Introducing Mood Self-Tracking at Work: Empirical Insights from Call Centers

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The benefits of self-tracking have been thoroughly investigated in private areas of life, like health or sustainable living, but less attention has been given to the impact and benefits of self-tracking in work-related settings. Through two field studies, we introduced and evaluated a mood self-tracking application in two call centers to investigate the role of mood self-tracking at work, as well as its impact on individuals and teams. Our studies indicate that mood self-tracking is accepted and can improve performance if the application is well integrated into the work processes and matches the management style. The results show that (i) capturing moods and explicitly relating them to work tasks facilitated reflection, (ii) mood self-tracking increased emotional awareness and this improved cohesion within teams, and (iii) proactive reactions by managers to trends and changes in team members' mood were key for acceptance of reflection and correlated with measured improvements in work performance. These findings help to better understand the role and potential of self-tracking at the workplace, and further provide insights that guide future researchers and practitioners to design and introduce these tools in a work setting.

CCS Concepts: • **Information systems** → **Collaborative and social computing systems and tools**; • **Human-centered computing** → **Computer supported cooperative work**; **Empirical studies in collaborative and social computing**; • **Applied computing** → **Collaborative learning**; • **Social and professional topics** → *Socio-technical systems;*

Additional Key Words and Phrases: Call center, field study, mood self-tracking, reflection, work performance

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1. INTRODUCTION

Self-tracking applications are popular in many areas of life, ranging from health[1] to time management[2] and mood tracking.[3] The usage and development of these tools is driven by a community called the Quantified Self[4] (QS). Quantified-Selfers share an interest in using self-tracking to gain self-knowledge about their own behaviors and habits. The ultimate goal of self-tracking is to reflect upon data about oneself, thereby, finding meaningful insights and making positive changes [Choe et al. 2014]. Therefore, reflection upon data is the means to bring meaningful self-knowledge that leads toward such changes. Reflection has also been identified as a core process for improving work performance both on an individual (e.g., Eraut and Hirsh [2007]) and collective level (e.g., Høyrup [2004]). Following the success of self-tracking applications in more private areas of life, we see a high potential for self-tracking applications to make also positive changes in work processes. However, the usage of self-tracking applications in work settings has to account for, among others, the collaborative aspects of teamwork, privacy concerns, and the focus on work performance in organizations.

Taking these aspects into account, our investigation focused on the following four key challenges that differentiate work environments from private areas of life: (i) the acceptance of mood self-tracking, (ii) its impact on team collaboration and communication, (iii) the influence of management and hierarchical relationships, and (iv) the improvements in work performance. Work performance is crucial in settings such as call centers, where periodic performance data is the key output for the service provider, and the measured performance of the call center is quite literally the aggregated performance of all its agents [Colombino et al. 2014]. Although many aspects of employees' performance are monitored, mood is traditionally not tracked despite call center work being an emotional labor job [Jaarsveld and Poster 2013]. Self-tracking of mood is an example in which the benefits of self-tracking are not limited to mental health and well-being, as mood and emotions influence work performance by affecting creativity, goal persistence, and helping behavior [Brief and Weiss 2002]. Although research has concentrated on the impact of tracking mood at the individual level [McDuff et al. 2012; Morris et al. 2010; Ståhl et al. 2009] and studying how affect is conveyed with technology [Church et al. 2010; De Choudhury and Counts 2013; Huisman et al. 2013; McDuff et al. 2012], we lack an understanding of the impact of mood self-tracking in a work environment.

In order to address this gap, we investigated the impact of mood self-tracking on work processes in call center teams. A preliminary field study with a mood self-tracking application, called MoodMap App, outlined the necessary adaptations of the application that fulfill acceptance and integration requirements in a work setting. Subsequently, a 4-week field study involving 71 participants split across four teams evaluated the adapted application. We present the results of this main field study and analyze the four investigated hypotheses related to the mentioned key challenges at work. By understanding the appropriation, successes, and failures of the MoodMap App in the call centers, we can inform the design of future mood self-tracking tools.

We contribute to the state of the art by examining the impact of mood self-tracking in working teams at call centers, which is still a fairly unexplored domain. The conducted field study allows us to derive the following key contributions:

[1]http://www.myzeo.com; http://www.fitbit.com.
[2]http://www.rescuetime.com.
[3]http://www.moodscope.com.
[4]http://quantifiedself.com.

—Empirical evidence that mood self-tracking in workplaces can improve work performance, emotional awareness, and team communication.
—Insights on the introduction and role of self-tracking in work environments at technical and organizational levels.

To this end, the following section relates our approach to the state of the art and derives four hypotheses, before describing our research approach and the investigated use case. Next, we summarize the preliminary field study where we tested an existing mood self-tracking application and outline the resulting adaptations of the app. Following, we describe the main field study on the impact of mood self-tracking on work patterns in call center teams and the obtained results. Finally, we discuss our results and design implications with respect to our hypotheses before concluding.

2. BACKGROUND AND RELATED WORK

Self-tracking has been mainly studied in private areas of life. However, although research emphasizes the crucial role of reflection in work environments, the benefits of reflection on self-tracked data—and particularly on mood—have not been explicitly addressed. This section reviews the current state of the art and outlines the open issues with respect to the workplace environment.

2.1. Self-Tracking

The Quantified Self (QS) community has driven self-tracking to become an emerging trend, by promoting an interest in gaining self-knowledge about own behaviors, habits, and thoughts. Quantified-Selfers collect and analyze data about oneself, often related to well-being, health, and sustainable living. Recent studies aimed at gaining insights on self-tracking practices from this *extreme user group* [Choe et al. 2014] by analyzing their experiences and identifying main challenges, motivations, as well as pitfalls. Problems of users that collect and reflect on personal information were analyzed by Li et al. [2010] in order to derive a model composed of five stages (preparation, collection, integration, reflection, and action). Subsequent studies analyzed which questions people seek to answer by reviewing their captured data [Li et al. 2011]. Work by Gimpel et al. [2013] explored the underlying motivations of self-triggered health monitoring and defined a *Five-Factor-Framework of Self-Tracking Motivations* (self-entertainment, self-association, self-design, self-discipline, and self-healing). Rooksby et al. [2014] investigated what *people are making of personal trackers for themselves* and reported an interview study with current users. These studies provide valuable insights about personal tracker users, but we lack empirical evidence whether these insights also apply in a work setting.

Previous research in self-tracking has predominantly focused on improving physical activity, health, and well-being [Isaacs et al. 2013; Li et al. 2011; Morris et al. 2010]. By embedding mood self-tracking in work processes and linking it to work activities, we shift the focus from health and well-being toward reflection on work-related issues. To achieve this, we use mood as a *fast entry point* for reflection where mood serves as an intuitive starting point to think more deeply about work-related issues that have impacted individuals' mood and daily work. In the end, it is not reflection about mood itself aiming at improving well-being, but reflection about work achieved by linking moods and work.

Furthermore, applications typically target individuals rather than teams. Issues under investigation are often tracking effort [Li et al. 2011] and support for behavior change [Isaacs et al. 2013]. Although social features are common in QS tools (e.g., sharing activity levels in minutes or distance run), Rooksby et al. [2014] argue that these features are not necessarily put to use, but users rather share data to announce

their achievements to friends or compete with other users. Hence, sharing typically serves to increase user motivation via competition or peer recognition [Maitland et al. 2006] rather than to support team and communication processes, as it is necessary in work settings.

2.2. Reflection

Reflection can be understood as the re-evaluation of experiences with the goal to learn from them by changing knowledge, behavior, or attitude with respect to (future) experiences [Boud et al. 1985]. Schön [1984] distinguishes two kinds of reflection: *reflection-in-action* refers to reflection which takes place while doing own work, whereas *reflection-on-action* means analyzing reactions to any situation and exploring the reasons and consequences afterwards. Munby [1989] further explains that reflection-on-action *involves bringing new thinking to bear upon unsurprising and given data*, whereas reflection-in-action is driven by the *unexpected feedback of the situation*. Prilla and Renner [2014] define a coding scheme which essentially differentiates instances of reflective learning according to their depth. With this, they distinguish nine phases subsumed into three stages of reflection, similarly to the description of Fleck and Fitzpatrick [2010]. Synthesizing these relevant works, Boud views reflection from a process viewpoint and emphasizes the affective aspects. Schön analyzes how reflection relates to professional practice and introduces the in-action and on-action dichotomy. Finally, Prilla and Renner view reflection in terms of impact on the operative activity, i.e., its depth—how deeply the pattern of operative activity is questioned, and re-thought.

Self-tracking technology can support reflection by (i) facilitating the collection of cues to reflect, (ii) fostering the initiation of reflective processes, and (iii) supporting the exploration and analysis of data to make sense of past experiences [Rivera-Pelayo et al. 2012]. Self-tracking tools aim at stimulating reflection by providing accurate data as basis for the reflective process, which is a core process for improving work performance [Eraut and Hirsh 2007; Høyrup 2004]. Similar tracking processes take place at an organizational level, when organizations define and track key performance indicators (KPIs) to facilitate reflection on work processes and evaluate the success of the organization [Colombino et al. 2014].

