shared by their team members? What kind of information is the most valuable?

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. After having a look at the study procedure in the next chapter, each of the three data sources and their relevance for the research questions are elaborated.

To find participants, a recruitment flyer (see .) The study was conducted with two knowledge worker teams, each team fulfilling the following participation requirements:

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

3.3.1 Procedure

1. Initial meeting: Installation, registration, team creation, give each team member a participant ID (see subsection 3.3.2)
2. Pre-study questionnaire (see subsection 3.3.3)
3. Evaluation phase (see subsection 3.3.4)
4. Post-study interview (see subsection 3.3.5) with data collection (see subsection 3.3.6)
5. Post-study questionnaire (see subsection 3.3.3)

3.3.2 Initial meeting

Installation

3.3.3 Pre- and post-study Questionnaires

The pre and post study questionnaires are used to assess the feeling of workplace isolation before and after the evaluation period. The questions are taken from

3.3.4 Evaluation Phase

How long?

During the study notes from notion

3.3.5 Interview

Interview questions and their relevance for the research questions

3.3.6 Data Collection

Table 3.1 shows an overview of all data collected and for which research question they are relevant.

Data collected	Storage	Relevant for
cell4	Local	cell5
cell7	Local	cell8

Table 3.1: The data collected during the preliminary evaluation and its relevance for the RQs

Results

- 1) Analyse interviews
- 2) Analyse questionnaires
- 3) Analyse usage data
- 4) Compare data between teams
- 5) Check alignment of qualitative data and quantitative data (→ find potential contradictions)

Conclusion

Appendices

Additional Documents

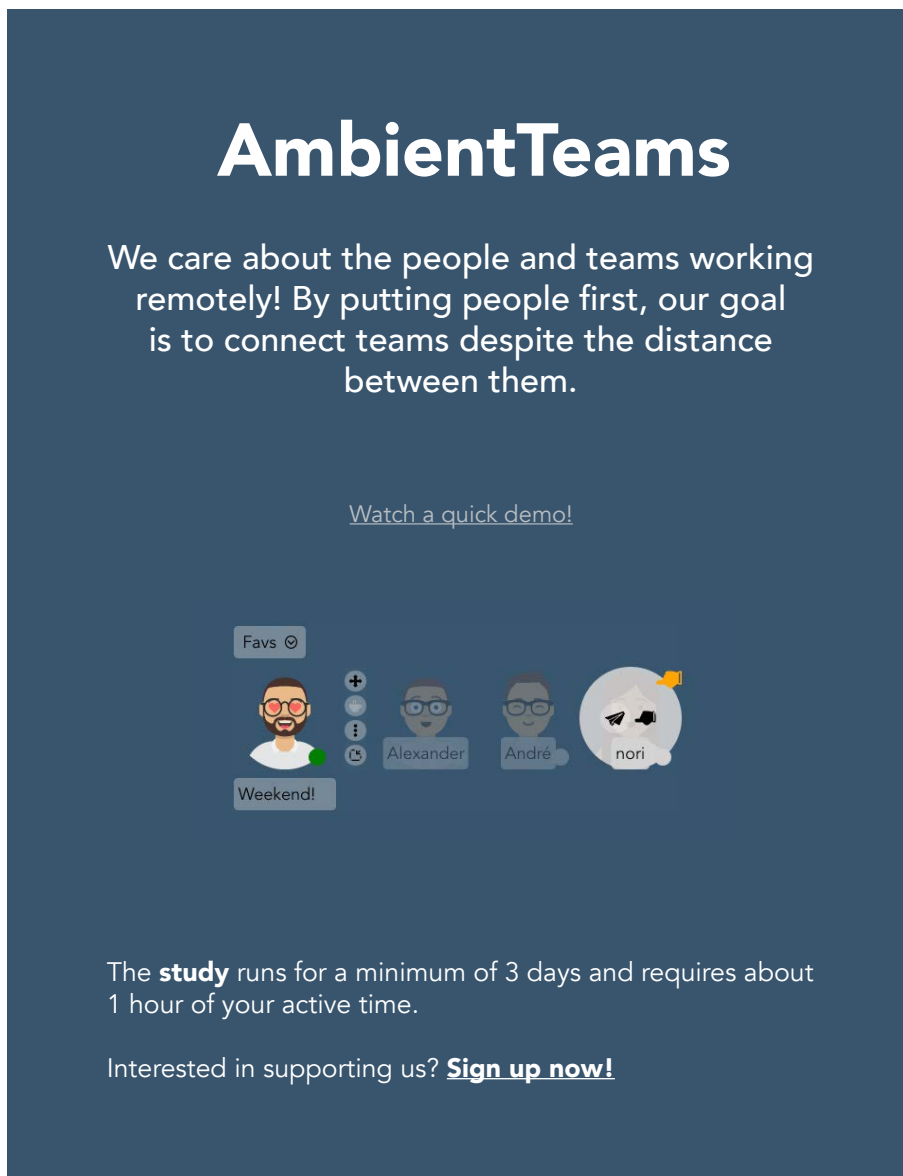


Figure A.1: Recruitment flyer to find participants

Interview Transcriptions

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