From a theoretical perspective, the works of Fleck and Fitzpatrick [2010] and Baumer [2015] have reviewed literature on reflection and existent approaches in order to achieve a conceptual grounding and derive new insights for technological design. From a pragmatic perspective, the benefits of reflection for individuals have been investigated among others in HCI design [Fleck and Fitzpatrick 2009; McDuff et al. 2012; Sengers et al. 2005], CSCW [DiMicco 2005; Johnston et al. 2005], and ubiquitous computing [Li et al. 2011; Rachuri et al. 2010; Reitberger et al. 2013]. Although it is the individual who reflects, reflection processes in organizations are embedded in social interaction and therefore individuals reflect together in an organizational context [Høyrup 2004]. Furthermore, in organizational settings, collaborative reflection enables the *collaborative re-design of work* [Prilla et al. 2013] by transforming work experiences into applicable lessons learned. This reflection on work experiences can benefit from tracking additional data. As mentioned above, Prilla and Renner [2014] present a case study on collaborative reflection at work and define a coding scheme to analyze the articulations made by reflection participants within group conversations. The developed coding scheme can be also used for the investigation of individual reflection, as the analysis is based on individuals' articulations, which may be an online group conversation but can also be a diary-like entry as in the MoodMap App. Therefore, we use this coding scheme in our work for the analysis of recorded articulations.

2.3. Mood Tracking

Mood is in the top five of the most popular items tracked by Quantified-Selfers [Choe et al. 2014] and numerous applications for mood tracking exist.[5] Research works [Boud et al. 1985; Choe et al. 2014] as well as practical approaches [Carmichael 2012; Cousins 2010] have shown the potential of mood to trigger reflection and support learning. In HCI, mood tracking to support awareness and reconstruction of the emotional memory has been addressed from a design perspective [Church et al. 2010; McDuff et al. 2012; Ståhl et al. 2009; Sundström et al. 2007].

On the other hand, the relevance of moods and emotions at work has been confirmed by several studies on workplace communication. Dullemond et al. [2013] investigated mood sharing in a micro-blogging system to facilitate knowledge sharing within a fully distributed team of software engineers and showed that members of software development teams feel more connected to each other when they are able to share activities and moods. Although sharing moods and investigating team-connectedness are points in common with our work, our research differs in considering the benefits of self-tracking on individual work performance as well as the impact at organizational level. In De Choudhury and Counts [2013], social media has been used to understand the mood of employees in organizations, e.g., to assess employees' reaction to important organizational changes. Mark et al. [2014] describe an in-situ study on comparing online and face-to-face interactions to examine their influence on people's mood at the workplace. The relationship between daily work routines and how they influence mood has gained attention too. For example, in Matic et al. [2010], parameters like localization, sound, or speech are monitored to uncover correlations with mood states inferred through self-reporting.

Although there are automatic methods to recognize moods and emotions, e.g., from video [Byun et al. 2011], our approach is deliberately based on manual self-tracking. On the one hand, automatic methods lower the tracking effort, can raise awareness, and influence behavior [DiMicco 2005]. On the other hand, reflection requires the cognitive focus to analyze and understand the data. We see the manual mood capturing itself as a reflection opportunity.

Supporting reflection to increase emotional awareness has been addressed from a psychological perspective [Morris et al. 2010], but the implications of such awareness on collaborative work are less well understood. Awareness of others in work settings is about knowing *where others are working, what others are doing* [Gutwin and Greenberg 2002]. In particular, emotional awareness enables users to become aware of the emotional state of their collaborators and act accordingly to achieve better results in their joint work [García et al. 1999]. Therefore, existing literature indicates that self-tracking of mood can increase reflection about personal work behavior, which in turn influences collaborative work.

2.4. Synthesis and Hypotheses

In summary, self-tracking and concretely in the case of mood has been investigated in many laboratory settings or with knowledge workers in research environments. However, to our knowledge, no study has examined the impact of introducing mood self-tracking in a fast-paced and stressful work environment like call centers. The reviewed tools have been designed and mainly used for individual and personal tracking, with a strong focus on health and physical activity. To fill this gap, we investigate the requirements to integrate an application for mood self-tracking in work processes as well as the impact that mood self-tracking has on individuals and teams. Reflection

[5]For example, http://www.moodjam.com, http://www.moodscope.com.

as a cognitive process cannot be measured itself. Nevertheless, we can (a) monitor the interaction and time spent with data, and (b) record observed outcomes such as work improvements. The expected correlation between both reflective practice and outcomes has to be augmented with qualitative data to analyze a potential causal relationship. For (a), we performed content analysis on the articulations of reflection that individuals did in the app. For (b), we analyzed KPIs which are an established mechanism to measure employees' performance.

As mentioned in Section 1, four key challenges for self-tracking are particularly salient in work settings. Based on the reviewed literature, we relate a hypothesis to each of these four key challenges (i–iv):

(i) *Acceptance of self-tracking in work settings*: Many workplaces today, and concretely call centers, are characterized by a chronic workers' lack of time, relentless pace of work, and routine work tasks [Callaghan and Thompson 2002]. In order for self-tracking to be used, these characteristics have to be taken into account and the application needs to be well integrated into employees' workflow. Then, workers will be able to reflect on collected data (in our case, moods and related work experiences).

H1. The mood self-tracking app has to be well integrated into the employees' workflow in order to be used to reflect on their emotions and work experiences.

(ii) *Collaboration within the team*: In most work settings, having teams with common objectives makes teamwork crucial, and incorporating emotional awareness with different tools (in our case, a mood self-tracking application) can be a collaboration and communication aid [García et al. 1999].

H2. Mood self-tracking facilitates awareness between colleagues.

(iii) *Hierarchical relationships*: In these teams, employees have different hierarchical roles. Therefore, management and hierarchical relationships may be positively affected by providing an informal communication mechanism. However, privacy issues have to be considered, as this includes the risk that self-tracking turns into an observation tool to enforce desired behaviors [Stanton and Weiss 2000].

H3. Mood self-tracking is accepted as an informal communication mechanism between management and staff.

(iv) *Work performance*: Measuring the improvement in a work setting implies analyzing productivity metrics, which in call centers are the direct product of the agents' activities [Colombino et al. 2014]. Moreover, employers expect to measure significant work improvements in order to justify the introduction of any new tool.

H4. Mood self-tracking leads to measurable work improvements.

3. RESEARCH APPROACH

Before testing these hypotheses in a field study, it was necessary to better understand the work processes on site, to explore the plausibility of our hypotheses, and to adapt the existing application where necessary in order to ensure sufficient suitability for the call center's work processes. To achieve this, we followed a participatory design approach that actively involved call takers, managers, and coaches in the design process and helped ensuring that the result meets their needs and is usable. Therefore, the design and evaluation process was as follows:

—We started with a visit to one of the two participating call centers in order to analyze the work processes on site and explore the potential of mood self-tracking. This allowed us to obtain a detailed description and analysis of the investigated use case.
—After this visit and the conducted discussions, the commitment to carry out a preliminary field study in one team of a call center was achieved. This preliminary study

focused on identifying required changes to obtain acceptance by call takers and management. As an outcome of the study, the changes were designed and implemented.
—Finally, the investigated hypotheses were examined through the evaluation of the resulting MoodMap App. It consisted of a field study with four teams of two different call centers.

Both field studies followed a mixed research methodology, i.e., accompanied quantitative data with explanations based on qualitative sources, such as interviews. The evaluation procedures were performed in compliance with the institutional guidelines. The conduction of the studies was approved by the organization as well as the participating employees through the corresponding consent forms.

4. USE CASE DESCRIPTION AND ANALYSIS

In order to thoroughly prepare our field studies, we visited a call center to familiarize ourselves with the work processes on site. As part of the visit, we also organized a workshop with the responsible person for training and coaching in the telecommunications company as well as one manager and one coach of the visited call center. The application was presented to the participants and opportunities for usage and benefits for the different types of employees (call takers, coaches, and managers) were discussed. Following, we could familiarize ourselves with the call center by visiting the working rooms and observing the work done by employees. We could witness the activities of the call takers during their work and listen to customers' incoming calls. Finally, we had the opportunity to interview one of the call takers to deepen our understanding of their daily working processes and their needs.

4.1. Call Center Setting

We carried out our work in two call centers in the United Kingdom, belonging to the same telecommunications company. They are responsible for incoming product support and information inquiries from business customers. The main contact point for the researchers was the second-level manager who coordinates both call centers. Roles and processes in the investigated call centers, described below, align well with the characteristics of emotional labor [Jaarsveld and Poster 2013]: contact with the public, manipulation of customers' emotional state, and control of employer organization via supervision and training.

Work in these call centers is organized in teams of 10–20 *call takers* that are led by one *manager* and have the support of one or two *coaches*.

Call takers are responsible for taking calls and solving any issues directly with the customers in an efficient, professional, and friendly manner. They need to have excellent listening, problem solving, and communication skills to face highly demanding situations occurring with every different customer. Call takers work individually in an open plan office and have individual callback queues. It has to be noted that the tasks of call takers are not inherently collaborative, i.e., they usually attend their calls individually. However, they do cooperate as a team: They discuss their calls and help each other, they have common objectives, and their performance is partially evaluated at team level. A specialized software program guides them through each call. Company's internal portals are used to retrieve necessary information (e.g., customer profiles). Instant messaging is used for internal communication and a desktop application is available for taking notes on calls. Individual breaks between calls leave them limited room for exchanging experiences. Inside the team, collaboration in form of teamwork means working together toward a common goal sharing both information and resources that enable each member to make the greatest contribution to reach this goal [Garber 2007].

Managers coordinate work within a call center team and ensure that call takers perform against targets, supervise their coaching, and train them. As a supervisor, one must create a work environment in which collaboration can exist among the call takers that form each team [Garber 2007]. Managers see it as challenging to be aware of ongoing difficulties of the call takers and cannot always be available for a call taker when an issue or problem occurs during a call. Furthermore, it is not always possible for managers to talk to each of the call takers during a working day.

Coaches support and train call takers for their work. They conduct weekly coaching sessions of 30 minutes with each call taker, focusing on individual work performance and possible improvements. Company-specific KPIs and call recordings serve as basis for the coaching sessions.

4.2. Potential of Mood Self-Tracking at Call Centers

The problems and communication patterns of customers affect call takers' mood, while call takers have to continue communicating in a friendly and professional manner toward customers. Previous research [Colombino et al. 2014; Jaarsveld and Poster 2013] has shown that call centers are challenging work environments in terms of being a fast-paced work. However, the articulation of mood and emotions at work is often seen as unprofessional. Reflection may be considered a liability rather than a benefit because it distracts attention from the next call.

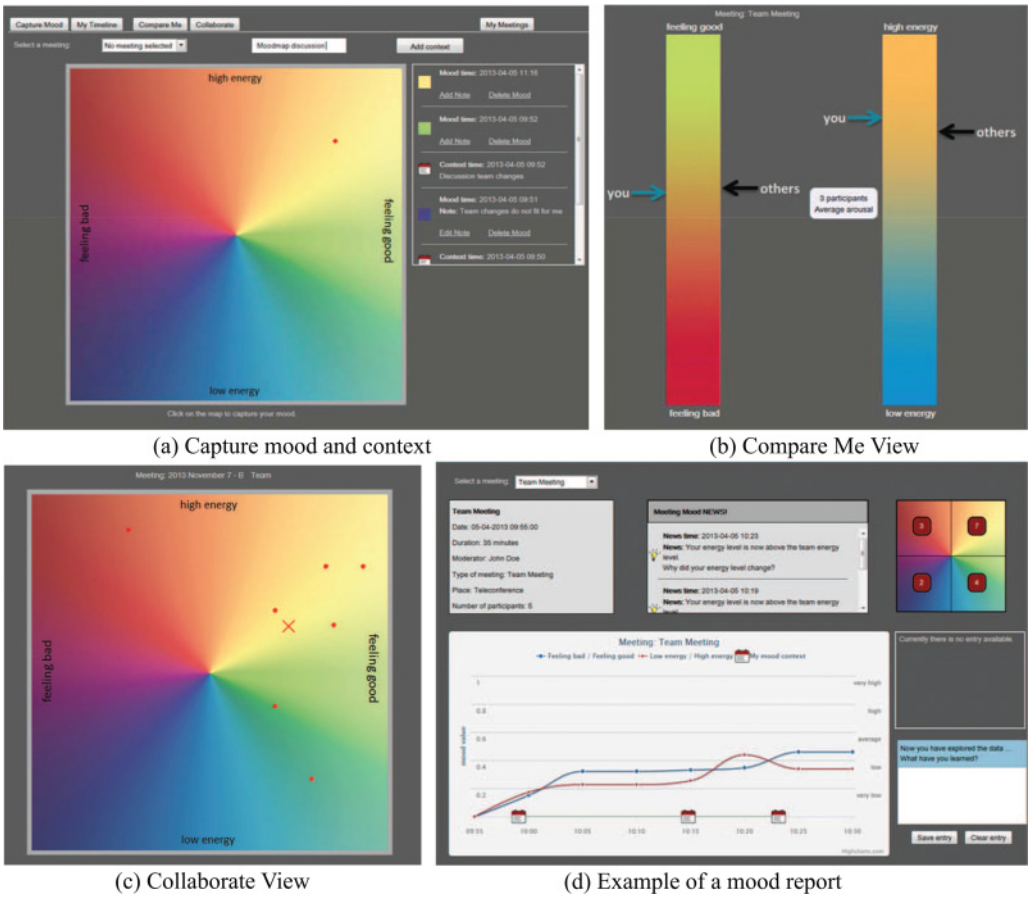
As Burgess and Connell [2006] summarize, call centers allow us to observe most of the characteristics and issues that are present in the post-industrial work. Among others, these include the potential for subordination in comparison to the potential of autonomy through ICT [Russell 2004] or managing a workforce to deliver cost efficiency and service quality [Batt 2000]. Accordingly, call centers give us the opportunity to investigate mood self-tracking in a well-known environment that at the same time can inform future research in other work settings.

The work of call takers is mainly based on individual working routines (e.g., answering a customer call). At the same time, call takers are part of teams working together. This structure offered us the potential to achieve positive improvements in both individual performance and team working atmosphere. Taking this into account, we identified together with call takers, managers, and coaches the following possibilities to embed mood self-tracking into work: (i) mood is captured by call takers before and after calls; (ii) mood is reviewed during the coaching sessions, and captured during and after coaching sessions; and (iii) managers review mood of their team as part of their routine work process.

4.3. Mood Self-Tracking Application: MoodMap App

We base our work on a web app for mood self-tracking resulting from prior work [Fessl et al. 2012]. In line with existing research, we understand *mood* as more diffuse than *emotions* and with a less clear cause, longer in duration and less focused and intense [Frijda 1994]. Emotions are affective reactions to an event, typically short-lived and directed at a specific object or event, whereas mood is a longer term affective state. Emotions can contribute or influence the mood of an individual, whereas moods tend to affect which emotions are experienced [Brave and Nass 2003]. A self-tracking application cannot differentiate between mood and emotion, but this does not affect our research. Russell [2003], who conducted extensive research on emotion and cognition, downplays the relevance of terminology to a pragmatic level: *At the heart of emotion, mood, and any other emotionally charged event are states experienced as simply feeling good or bad, energized or enervated.*

The MoodMap App understands moods along the two dimensions of Russell's Circumplex Model of Affect [Russell 1980]: valence (feeling good–feeling bad) and arousal



(a) Capture mood and context (b) Compare Me View

(c) Collaborate View (d) Example of a mood report

Fig. 1. Main features of original mood self-tracking app: (a) capturing moods, (b) *Compare Me* view (c) *Collaborate* view, and (d) daily report.

(high energy–low energy). Similar interfaces following this model have been investigated and validated in previous researches [Mora et al. 2011; Morris et al. 2010; Ståhl et al. 2005]. Mood is captured by clicking on the bi-dimensional mood map based on Itten's color system [Itten 1971] as depicted in Figure 1(a). Personal notes (free text) can be attached to mood entries and context information can be added outside of mood entries (e.g., a task has been finished).

Moods, notes, and context are aggregated and visualized in different views on an individual as well as collaborative level. At the team level, the average mood of each team is calculated with the last mood of each user captured in the present day. In the MoodMap App, visualizations were designed to support *reflection-in-action* and *reflection-on-action* as defined by Schön [1984] and Munby [1989].

With respect to *reflection-in-action*, three live visualizations aimed at providing unexpected feedback and allow users to see the development of own and others' mood live: *My Timeline*, *Compare Me*, and *Collaborate*. The *My Timeline* visualization presents the own mood development during a day on a timeline. The *Compare Me* visualization (see Figure 1(b)) allows to directly compare own mood with the average mood of a team in the two mood dimensions. On each bar, the blue arrow on the left

represents the individual user's value, whereas the black arrow on the right shows the average value of the team. By moving the mouse over the arrows, the user gets more information about the current number of participants. The *Collaborate* visualization (see Figure 1(c)) presents the average mood of the team through a red cross as well as each single mood point of all team members anonymously. This allows users to visualize the moods of the team's colleagues and identify potential clusters and deviations.

In order to support *reflection-on-action*, two types of reports summarize the mood tracking of a working day to facilitate a retrospective overview and reconstruction of past experiences (see an example in Figure 1(d)). These reports include general information about the shift, their mood trends, the number of captured moods in each quadrant of the mood map, and the relevant mood changes detected during the shift. Online Appendix A contains screenshots of the MoodMap App in a high resolution.

5. PRELIMINARY FIELD STUDY

This study aimed at eliciting changes required for the MoodMap App to obtain acceptance by call takers and management and to embed it into their existing work processes at the call center.

5.1. Procedure and Evaluation Tools

The MoodMap App was tested within two teams of one call center. In total, 17 participants (2 managers, 5 coaches, and 10 call takers) used the app over 4 weeks. Managers introduced the app to their teams and organized weekly meetings to discuss the usage and potential of the app. Furthermore, they committed to using the collected information as basis for their work. The participants were asked to integrate the MoodMap App in their daily working routines, but each participant decided when to enter a mood or use any app feature. No specific or additional tasks were given to the users to avoid interfering within their daily work tasks.

We had regular informal meetings (via videoconference) and email communication with call takers and managers which contributed to the design process. Additionally, pre-questionnaires and post-questionnaires were used to collect qualitative and quantitative data of all the team members (including end users from all involved roles). At the end of the study, interviews with two managers and one call taker were conducted.

5.2. Results

The participants saw potential in using the MoodMap App, what is well illustrated by the words of one call taker: "*The whole thing was a good idea. It seems morale is pretty poor in this place at the moment so something like this is a good step in to actually caring about the staff here and getting to the bottom of when or why people feel bad.*" However, the overall usage rapidly decreased because the barriers outweighed the desired benefits. These were the identified requirements to overcome these barriers:

—*Easier data capturing*: The click-path to capture a mood-entry was too long. Users had to start the app, log in, and select a meeting. Thus, the click-path should be reduced.
—*Better integration of data and work*: The captured moods were not set in context to specific events and calls. The visualizations that allowed them to review captured moods had not enough information to reflect on and find ways to improve their work. Therefore, moods should be clearly connected with work process related information, e.g., with the call takers' activities.
—*Easier analysis on an individual level*: The anonymous sharing of moods made it impossible for managers to react to observations. Before lifting the anonymity, we

explicitly included questions about this in the call takers' survey. The results showed that call takers did not fear losing their anonymity if this facilitates an easier analysis of their individual moods. For instance, participants mentioned that they would agree "*if data collected was looked at and used to get things improved to raise moods to feel one is being productive or cared about*" or "*Discussing the information I have entered in the app during coaching sessions.*" Thus, managers and coaches should be able to analyze non-anonymized moods and notes. New visualizations showing the mood of individual call takers in their teams should allow managers to react directly on the data.

5.3. Adaptation of the MoodMap Application

To achieve an *easier data capturing*, a direct link to the MoodMap App was placed into the user interface of the call center software. Furthermore, call takers automatically enter a session with their team members and managers to share data when logging in. This reduced the required clicks from three to one.

A *better integration of data and work* was implemented by making the connection between mood entries and work processes mandatory. After capturing a mood, users contextualize the mood entry by choosing a context from a radio button list (see Figure 2(a)). This list includes the following options: "after a call," "after a coaching session," "after a break," and "other." In the case of calls, a specific field for the call reference is available to directly refer to processed calls.

In order to make *data analysis easier* for managers and coaches, three new visualizations based on non-anonymized data were added: (1) a smileys' visualization (see Figure 2(b)) shows managers and coaches the current average mood of every team member (including themselves). By clicking on a smiley, a daily timeline of the user's mood with context and notes appears. This live visualization was designed to support *reflection-in-action*. (2) A daily team timeline visualizes aggregated information per team. It shows each single mood point captured by the whole team and the average team mood development, depicted in two timelines (for valence and for arousal). (3) A weekly timeline (see Figure 2(c)) helps identifying trends across multiple days by showing the mood development (valence and arousal) of all team members. In the interactive timeline, the team mood trend (average) can be compared to each single user or between selected users (see Figure 2(c)). These daily and weekly timeline visualizations offered support for *reflection-on-action* processes. Further screenshots in a high resolution of this final version of the MoodMap App can be found in Online Appendix A.

These changes were backed by adapting managerial work processes. Managers and coaches committed to using these visualizations in their routine supervisory work processes and to acting on captured mood data.

6. MAIN FIELD STUDY

The goal of this field study was to investigate the impact of mood self-tracking on work patterns in call center teams with respect to the hypotheses described in Section 2.4.

6.1. Procedure

Before the evaluation started, a conceptual integration and introduction scenario with clear defined goals was developed together with the project manager of the call centers. First, this scenario included the idea to integrate the app in the call centers internal system. Second, the project manager set up several meetings with the involved managers and coaches of the participating teams in order to motivate them to support and conduct the evaluation actively. Within these meetings, the project manager explained

(a) Capture mood and context

(b) Smileys' Team View with timeline

(c) Weekly Team View

Fig. 2. Features added after the preliminary field study: (a) contextualization of captured moods and (b, c) team visualizations.

the app to them in detail, and clearly stated the envisioned goals of the evaluation as well as the envisaged benefit for them and their teams.

The MoodMap App was used by managers, coaches, and call takers within four teams over four weeks. Participants could access the web application at any time of the day and capture their moods through the whole shift. Analogous to the preliminary field study, participants did not have any additional task to do and were not forced to capture their moods at certain times. This freedom of app usage also gave us the possibility to investigate in which situations they captured their moods.

When users captured a mood, they selected a predefined context and entered a note to describe the current situation or the reasons behind it. All users were asked to use the different visualizations in order to reflect on their own and the teams' moods. Managers and coaches committed to using the team views to track the mood development of each call taker and their team as a whole.

6.2. Evaluation Tools

Table I provides an overview of the evaluation tools used. Pre- and post-questionnaires measured agreement with questions on a five-point Likert scale (from 1 = strongly disagree to 5 = strongly agree). A full version of the post-questionnaire can be found

Table I. Evaluation Tools

Tool	Evaluation stage	Consent
Pre-questionnaire	Begin of evaluation	Consent form, demographic data, sharing and privacy
Post-questionnaire	End of evaluation	Questions on usage and user satisfaction, sharing and privacy, reflection, benefits, and insights
Interviews	End of evaluation	Feedback to the overall experience, acceptance within the teams, benefits and insights at collaborative level, and management perspective
KPIs	Begin, end of, and 1 month after evaluation	Average Rating, Net Promoter Indicator, Call Taker Satisfaction, Recap (see details in Table II)
Logging and database	End of evaluation	Interactions with the application and captured moods, notes, and context

Table II. Investigated Key Performance Indicators

KPI	Description	Scale
Average Rating	Average of customer satisfaction rating	0–100
Net Promoter Indicator (NPI)	Based on customer advocacy; reflects the answers to the question: *How likely are you to recommend our services to others based on your recent experience with us?*	−100% to 100%
Call Taker Satisfaction (Call Taker Sat)	Indicates the customer overall satisfaction with the call	1–10
Recap	Evaluates whether the call takers proactively summarized the call to the customer (objective is lowering number of repeat calls). Question answered by customers is: *Did the last call taker recap what had been agreed?*	0–100

in Online Appendix B. Qualitative results were gathered through open questions included in the questionnaires as well as interviews to gain rich information about our hypotheses, including anecdotal examples. We also used log data for descriptive statistics about app usage and interviews.

In order to investigate whether self-reflection on captured mood has taken place, we analyzed the inserted notes with the coding scheme for reflective content developed by Prilla and Renner [2014]. The process was carried out by three researchers, who independently categorized all notes. The coding scheme defines nine main categories: (1) describing experiences or mentioning an issue/problem, (2) mentioning and describing emotions, (3) interpreting or justifying behavior during work, (4) linking an experience explicitly to other experiences, (5) linking an experience to knowledge, rules or values, (6) responding to interpretation of an action, (7) providing solution proposals to a problem, (8) showing insights by describing better individual understanding or generalizing, and (9) describing or implementing change. First, three researchers categorized all notes independently. The inter-coder reliability varied with an average value of compliance between 87% and 93% in all categories. In a second categorization round, the researchers discussed the notes with different categories and achieved 100% accordance.

The impact on work performance was measured by using the existing KPIs of one call center. They were provided at three reporting periods (see Table I). Customers receive automatic SMS messages from the call center to elicit feedback after they have spoken to a call taker and the KPIs are calculated based on the collected feedback. Table II lists the KPIs, their description, and their rating in detail. Due to the different systems used to track and monitor KPIs, *Average Rating* was made available at an individual level; *NPI*, *Call Taker Sat*, and *Recap* on a team level. The company imposed restrictions on the access to KPIs, delivering data from two out of the four teams.

Table III. Overview of Teams Composition and Data Collected

Team	ct./mgr./coach	No. moods	Avg. moods*	No. notes	Indiv. KPIs	Team KPIs
CCA_1	19/1/1	427	23.72	423	19	Yes
CCA_2	17/1/1	315	21.00	302	17	Yes
CCB_1	15/1/0	138	10.62	137	–	No
CCB_2	14/1/0	111	9.25	84	–	No
Total	65/4/2	991	17.09	946	36	–

*Average number of moods captured by each individual team member.

After the post-questionnaires, we asked for volunteers from the call centers to participate in an interview. Two managers and one call taker participated in an individual interview. The interviews were intended to clarify the main issues seen in the detailed questionnaires which they had already answered as well as to collect some further personal impressions from the participants. Therefore, the interviews had to be concise, i.e., the duration varied between 15 and 18 minutes. They included questions about their personal opinion as well as about the feedback received from their colleagues or team members.

6.3. Participants

Two call centers, call center A (CCA) and call center B (CCB), with two teams each participated in the field study. A total of 71 people from these teams participated in the field study (see detailed distribution in Table III, column ct./mgr./coach). The pre-questionnaire was completed by 43 of these participants (38 call takers, 3 managers, and 2 coaches) and 38 of them answered the post-questionnaire (34 call takers, 2 managers, and 2 coaches).

Demographic data was elicited in the pre-questionnaire, and shows the following distribution of gender and age: 26 are male, 17 female; 24 are aged between 20 and 29, 11 between 30 and 39, 6 between 40 and 49, and 2 between 50 and 59 years. The average work experience in the current position was highly diverse, namely 3.47 years ($SD = 3.66$). The MoodMap App was used during 26 working days within a 31-day period. Table III gives an overview of the teams' members and roles, captured moods and notes, and available KPIs. It is important to note that KPIs and interviews are only available for the teams CCA_1 and CCA_2, as there were restrictions from one of the call centers.

7. RESULTS

Teams CCA_1 and CCA_2, belonging to the same call center (CCA), captured more than twice as much moods as teams CCB_1 and CCB_2 from the second call center (CCB), as can be seen in Table III. This indicates that the teams at CCA were much more active in using the MoodMap App than the teams at CCB. This relevant difference in participation will be taken into account in the analysis of the data and we will also discuss later the reasons and implications for the different behavior in the teams.

7.1. Application Usage and Log Data

The MoodMap App logged overall 1,914 user interactions (log events include the access to each of the views in the app). On average, each user had 36.11 ($SEM = 15.00$) interactions with the application during the whole evaluation period. From the three available live visualizations that provide direct feedback in real time, *Compare Me* ($M = 10.23$, $SEM = 1.40$) and *Timeline* ($M = 10.02$, $SEM = 1.38$) were the most used. In contrast, neither the *Collaborate* visualization ($M = 1.21$, $SEM = 0.17$) nor both daily reports ($M = 0.08$, $SEM = 0.01$) were used by the participants.

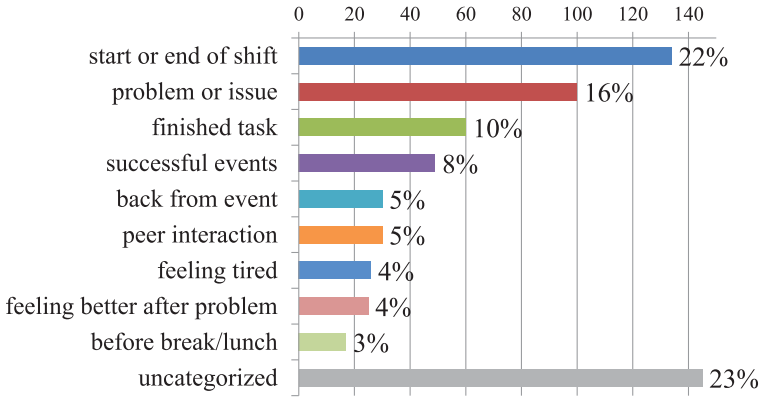


Fig. 3. Distribution of situations mentioned in the notes attached to moods with non-categorized context.

The analysis of contexts ($N = 991$) and non-empty notes ($N = 946$) revealed information regarding in which situations call takers captured their moods and which reasons were behind them. Only 38% of the entered moods were connected to one of the three predefined contexts: "after a call" (27%), "after a break" (9%, and "after a coaching session" (2%). Unexpectedly, in 62% of the cases users preferred to choose "other" as context and manually key in an alternative text. In order to get more insights about these 617 moods with non-categorized context, the corresponding personal notes were evaluated and several situations were identified,e.g., "start/end of shift" or "problem/issues" (see Figure 3).

7.2. Content Analysis

The personal notes entered by the participants constitute the articulation of their reflection. The content of all personal notes ($N = 946$) was analyzed using the coding scheme for reflective content. Reflective notes could be assigned to more than one category. Out of these notes, 25% were categorized as reflective items, including the following five categories: description of experiences or problems (141 notes), expression of own emotions (185 notes) or customers' emotions (50 notes), interpretation or justification of work actions (17 notes), linking an experience explicitly to other experiences (3 notes), and giving suggestions for solutions (1 note).

7.3. Questionnaires

Call takers considered the app intuitive and easy to use without the need for further guidance ($M = 4.03$, $SD = 0.83$). They were asked about the barriers to using the MoodMap App and we could see some differences between the teams (see further details in Section 7.5).

Regarding the self-reporting approach in the MoodMap App, participants of teams CCA_1 and CCA_2 rated the gathering of data with a slightly higher score ($M = 3.78$, $SD = 0.84$) than the participants of teams CCB_1 and CCB_2 ($M = 3.57$, $SD = 0.75$). This score was composed of four questions that assessed whether the data gathering was accurate, effortless, relevant, and timely. Table IV includes these results and the corresponding comparison of the means through an independent samples t-test.

Participants attached a high importance to the direct comparison of their mood to the teams' average mood and mentioned the *Compare Me* visualization as the most important feature. 77% of the call takers could imagine using the app in the future. Out of these, 42% would use it if their manager or coach thinks it is important, 31% if

Table IV. Mean Values and Significance for Post-Questionnaire Items about Data Gathering ($n = 38$)

Data gathering with the MoodMap App was...	CCA_1 CCA_2	CCB_1 CCB_2	*p-value*
Accurate	3.88 ($SD = 0.72$)	3.56 ($SD = 0.78$)	0.23
Effortless	3.75 ($SD = 1.00$)	3.61 ($SD = 0.78$)	0.65
Relevant	3.81 ($SD = 0.83$)	3.50 ($SD = 0.79$)	0.27
Timely	3.69 ($SD = 0.87$)	3.61 ($SD = 0.70$)	0.78

Table V. Mean Values and Significance for Items from the Post-Questionnaire ($n = 38$)

Questionnaire item	CCA_1 CCA_2	CCB_1 CCB_2	*p-value*
I am satisfied with the MoodMap App	4.00 ($SD = 0.87$)	3.17 ($SD = 1.35$)	0.005
The app helped me to become aware of my own mood	4.06 ($SD = 0.83$)	3.11 ($SD = 1.28$)	0.014
The app helped me to become aware of my colleagues' mood	3.88 ($SD = 0.93$)	3.06 ($SD = 1.06$)	0.020
The app helped me to identify significant *situations* worth reflecting	3.71 ($SD = 0.85$)	2.83 ($SD = 1.10$)	0.013
The app helped me to identify significant *mood changes* worth reflecting	3.65 ($SD = 1.00$)	2.72 ($SD = 1.07$)	0.013

their colleagues attach importance to it, 24% of them would use the app regularly, and 4% from time to time.

Table V shows the average ratings of items in the post-questionnaire on app satisfaction, emotional awareness, and identification of issues worth reflecting. For each question, an independent samples t-test was conducted to compare the means statistically. For instance, members of the more active teams (CCA_1 and CCA_2) agreed that the app helped them to identify situations worth reflecting, whereas the less active teams (CCB_1 and CCB_2) were slightly negative. In result, active teams consistently rated all these items higher than the less active ones and the difference between the two types of teams is statistically significant at the 95% level.

Regarding privacy concerns, we asked call takers in the pre-questionnaire ($n = 38$) how comfortable they are with sharing experiences and challenges with coaches and managers. Thirty-two call takers (84%) agreed being comfortable with sharing, three (8%) mentioned that sometimes, two (5%) were unsure, and one participant (3%) was not convinced about it. After the study, we explicitly asked call takers again in the post-questionnaire ($n = 34$) about their opinion on sharing and the benefits it can bring. They agreed (CCA teams: $M = 4.07$, $SD = 0.88$ and CCB teams: $M = 3.50$, $SD = 0.97$) with the fact that sharing their moods with their manager and coaches is fine for them (in total, 8 strongly agreed, 11 agreed, 9 were neutral, 3 disagreed, and 0 strongly disagreed). Regarding the goal pursued by sharing the data, i.e., that managers know the feelings of their team members to help them identify problems and directly help the appropriate person, participants restated their agreement (CCA teams: $M = 4.20$, $SD = 0.68$ and CCB teams: $M = 4.13$, $SD = 0.62$). As it can be appreciated, these both items were given a higher score by the members of the CCA than by the ones in the CCB teams.

Two managers (from teams CCA_1 and CCB_2), who completed the post-questionnaire, appreciated the team views because they helped them to improve collaboration with their teams. Especially, the smileys' visualization made them aware of the mood of each single team member ($M = 4.5$, $SD = 0.71$) and helped them to gain insights about each individual ($M = 4.5$, $SD = 0.71$). The weekly timeline view made them aware of the mood development of the team ($M = 4.0$, $SD = 0.0$) and where actions need to be taken to increase the overall team's mood ($M = 4.5$, $SD = 0.71$).

Table VI. KPI *Average Rating* of Teams CCA_1 and CCA_2 During the Usage Period: Descriptive Statistics and *t*-Test Results

	pre-test		post-test					
Team	*M*	*SD*	*M*	*SD*	*n*	*t*	*df*	*p*
CCA_1	82.79	7.98	89.58	5.81	19	−3.39*	18	0.003
CCA_2	82.82	8.24	83.00	11.86	17	0.06	16	0.95

*$p < 0.01$.

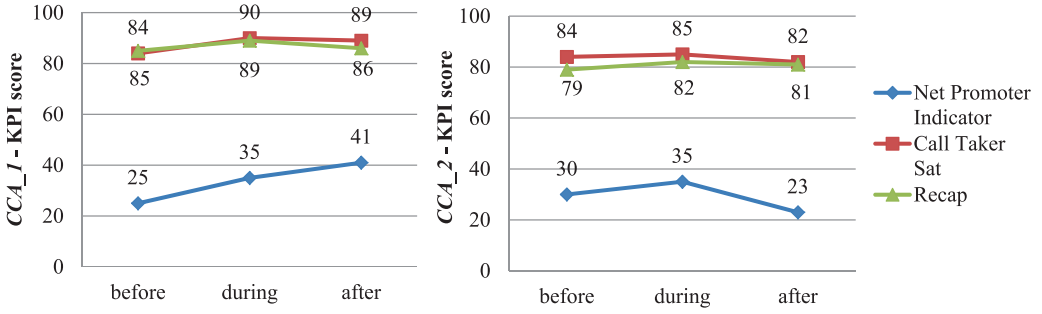


Fig. 4. Team KPIs before the study, during the MoodMap App use, and a month after the app use.

7.4. Key Performance Indicators

Measured KPI values at both the team and individual levels show the strongest increase directly after the MoodMap App usage. The individual KPI *Average Rating* increased in both teams CCA_1 and CCA_2 during the usage of the MoodMap App and dropped after the end of the study. These changes were compared with a paired-samples *t*-test (see results in Table VI). The values for team CCA_1 increased significantly ($p < 0.01$) by 8.20% during usage (from pre-test to post-test), whereas the 0.21% increase in team CCA_2 was not significant. In the follow-up rating, KPIs slightly decreased in both teams, but the reduction was not significant according to the *t*-test (team CCA_1 −0.06%, team CCA_2 −8.62%).

Figure 4 shows the changes of the three KPIs at the team level. Team CCA_1 increased their NPI value by 40.00% (from a score of 25 to 35 points) during the app usage period, whereas its improvement afterward was only 17.14% (from 35 to 41 points). The metrics from team CCA_2 were highest directly after the study. The *NPI* improved by 16.67% (from 30 to 35 points) with the MoodMap App and decreased by 34.29% (from 35 to 23 points) in the period after the cessation of mood self-tracking. In both teams, *Call Taker Sat* and *Recap* improved during the MoodMap App usage period and decreased minimally afterward.

7.5. Qualitative Results

Initially, the interviewed call taker explained how the overall experience of using the MoodMap App was: "*Positive, it was something different, something new and quite nice... and just generally the team as well thought that it was a very positive experience, quick to fill in [...]*". The call taker also commented on the usability of the app as well as the relevance of reviewing her own moods and comparing herself to the team: "The app is quite easy to use to be honest because you get the different options, you have got a call, you have other options..., it is quite easy and it just takes seconds, it is not intrusive and you can do it while you are going to the call and I just think. [...] you know... it can just be a very good experience, because as the day goes on you may forget things so you can go back and look and think 'oh yes I was feeling down there because

of... but obviously I'm an up here now,' so I think it is a good thing. I like looking at this, I like looking and checking where people are."

With respect to barriers and usability issues, we found divergence in the post-questionnaire answers of the different teams. Participants in the less active teams CCB_1 and CCB_2 mentioned several barriers they had encountered: "*It was a very basic page, I think the MoodMap App only benefits managers and coaches to reflect on the team as a whole so making advisors fill it out has no benefit directly to us but benefits as it lets our coach/manager know how the team is,*" "*The constant feedback – more to fill in when we've been cutting things down to perform our jobs better,*" or "*Time restraints.*" However, participants in the most active teams CCA_1 and CCA_2 encountered less barriers for usage, as we can read in their answers: "*None, very simple to use,*" "*None,*" "*No barriers,*" "*None that I can think of,*" "*I found it easy to use and it became part of my normal working day,*" but also in one case "*Personally I don't feel it's a tool I need.*"

During the call taker's interview, we asked her about the analysis of contexts we performed, which revealed that a high percentage of them were not related to the predefined contexts and therefore moods were captured in many other types of situations. Her comments on that were: "*Yeah, yeah after a break or when going home or I just think during the day I used . . . it wasn't always after a call for me personally . . . you know after a break I was feeling on a high or feeling on a low whichever the situation was [. . .] so it's quite good that it does not just depend on the call and you have a stress or a good experience all about the experience you have within the business really and with the customers.*"

To the question if there was any situation where she had decided to change something after having reflected about it she mentioned: "*If I have had a customer that's been quite rude or has upset me, I put in the mood that the customer was not very nice so it made me feel, [. . .] you can reflect on that and then to get above it and move on to the next customer so I think that is a very positive thing.*"

Both managers and the call taker emphasized in their interviews the positive impact of the MoodMap App on the collaboration between call takers. For instance, the call taker, who was from team CCA_2, explained: "*we sort of discussed it just to get a better time offline you know, the wait-time in between calls and speaking to my colleagues they find it very positive [. . .]*". The manager of the same team confirmed: "*It improved communication within the team. [. . .] It opened the channels of communication around call drivers, energy dips and fluctuation in moods.*"

Even more important for the acceptance of the MoodMap App was the improved collaboration between managers and call takers. Both interviewed managers said that the MoodMap App triggered new insights about their teams. They appreciated seeing how their individual call takers were feeling at a glance, especially when not having direct contact with each of them every day. One manager said: "*I see the smileys, like I can always tell how people are feeling and if someone is having a really hard time or someone has done something really good.*" This allowed managers being more proactive, by, e.g., directly contacting a call taker if he/she was in a bad mood and offering support or further encouraging if necessary. During the app usage, the managers directly discussed the moods with their call takers on the floors during work and asked if there is anything to discuss in-depth or where the manager might provide further assistance. Managers also recognized that there were particular points in a day where the mood of the team dropped, e.g., mid-afternoon and after lunch. Hence, they reflected on possible changes in order to increase the average team mood.

Regarding privacy concerns about showing their moods, call takers commented in the pre-questionnaire on how comfortable they are with sharing experiences and challenges with coaches and managers. One of the call takers who agreed being comfortable with

sharing them mentioned "*I share all experiences and challenges so that processes can be improved upon and I believe in knowledge sharing.*" Some of them added clarifications about why they are unsure, e.g., "*it depends on what the topic involves*" or "*I'm not sure yet, but I'm about to find out.*"

In one of the interviews, the manager of team CCA_1 illustrated how he used the app and reacted on the mood of one of his call takers: "*I sit in a little corner of the office so I don't actually get a chance to interact with all of my team all the time. So I find the MoodMap App very useful to see how everyone was feeling because not everyone obviously comes to tell you how they are feeling and I had one guy, he sits quite far away from me and he was on a really hard time with a difficult customer. [. . .] He made a comment on the MoodMap App of having a really hard time and that he was not feeling like that he was getting any help. So straight away I went over to him and asked what I could do to help him and an hour later his mood had gone from like really low to really high because I had gone over to help. [. . .] I would have never known about that and he would have probably struggled on, so there sitting without me knowing anything.*"

In contrast to these positive insights with respect to the benefits of the app, managers said they deliberately did not provide the time and space for call takers to reflect on their own data: "*We think in numbers and money. If we give 2 minutes per day per person, that is 10 minutes per week and if we have 200 people online . . . that means . . . a lot of time and a lot of money. It is about the business.*" This fact, driven by the intrinsic fast-paced work in call centers, also reinforces the results obtained about which features of the MoodMap App were more or less used (see Section 7.1).

8. DISCUSSION

The results of the field study with the MoodMap App have revealed the role of mood self-tracking in a work setting, and its potential to improve work performance and team communication. The preliminary field study and the different usage patterns in the teams let us also identify barriers for adoption of mood self-tracking. Some benefits and barriers that have been attributed to mood self-tracking in private life are applicable to the workplace, whereas others are influenced by the particularities of work settings, as identified by our four key challenges. In the following, we analyze and discuss how these results contribute to each of the investigated hypotheses, as well as the implications of the used method.

H1. The Mood Self-Tracking App has to be Well Integrated into the Employees' Workflow in Order to be Used to Reflect on Their Emotions and Work Experiences

The main challenges of introducing a self-tracking app in a work setting are the *time pressure and additional efforts* that this constitutes. Our results show that building a tool which lowers the user burden to track data and increases awareness achieves its immersion in the work setting. Participants from the call centers considered the tracking interface quick and easy to use.

In order to make sense out of the inserted data, *data must be easy to understand and linked to the work process*. In the preliminary field study, we identified the main tasks of call takers processes with potential to be related to mood data: calls, coaching sessions, and breaks. This direct link of moods to their daily tasks was intuitive and *guided the capturing* phase by showing examples of situations worth reflecting upon. Additionally, the collaborative setting requires that moods are contextualized to be understood by others. However, a high percentage of the captured moods fell outside the initially defined categories. Consequently, this demands an *iterative approach to defining appropriate initial categories, as well as giving people the freedom to dynamically create new categories to support appropriation by different teams.* The results of the content analysis show that this freedom let users mention problems and specific situations

that constitute a trigger for reflection. Thereby, we gained a deeper understanding on mood tracking practices to improve future development of mood self-tracking apps. The approach used by the MoodMap App to allow participants to contextualize their moods along with these gained insights can be reused by other designers to develop future tools.

Our results indicate that individuals *make sense of data especially when they collect it*. This fact is not only confirmed by the analysis of the inserted notes but is also influenced by the self-tracking approach and its associated constraints (including motivation and priorities), as we further discuss in the next paragraph. The analysis of the content of notes shed light on what situations (both work tasks like starting the shift but also more general situations like problems) triggered certain emotions and were considered worth reflecting upon. This so-called reflection-in-action (which occurs during an on-going activity [Schön 1984]) took place during the MoodMap App usage. This is indicated by (i) the identification of reflective content in 25% of all notes attached to moods; (ii) the higher usage of those visualizations that provided on-the-fly and real-time insights they could directly react upon (*Compare Me* see Figure 1(b) or *Smileys' team view* see Figure 1(b)); and (iii) the answers from participants related to emotional awareness and issues worth reflecting (see Table V). Some examples of notes containing reflective content shed light on what type of reflection-in-action took place, and revealed that participants reflected on both positive and negative issues:

—"*Talk with manager, feeling a bit more positive,*"
—"*Back and forth we go, another day of getting nowhere with our control desks. Honestly not sure why the customer wants to stay at this stage,*"
—"*Got customer information and he is happy,*"
—"*KCI 2 for important job and customer did not have much of a clue and had unrealistic expectations. Will have to refer to sales to move.*"

Self-tracking is a voluntary activity driven by both intrinsic and extrinsic motivations [Gimpel et al. 2013] that requires besides preparation, collection, and integration additionally effort for reflection and action on the data [Li et al. 2010]. Especially, this *effort for reflection* was a major challenge: the motivation and priorities of participants to take time to review the gathered data to create new insights about their work. This confirms that the finding by Choe et al. [2014], who stated that the hardest part of QS is *to reflect upon one's data, extract meaningful insights, and make positive changes*, applies in the work setting as well. The low usage of the mood reports and the fact that no dedicated time was made available to reflect during work show little evidence that reflection-on-action, i.e., thinking back on what happened [Schön 1984], has taken place.

The fact that reflection did not take place as a separate activity after a task (reflection-on-action), but rather during the capturing of data embedded into work (reflection-in-action) contrasts with existing research on Quantified-Selfers in the private life [Choe et al. 2014]. There is a significant difference in terms of duration, depth of, and position within the workflow between the reflection supported by the live visualizations and the reflection that happens based on daily and weekly reports created by the MoodMap App, which could be reviewed by call takers at the end of the shift. Employees in the call centers are used to dashboards and performance reports that they review on a weekly basis with their managers and coaches. Therefore, we had spent efforts on designing visualizations in the MoodMap App to support both reflection-in and on-action. After the preliminary field study, the end users also believed that using the application for longer periods of time and tracking more data would be a solution to increase reflection and gain more insights. However, our final results show that *supporting reflection-in-action was more successful and therefore it becomes a priority*

when designing a tool for self-tracking in work environments. This lesson learned can inform the design of future self-tracking tools in different work domains.

H2. Mood Self-Tracking Facilitates Awareness between Colleagues

Findings on activity tracker users showed that data tracking is often social and collaborative driven rather than personal [Rooksby et al. 2014], but this is exploited in the sense of competition (e.g., rankings) or showing success (e.g., announcing achievements in social media). However, in the call centers, *sharing of data achieved cohesion in the teams as well as empowerment of employees* rather than competition or recognition, by increasing emotional awareness and providing meaningful triggers to collaboratively solve problems and improve work. As call takers confirmed in the questionnaires, being aware of their colleagues' mood is relevant for them. During her interview, we asked the call taker if she had learned something by reflecting on her mood. She highlighted the fact that she could see the mood of her colleagues and compare herself to them: "*Yeah, I like the way you can see the team members as well, you can see where they are, or you sort of wonder yourself why are they there, or why are they are up there and I am down here or vice versa. So you sort of wonder and I ask these things to myself if they have to had a really bad day or have to had a bad call or just generally feeling unavailable [. . .] So I think it is quite a good thing to look at, and I always compare myself to others.*" She also mentioned that reflecting on a certain call helped her move on to the next customer feeling better and not being affected by past negative experiences. Also the log data shows that the *Compare Me* visualization was the most used feature and in order to meaningfully compare themselves users had to capture their own mood. Taking all these results into account, we see that this *curiosity of call takers in the mood of colleagues has not only contributed to motivating call takers to use the visualizations, but also to capturing more moods*. Thereby, our results extend the insights from Church et al. [2010] on sharing of mood within distributed groups of friends to employees in an open-plan office.

Moreover, the interviews with the call taker and two managers as well as the feedback from questionnaires revealed that mood self-tracking can achieve improvements in the communication channels within the teams and awareness of the mood of their colleagues. This *social influence driven by the collaborative aspects of their daily teamwork [Garber 2007] is crucial for the long-term usage of the app*. More than 50% of the participants made reference to social aspects, be it if managers and coaches attach importance to the usage of the MoodMap App or if their colleagues do it. Nonetheless, work in call centers is usually considered as rather individual (e.g., while taking calls) compared to other work environments and therefore this social aspect could be even of higher importance in other more collaborative work settings.

Especially, in work environments with a rather hierarchical structure, the fact that managers can see self-reported moods can create social pressures and self-presentation issues. However, according to interviews, the social aspects mentioned above were more important than self-presentation. Additionally, the gathered mood data also shows that participants reported positive and negative moods ranging from the minimum to the maximum values (valence: AVG = 0.67, MIN = 0.11, MAX = 0.90). Therefore, no signals of biases were detected, e.g., that participants only capture positive moods or that they restrict themselves to negative moods.

H3. Mood Self-Tracking is Accepted as an Informal Communication Mechanism between Management and Staff

The introduction of the MoodMap App *positively affected the communication between managers and call takers*. As questionnaires and interviews show, managers increased

their awareness of their team's emotional state [García et al. 1999]. This allowed them to react quickly to the needs of each individual member of the team. The fact that managers work in separate offices and are not always present in the common working space of call takers provided additional value to the insights gained from mood tracking. Feedback of call takers revealed that the app allowed them to vent and to quickly communicate problems to their manager when they had no immediate solution on their own and needed further support. Thereby, the MoodMap App was also used as a back-channel between employees and management. Communication between management and staff was positively affected and this indicates that such a mood tracking application can provide a benefit for an organization beyond individual reflection.

Especially in the CCA teams, managers reacted to call takers' moods as identified in the results from the questionnaires and illustrated by the exemplary situation described by one of the managers. This correlates with the measured improvements in the employees' work performance. It also shows how simple interventions implemented through self-tracking can enrich the "reporting upstream" [Colombino et al. 2014] so that employees' input can trigger changes in established work processes.

The differences of usage that we encounter in more versus less active teams showed a direct connection with the *different management styles* as confirmed by discussions with the second-level management. Whereas the more active teams from CCA had managers who were engaged with the MoodMap App, encouraged their teams, and proactively reacted to the data, managers from CCB adopted a more passive attitude. For the active teams, this was seen as a direct benefit that enables later long-term benefits of reflection. This fact was further reinforced by the answers of the participants in the post-questionnaire regarding barriers as well as sharing of moods and the benefits it can bring: The more active teams from CCA rated these questions with higher scores and mentioned less barriers (see Sections 7.3 and 7.5). Call takers of the CCB teams, when asked about the main barriers for usage, mentioned that their main barriers were time pressure and seeing only benefits for managers/coaches (see Sections 7.3 and 7.5). Some of the final comments made by participants of the CCB teams in the post-questionnaire also suggest that the involvement with the manager and the app was not favorable, e.g., "*I feel that if it [the MoodMap App] were to be used regularly / again more agents would need to use it, and perhaps more notice of moods could be made by managers*" or "*. . . it's like a therapy session, if my manager does his job right then I should be able to approach him and actually tell him how I feel, not through a web app which I do.*" Additionally, despite our initial presumption that this difference in usage could also be due to the team members, no other observable differences between both groups of teams were found in terms of demographics (age and gender) or attitude with social networks and sharing of feelings at the initial state of the evaluation (obtained through the pre-questionnaire).

Privacy was expected to be a major barrier for self-tracking at the workplace and was targeted by questionnaires before and after the main field study. For the participants, the benefits outweighed any privacy concerns because sharing and visualizing the annotated mood data led to clear benefits for both parties, i.e., team cohesion and empowerment of employees. Nonetheless, some employees may be uncomfortable with sharing their mood data and therefore *the decision on what and when to track should be left to each individual user*. Generalizing a positive attitude regarding privacy to other domains should be carefully considered; call takers are used to be monitored during their work (e.g., calls are recorded) but this is not the case for all professionals. These challenges also apply to the organizational culture, which in our case welcomed the approach of mood self-tracking very well, but we may not find this initial predisposition in other work settings.

Introna [2003] defines workplace surveillance as *the multiplicity of formal and informal practices of monitoring and recording aspects of an individual or groups' behaviour "at work" for the purposes of judging these as appropriate or inappropriate; as productive or unproductive; as desirable or undesirable.* This establishes a relevant difference with respect to the purpose of introducing self-tracking in our studies. The captured data was not intended to judge employees' work, but to increase awareness and facilitate reflection that drives improvement. Using self-reporting approaches allows leaving the decision on what data to track and when to do it to the users. Consequently, this form of tracking gives the employees significantly more control over the data than in the case of most other KPIs. Despite being an additional type of tracking added to the corporate arsenal, this fact may have also contributed to a higher acceptance of self-tracking, as in call centers monitoring is viewed as an inevitable and generally acceptable part of the work environment [McPhail 2013]. Nonetheless, as Mason et al. discovered in their ethnographic studies, the complex social relations of work have a clear and variable effect on the ways in which *technology is variously deployed, struggled with, sidelined, manipulated, circumvented and appropriated, often in surprising ways* [Mason et al. 2003]. In line with this, our results (especially the difference observed between groups in both call centers) indicate that there are many other factors that have to be taken into account in order to achieve a high acceptance of a self-tracking tool. We have also observed an unexpected lower usage of data reports, which are the traditional types of reporting used in their KPIs. Therefore, adapting and integrating the self-tracking approach to each concrete work environment and work processes in place is crucial for acceptance.

H4. Mood Self-Tracking Leads to Measurable Work Improvements

In a work environment, *self-tracking needs to translate into performance improvements*, which are the metrics used by the organization itself and constitutes their most objective indicator for success. Individual and team work performance improved in correlation with app usage as shown by KPI measurements. For strong usage in team CCA_1, this correlation was statistically significant and is further supported by the slight decline of the KPIs in the follow-up measurements. It should be noted that it is very difficult for any study in a real workplace to exclude the Hawthorne[6] effect. Moreover, KPI improvements are the main criteria for management decisions, even if their factual value can be debated. Although other factors may influence these organizational measurements, no clear influence outside the evaluation could be identified by the second-level coordinating manager. Unfortunately, neither data about the historical variance of the KPI values nor KPI values from control groups were available to put these changes into the wider context of the call centers. We tried to overcome this by performing follow-up measurements, which should indicate if the observed trend is rather driven by external factors. Although this increased the evidence for a positive relationship between the usage of the MoodMap App and the KPIs, we cannot infer a definitive causal effect between them.

Work done in HCI has confirmed the importance of emotions not only for self-tracking purposes in private areas of life but also in work settings to better support the re-evaluation of past working situations based on emotions [McDuff et al. 2012], as well as to improve communication in work environments [De Choudhury and Counts 2013; Dullemond et al. 2013]. However, interviews in our study revealed that due to time and business constraints, time and space for reflection by reviewing their gathered mood data was not given to call takers. This attitude is unlikely to change because

[6]The Hawthorne effect [Mayo 1933] is a psychological phenomenon that refers to the fact that individuals will improve their behavior or performance in response to their awareness of being observed.

reflection is seen as of secondary importance to work tasks. Designers and developers have therefore to carefully consider how to introduce the self-tracking application for the first time and how to embed reflection in the daily work.

Method and Limitations

Conducting field studies in a real work environment involves several challenges which have to be addressed to obtain successful scientific results and, at the same time, provide tangible benefits for the participating employees (and the overall organization).

Two important issues to take into consideration in our studies were the introduction of the application at the call centers and the voluntary participation in the studies. The MoodMap App was introduced by managers of the company themselves in order to reinforce the organizational commitment and avoid the feeling of being observed by externals. These managers were instructed by the researchers on how to use the MoodMap App in their particular environment. The participating managers also communicated the optional participation and the main goals of the application. Call takers, managers, and coaches were able to opt out from participating and only participants who gave their consent with the corresponding form were considered for the studies. All members of the teams, including managers and coaches, shared their moods in the application and were shown as part of the team moods.

One of the drawbacks of conducting a study in a real work environment and guaranteeing voluntary participation is the difficulty to obtain data across all variables for all participants. Additionally, dealing with a big telecommunications company poses challenges such as not being able to get part of the corporate data and giving warranties that the conducted study will not disturb the call takers' daily work. Besides the effort of the researchers, it was not possible to obtain a control group, as the organization could not find a team which is able to provide the data needed for comparison without actually using the application. However, having a real work environment allows us to fully assess our approach in the environment it was designed to (opposite to lab settings), as well as to elicit feedback from real target users.

Besides these drawbacks, we achieved not only to obtain the data from the KPIs but also to show changes and improvements in these metrics. This constitutes a successful outcome, considering that these metrics are the basis of decision making in organizations and it is very challenging to show variations that have an effect at the management level.

Being aware that surveillance can have an impact on the emotional state and the comfortableness of call takers, the relationship between KPIs and moods was only used to evaluate our approach, i.e., for research purposes. These data are already collected at the call center with the consent of the employees and participants. The analysis of the data and the direct link between application usage and improvement of the KPIs metrics (both at individual and team levels) served as means of proof that our approach can be beneficial for learning and work improvement.

A further factor to take into consideration is the intended usage frequency of the mood self-tracking app. The log usage numbers may suggest a low average usage per day; however, the MoodMap App was designed to be used occasionally, in-between work tasks, in order to interfere as little as possible with their daily duties and therefore no continuous usage in time was expected. This is also related to the nature of reflection, as reflection cannot be expected to occur regularly, but a trigger has to initiate it. Additionally, in these first studies, it was not possible to integrate the MoodMap App in the interface of their own tools to a full extent (e.g., their tool for call guidance), what may also increase usage frequency in the future. Currently, the managers of the call centers are discussing how to adapt and fully integrate the MoodMap App in a new internal coaching tool they are developing for their staff.

9. CONCLUSION

We have presented two field studies of a mood self-tracking app conducted in two telecommunications call centers. Our goal was to investigate the benefits of mood self-tracking at work, thereby extending research on self-tracking from private areas of life and "extreme users" to employees in work settings. From the preliminary study, we saw that it is required to adapt a mood tracking tool according to the needs of the users and the work processes in order to ensure a successful integration into such a challenging workplace. Our findings from the main field study provide evidence that mood self-tracking can improve work performance by facilitating reflection and enhancing team communication. The obtained results have revealed that the workplace setting leads to different reflective practices in comparison to reflection in private areas of life. The act of mood capturing itself triggered reflection during the work process and live visualizations that provide unexpected feedback had a higher usage. Consequently, future design of self-tracking tools should prioritize the design of features for supporting reflection-in-action rather than features for reflection-on-action. Furthermore, managers' analysis of mood and their proactive reactions to trends and changes in team members' mood were key for acceptance by employees. Mood self-tracking turns out to be a promising approach for individuals and teams to improve work performance and collaboration at work by facilitating reflection on new insights. This article contributes with promising and valuable insights about the benefits of mood self-tracking for individuals as well as teams at work, and provides readers with insights that guide future researchers and practitioners to design and introduce these tools in a workplace setting. This constitutes the basis for future research, which will verify our insights in different work environments and explore further types of self-tracking tools.

ELECTRONIC APPENDIX

The electronic appendix for this article can be accessed in the ACM Digital Library.

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